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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

Corn Breeding in Alabama

By

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INTRODUCTION.

During the past decade a very large amount of attention has been given to corn breeding, particularly in the corn belt, by the various Experiment Stations and the United States Department of Agriculture. The practical value of such work has been so apparent that several private corn growers have undertaken the work and have made important contributions to our knowledge of the subject. The net result is that we now have a rather extensive literature that is freely available to all who are interested in this line of investigation. Several factors contributed to show the necessity of undertaking this line of work in Alabama, among the most important of which we mention:—(A) the low average yield per acre of corn, (B) the high market price of corn, and (C) the increasing need of a larger corn yield as feed for the rapidly increasing number of live stock being grown in the State. Besides it seemed important to undertake this line of work here to show exactly what could be done in developing a type of corn better suited to our needs in this latitude and one giving higher yields than the sorts in common cultivation. We therefore arranged to undertake this work, and in 1905 planted the first breeding plot. All of our corn-breeding work has been done on the "Hurstview" farm near Montgomery, and to Mr. Jesse M. Jones much credit is due for his very intelligent interest in the work and for numerous valuable suggestions made from time to time. My personal thanks are due to the Funk Brothers, Bloomington, Illinois, Professor P. G. Holden, of the Iowa Agricultural College, and Dr. Cyril G. Hopkins, of the University of Illinois, for numerous kindnesses and suggestions while visiting their institutions.

I am also under great obligations to various seedsmen and corn growers for seed furnished for the first year's work.

In this Bulletin we have given a summary of the most important practical results secured, but have purposely postponed for subsequent treatment some of the theoretical questions that have come to light during the work. The writer has not had a very large amount of time in the past to devote to this line of work, but it is to be hoped that the very satisfactory results secured will cause several progressive farmers to undertake similar work on their own farms. During the present season the author proposes to continue and intensify this line of work along certain important lines.

VARIETY OF CORN EMPLOYED.

The original ears employed in the first breeding plot were secured from the Mississippi Experiment Station and were of the sort called Mosby's Prolific. This is a corn of medium sized ear having white kernels on a white cob and with the stalk characteristics of the other prolific varieties. The mere name of the variety is of much less importance than its characteristics which have been found to be very well suited to the soil and climatic conditions of central Alabama where this work has been done. And yet the corn we have today differs in several marked particulars from the ears with which we started.

The following table shows the variation as to number of rows per ear for those ears planted each year in the breeding plots, in percentages.

Rows per ear	12	14	16	18	20
1905	1.66	43.33	50.00	3.33	1.66
1906	10.20	55.09	31.62	3.06	0.00
1907	9.18	52.03	28.56	8.16	2.04

It should be understood that no attention was given to the number of rows per ear in selecting the ears for the breeding plots.

The small cob generally found in the prolific sorts like Mosby has an advantage that in the South is of greater value than is ordinarily considered. A large cob is generally very sappy at harvest time, and thus such ears dry out more slowly than small ones, and the kernels are more easily injured by unfavorable temperature conditions and are more subject to rotting.

OBJECTS OF CORN BREEDING.

All plant-breeding has for its object principally an economic one, i. e., the improvement of the plant with reference to some character considered important to man. This character may be one of yield, chemical composition or some mere question of beauty as in the case of decorative plants and flowers. In all cases the methods are much the same. The prime object in corn-breeding is the increase of yield and the development of sorts best adapted to the soils on which they are to be grown and to the climatic conditions there prevailing. In the Illinois work one of the main objects has been to develop strains of corn rich in one or more of the chemical compounds found in the kernel. As a result they have developed a "high-protein" corn and a "high-oil" corn and also a "high-combination" corn, i. e., one high in both protein and oil. But for the Alabama farmer the main point at present is to increase the yield. The present average yield in Alabama, according to the last census, is about 13 bushels per acre. The purpose of corn-breeding is to largely increase this low yield. And our results show that this object can readily be accomplished.

We must keep in mind, however, the desirability of correlating the high-yielding tendency with some character of the ear or stalk so that we can predict from a mere physical examination the probable yielding tendency of the progeny of a given ear or stalk. There can hardly be any question that uniformity of stalk and ear is a quality that we should strive to secure. As an example and illustration of what is meant by uniformity or conformity to type in the ear see Plate 2. A study of the ears shown on plates 3 to 7 inclusive will show that we have materially increased the uniformity of the Mosby corn.

It will no doubt be found desirable to secure by breeding and selection sorts of corn adapted to the various soil types found in the State. These soil types not only imply soils of different chemical and physical nature, but in many cases involve distinct methods of cultivation. In other words the methods of cultivation adapted to the sandy soils of the wire-grass region would scarcely be desirable for the black-belt or vice versa. We would be pleased to undertake co-operative work in corn breeding with several farmers in various parts of the State to test some of these questions and to demonstrate the highly satisfactory results secured by intelligent selection.

THE EAR-ROW METHOD.

The ear-row method of corn breeding, which we are using, depends upon the well known individuality of the ear, i. e., its ability to transmit to its progeny various characteristics that it in turn has received from its ancestors.

The method may be briefly described as follows: We select 98 ears to be planted in what we call a "breeding plot". The tip and butt kernels are removed from each of these ears and the balance of the corn from each ear is planted in a row to itself. In our work we have planted the corn by machine in checks three feet and eight inches apart in both directions. One should have 98 rows from as many different ears and should mark each row with its proper number. The rows should be 100 hills long and in each hill just two stalks should be allowed to grow. This will save much calculation when the results are being worked up for comparison of the different rows.

During the growing season this breeding-plot is to be carefully watched to note any peculiarities that may appear in any of the rows. Plate 1 shows one row in one of the breeding plots that started its growth much more slowly than the adjacent rows. And as a matter of fact, the harvest showed conclusively that the ear from which this row was planted must have been weak in some particular. The progeny of this row does not enter into our subsequent work, as the yield from it was so low it was at once eliminated. Care should be taken to note any barren stalks and to detassel them at once to prevent the pollen from such worthless stalks falling upon the silks of any of the other stalks and thus perhaps perpetuating this tendency towards barrenness. One should also be on the lookout for the finest stalks as to strength and number of good ears on them, and such stalks should be marked so that they can be told when the corn is harvested.

Desirable stalks are marked during the summer with tags of the form shown below:

O

Row .... Ear No. ....

Stalk

Height .... M.

Diameter........ ....Cm.

Leaves

No. ....

Length ....Cm.

Width .... Cm.

Ears

No. to Stalk.. ....

Height....... .. ..Cm.

Angle............. ....

Ear Stalk

Length....... ....Cm.

Diameter .... Cm.

At harvest time the ears selected for breeding purposes are marked in the following manner to show their origin and to connect them with the above data regarding the stalk on which they are produced. An ordinary gun wad has written on it the row and ear number, and this is attached to the butt of the ear by means of a strong pin known in the trade as "Bank Pins". These pins are driven into the butt of the ear, and in this manner the wad is rarely lost and can readily be seen when studying the ears in the laboratory. We of course gather a much larger number of ears in this manner than we subsequently use in the breeding plot, but for each ear we have all the data recorded on the tag referred to above.

BREEDING RECORDS.

It is absolutely necessary that detailed records be kept showing every character of each ear planted in the breeding plot. It is only by so doing that any definite progress can be made. For our work we are employing the following forms.

The form shown on page 9 is the one used in keeping our records of the characters of individual ears planted in the breeding plot. Our register number is so made as to indicate the crop-year in which the ear was produced, and the last two figures show the row number in which said ear is planted. For example, Register Number 642 shows that that ear was grown in 1906 and that it was planted in row 42 of 1907. We are attaching to each of these forms a photograph of the ear so that we believe we have a very satisfactory record of the ears we have employed.

The form shown on page 10 is the front page of our field record form. The form shown on page 11 is the back of this same sheet. This sheet is filled out for each row and gives us the exact performance record of each ear planted in the breeding plot.

Variety | Ear Reg. No. | Field

Source | Row No.

	First	All	Average
Plant Up			
Tassel Out			
Silks Out			
Ear Mature			

	Total	%
Plants with marketable ears		
Number of marketable ears		
Plants without marketable ears		
Number of unmarketable ears		
Barren stalks		
Leaning and fallen stalks		
Plants with suckers		
Number of suckers		
Smutted plants		

	1	2	3	4	5	Av.
Diam. of stem at 20 cm.						
Height in meters						
Height of lowest ear						
Height of highest ear						
Ear-angle of good ears						
Ear-angle of rotten ears						
No. of leaves						
Blade - length						
Blade - width						
Ear-stalk - length						
Ear-stalk - diameter						
Ears per stalk						

(Devised By E. Mead Wilcox 1907)

(Devised by E. Mead Wilcox, 1904.)

VARIETY

SOURCE

Register No.

Annual Ear No.

Plant		Ear		Cob		Kernels		Chem. Analysis	
Row No.		Weight		Weight		% Corn to Ear		Protein	
Plant No.		Length		Tip Circ.		Breadth		Oil	
Height		Shape		Butt Circ.		Depth		Starch	
Height of Lowest Ear		Tip		Color		Shape		Ash	
Height of Highest Ear		Butt				Indentation		Moisture	
No. of Ears		Tip Circ.				Color			
Ear-Angle		Butt Circ.							
Ear-Stalk		No. of Rows							
		Kernels to Row							
		Sulci							

Planted	
Harvested	

	Number of Stalks	Total No. of Ears	No. of Ears per Stalk	Wt. of Ears per Stalk	Total No. of Ears	Total Wt. of Ears	No. of Mark. Ears	Wt. of Mark. Ears	Av. Wt. per Ear
Row									
Acre									

CULTURE METHODS		Notes
How Planted		
Distance between rows		
1st cultivation		
2nd cultivation		
3rd cultivation		
Thinned		
Replanted		
Barren stalks detasseled		
Rows detasseled		

POLLINATION AND DETASSELING.

It has been estimated that a single tassel may produce as many as 50,000,000 pollen grains each one of which is sufficient to fertilize one ovule and produce one kernel of corn. These pollen grains to do this must fall upon the end of a silk that is ready to be fertilized, and there the pollen grain grows and sends a fertilizing tube down into the ovule at the base of the silk. The silks that are connected with the kernels at the base of the ear are fertilized first, and then from there towards the tip of the ear the work goes on. For each silk and each kernel therefore a single pollen grain is required. These pollen grains are blown about by the wind and may travel for some distance before falling on a silk. Of course large numbers are produced to be certain that enough fall on the silks to fertilize each one.

Now we may recognize three types of pollination or fertilization as follows:

1. The ovules of an ear are fertilized by the pollen of the tassel on the same stalk. This is called inbreeding, or self-pollination.

2. The ovules of an ear are fertilized by the pollen from the tassel of a stalk that arose from kernels produced on one and the same ear. That is these stalks might be called sister stalks and this type is called close-breeding or close-pollination.

3. The ovules of an ear are fertilized by the pollen of the tassel of a stalk not closely related to the ear stalk. This type is called cross-pollination or cross-breeding.

Now in the field and in the ordinary breeding plot some inbreeding probably occurs, but in the breeding plot we may have continuous and injurious amounts of close-breeding and this must be prevented. This is to be prevented by detasseling and gathering the seed corn for the next year's breeding plot from the detasseled rows alone.

Our plan is shown by the following diagram in which stars show stalks not detasseled and D denotes detasseled stalks. Of course the diagram does not show all the stalks in the plot, and shows only ten of the rows:

D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
D	*	D	*	D	*	D	*	D	*
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D
*	D	*	D	*	D	*	D	*	D

In other words, it is seen that we detassel alternate halves of adjacent rows. Our seed corn is then gathered only from the halves of each row that have been detasseled.

This work of removing the tassels can not be done at one time, but must be looked after at intervals of a week or more until the tassels cease appearing. Just before the tassel is exposed one can, by gently opening the leaves, take a firm grasp on the tassel and remove it by a steady pull, without injuring the stalk at all.

CULTIVATION OF THE BREEDING PLOT.

The important thing in corn culture is frequent and shal low cultivation. Our breeding plot receives 4 to 6 cultivations and one or more hoeings. Too good care cannot be taken of the breeding plot, for from it you are to secure your improved corn for future planting. At harvest time the plot should be free of weeds, at least this is the ideal condition towards which you should aim. For further information on this subject, and upon the question of fertilizers and other matters of this nature see the Bulletins of the Alabama and Georgia Experiment Stations on Corn Culture.

SOME RESULTS SECURED.

The increase in yield we have secured is well shown by the following table, which gives the percentage of the rows each year that have been above and the percentage of the rows that were below the average yield for all the rows of that year:

	Average.	P.C. of rows above.	P.C. of rows below.
1905	30.79	41.6	58.4
1906	36.62	47.9	52.1
1907	36.85	50.0	50.0

A comparison of the average or mean yield for 1905 with that for 1907 shows that we have increased the yield in three years 19.6 per cent.

The following table gives the yields of the fourteen best rows of the crop of 1907, together with the yields of the rows during the two preceding years which have been the ancestors on the female side of each of the fourteen ears. The yields are given in bushels per acre as calculated from the actual yields of the rows. In each case the yield is calculated to a perfect stand:

1907	1906	1905
642	537	425
53.7	41.9	43.9
650	550	433
51.2	36.2	58.2
691	539	435
49.2	50.4	35.4
652	522	429
46.9	37.7	37.7
623	535	445
45.3	40.8	34.7
661	551	422
45.1	43.9	35.1
649	593	458
44.1	39.6	39.8
656	527	429
42.9	35.6	37.7
630	510	443
42.3	49.9	39.8

684	510	443
42.1	49.9	39.8
647	577	418
41.6	45.3	31.6
645	583	417
40.8	40.0	25.2
653	519	426
40.5	37.9	42.9
646	513	425
40.5	35.2	43.9

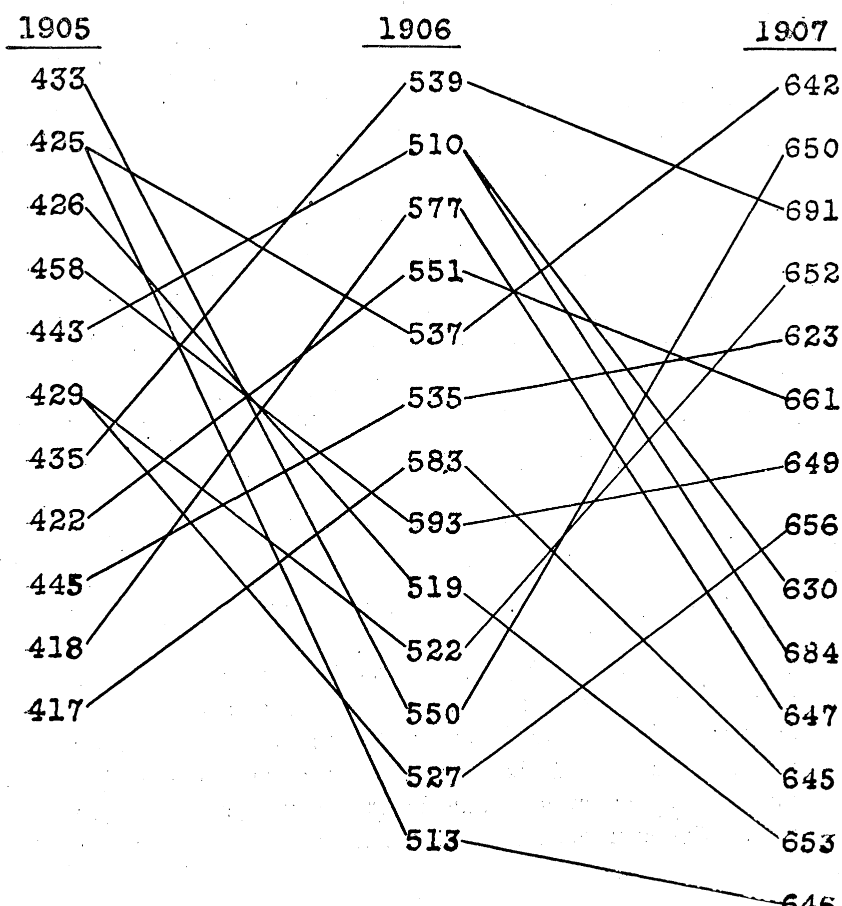

FIG. 1. Chart showing the pedigree of the fourteen best rows of the 1907 crop.

TESTS OF MOSBY CORN BY FARMERS.

The following yields are taken at random from a larger number of reports made by farmers in various parts of the State who have planted corn purchased from Mr. Jones. This corn was taken from the breeding plot of 1906:

J. G. Little, Greenville, 60 bushels.

Clark Adams, Greenville, 65 bushels.

Geo. A. Watson, Monroeville, 72.5 bushels.

W. M. Newton, Belleville, 97.75 bushels.

H. E. Hudson, Monroeville, 30 bushels.

HOW TO BEGIN CORN-BREEDING.

A farmer who desires to begin the systematic selection of corn should proceed as follows: During this season study carefully your field of corn and select enough of the best stalks to give you at least 200 ears. It does not matter about the name of the corn so much as it does about its being suited to your local conditions and to yourself. Where the land will stand it you had best select one of the prolific sorts, but under other conditions a 1-eared sort may be better. Allow the ears so selected to mature on the stalks, and under no circumstances "pull" the fodder from these stalks. When mature gather these ears and tag them in such a way that you will know the sort of a stalk each came from. These ears constitute your basis for further improvement, and should be well cared for during the winter.

PREVENTING INJURY BY WEEVILS AND MICE.

The corn for the breeding plot should be stored during the winter in some dry and cool place and in some barrel or box to which mice cannot enter, and tight enough to permit of fumigation against weevils. A good method to fumigate against weevils is to place the ears in a tight box or barrel and place an ordinary tea cup half full of carbon bisulphid on top of the corn and cover the whole with a blanket. After twenty-four hours every weevil will be dead. The corn should then be examined at intervals during the winter to see that weevils or mice have not entered the barrel.

SELECTING THE EARS FOR THE BREEDING PLOT.

During the winter while you have time study these 200 ears by means of the score card, and from them select the 98 best ears for the breeding plot.

THE SCORE CARD AND CORN JUDGING.

The main value of the score card to the corn grower is that it causes him to give close attention to the various characters of the ear and teaches him the most desirable features to be looked for in the corn he is breeding. We are well aware that in the ordinary corn shows and in ordinary corn judging little or no attention is given to the relative yields of the ancestors of the various ears being compared. In other words the ears in the exhibit are compared to one another without any reference to the performance record of their parents which may well be expected to appear in the progeny of the ears. For example, it might be possible to gather two samples showing equal perfection as to the points mentioned on the score card, but one sample might have come from a field yielding 50 bushels to the acre and the other from a nearby field yielding but 10 bushels to the acre. But from his high yielding rows in the breeding plot the corn grower must be able to select the ears which are best from the standpoint of the score card.

It must be left to future work to develop a score card that is well adjusted to our Alabama types of corn and for the present we offer the score card employed by the author in order to call attention to this line of work:

1.	Uniformity.	
	A. Trueness to type	10
	B Uniformity of exhibit	5
2.	Shape of ear	5
3.	Color	10
4.	Market condition	10
5.	Tips	5

6.	Butts	10
7.	Kernel uniformity	5
8.	Kernel shape	5
9.	Length	10
10.	Space.	
	A. Space between rows	5
	B. Space between kernels at the cob	5
11.	Percentage of corn to cob	15
	Total	100

SUGGESTIONS AS TO USE OF SCORE CARD ON MOSBY CORN.

1. The deficiency and excess in length of the ears that do not conform to the standard for the variety shall be added together and a cut of one point made for each inch thus secured. For the Mosby corn the standard length shall be 8 inches.

2. The deficiency and excess in circumference of all the ears that do not conform to the standard for the variety shall be added together, and for every two inches thus secured a cut of one point shall be made. The standard circumference, taken at one-third the distance from butt to tip, in the Mosby corn shall be 6 inches.

3. The shape of the ear in the standard is such that the proportion between length and circumference is the same as 4 to 3. Cut each ear that is off, 1-2 point.

4. For kernels off in color, i. e., yellow in the case of Mosby corn, cut 1-4 point for each two kernels. That is for 6 yellow kernels, cut the ear 3-4 point.

5. For a red cob in Mosby corn cut each ear 2 points.

6. Vitality is indicated finally by the germination test, but this is out of the question for score card purposes. The ears should be well-matured, firm and sound. For each ear that is off cut 1-2 point.

9. The kernels should be of uniform shape and true to the type. For each ear that is off cut 1-2 point.

10. The kernels should be so shaped that their edges touch from tip to crown. Cut 1-2 point for each two kernels not so shaped.

11. The proportion of corn to ear should be from 85 to 90 per cent. in the case of the Mosby corn. For every per cent below this standard cut the exhibit 1-2 point.

TESTING THE VITALITY OF SEED CORN.

This should never be neglected for the breeding plot, and would prove of great value even in the general fields. When we remember that 15 to 20 ears should give plenty of corn to plant an acre, we see that the time and labor to test enough corn for even large fields is not very great. It will certainly pay in better stands of corn and larger yields. The method is simple and requires no expensive apparatus. A box should be made 12 by 18 inches inside and about 3 inches deep. Do not make this water tight. At the bottom of this place two thicknesses of canton flannel moistened with water. The upper side of this cloth should be marked off into squares 2 inches square with a lead pencil. These squares should be numbered from 1 to 54. Now from the ears numbered in the same manner remove six kernels as follows: Near the base of the ear remove two kernels on opposite sides of the ear. Near the tip select two kernels also on opposite sides of the ear and directly above those previously removed. Then from near the middle of the ear remove two kernels from opposite side of the ear but at right angles with the kernels already removed. These six kernels are to be placed with the germ up in the square having the same number as that on the ear. Proceed in this manner until all the ears have had samples taken for the test. Then cover the kernels with two thicknesses of canton flannel. Sprinkle with water and cover the box with a piece of glass. Ordinarily no more water will be needed. But if so it should be simply sprinkled over the upper piece of cloth. At the end of six days examine the kernels by carefully removing the upper cloth. Ears whose kernels have not given a good strong sprout should be discarded. If any ears must be discarded select others to take their places and proceed to test their vitality.

SHELLING CORN FOR PLANTING.

To secure the corn from the breeding ears for planting first discard the tip and butt kernels. Then remove all the balance of the corn with the exception of two adjacent rows which are to be left as a means of telling at any time the character of the ear and its kernels. This ear should be tagged with a number so that it may be told at any time. These samples should be stored where they will not be injured. The corn should be placed in a paper sack until wanted for planting, so that there is no danger of mixing it with the corn from other ears.

BREEDING PLOT.

This should be the best and most uniform piece of ground on your farm, and be isolated to prevent the pollination of any of the silks by foreign pollen. The other details as to planting and care of the breeding plots have already been described.

MULTIPLYING PLOT.

After selecting the breeding ears for the next year all the remaining good ears should be saved to be planted in the multiplying plot. Place this plot where no foreign pollen can reach it. The corn from this field is to be selected and planted the following year in the general field as follows:

1908	1909	1910
B. P.	B. P.	B. P.
		M. P.
	M. P.	G. F.

In this diagram B. P. stands for the breeding plot, M. P. for the multiplying plot, and G. F. for the general field.

THE FUTURE OF CORN BREEDING IN ALABAMA.

There is no doubt that corn-breeding will in the near future occupy much more attention at the hands of Alabama farmers than at present. To the man who engages in it now with the determination to produce the best type of corn possible this field of work offers good returns on the time and money invested. Not only will the individual corn-breeder secure higher yields, but there is a fine chance to dispose of high-grade seed corn when it is backed by good honest work and detailed records as to pedigree. The time is coming when more and more people will demand seed corn on the ear and from fields that have given high yields. We should be glad to enter into correspondence with all persons interested in this line of work, and stand ready to offer the best suggestions we have on the subject.

LITERATURE OF CORN BREEDING.

The following list includes some of the more important publications of the Experiment Stations and United States Department of Agriculture that should be read by farmers who desire to undertake work along this line. Publications referring particularly to sweet corn are omitted:

Card, F. W.
1906. Corn Selection. Bull, R. Is. Exp. Stat. 116: 1-35. Fig. 1-9.

Davenport, E.
1906. Methods of testing variability in corn. Circ. Ill .Exp. Stat. 101 :1-7.

Davenport, E., and Rietz, H. L.
1907. Type and variability of Indian corn. Bull. Ill. Exp. Stat. 119 :1-29.

Crosthwait, G. A.
1907. Indian corn. Its production and improvement. Bull. Idaho Exp. Stat. 57 :1-59. plate 1-11.

Duvel, J. W. T.
1906. The germination of seed corn. Farmers' Bulletin 253 :1-16. fig. 1-4.

East, E. M.

1906. The improvement of corn in Connecticut. Bull. Conn. Exp. Stat. 152:1-21.

Hartley, C. P.

1903. Improvement of corn by seed selection. Yearbook U. S. Dept. Agr. 1902:539-552. plate 71-77.

1904. Corn Growing. Farmers' Bulletin 199:1-31. fig. 1-23.

1905. The production of good seed corn. Farmers' Bulletin 229:5-20. fig. 1-10.

Hayward, H., and Jackson, H. S.

1907. A study of Delaware seed corn with some suggestions for its improvement. Bull. Del. Exp. Stat. 77:1-16. fig. 1-10.

Holden, P. G.

1902. Storing and purchasing seed corn. Press Bull. Iowa Exp. Stat. 4pp.

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1904. Selecting and preparing seed corn. Bull. Iowa Exp. Stat. 77.

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1898. The chemistry of the corn kernel. Bull. Ill. Exp. Stat. 53.

1899. Improvement in the chemical composition of the corn kernel. Bull. Ill. Exp. Stat. 55.

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Hopkins, C. G., Smith, L. H., and East, E. M.

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1903. Corn experiments in Illinois. Circ. Ill. Exp. Stat. 66.

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Hume, A. N.

1904. The testing of corn for seed. Bull. Ill. Exp. Stat. 96.

Miller, M. F.

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EXPLANATION OF PLATES.

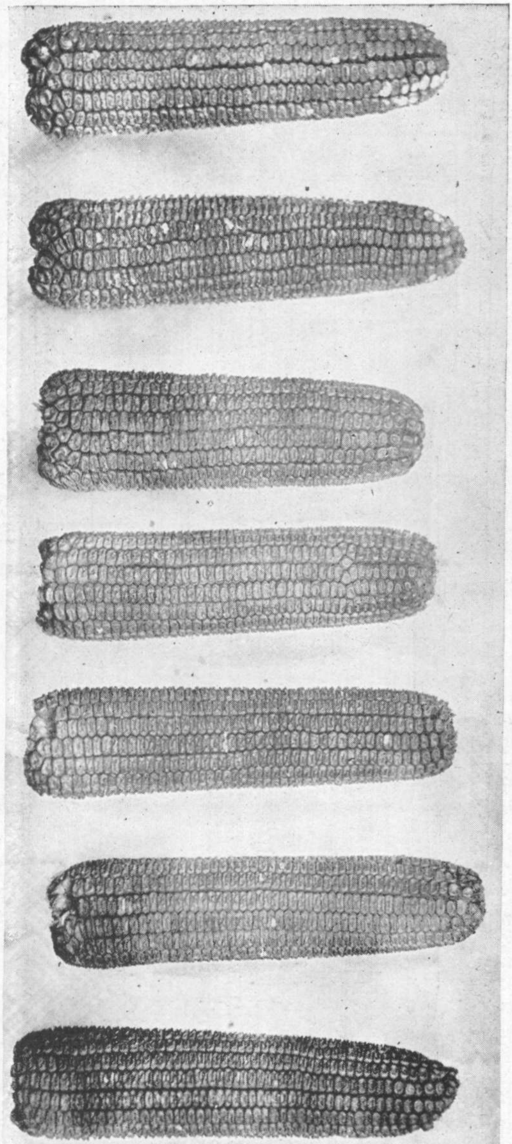
Plate 1. Individuality of the ear as shown by differences in height of the stalk during the season. Note particularly the low row in the center of the field.

Plate 2. Funk's Yellow Dent corn grown by Funk Brothers of Bloomington, Illinois. Note the great uniformity of the ears.

Plates 3 to 7 inclusive. Showing the ears in the ancestry of the ten best ears grown in the breeding plot during 1907. The ears marked with numbers in five hundred were grown in 1905, those marked in six hundreds were grown in 1906, and those marked in seven hundreds were grown in 1907. Ear 702 was from row 42 of 1907, and this in turn from row 37 of 1906. Each horizontal series of three ears is similarly related.

PLATE I.

PLATE II.



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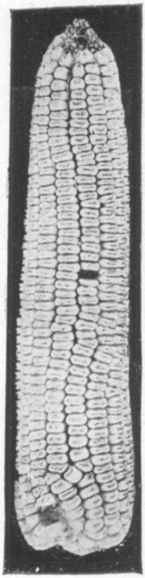

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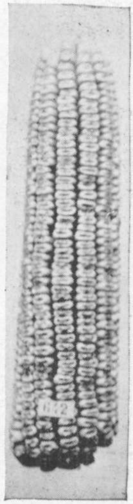

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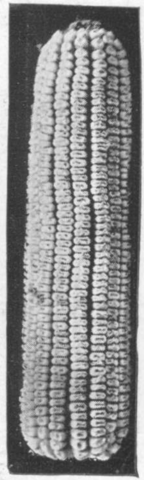

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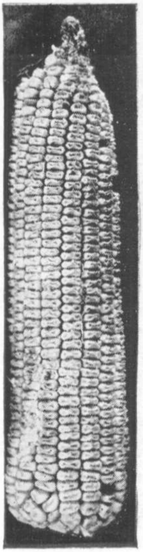

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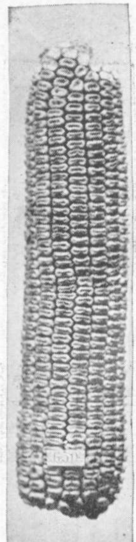

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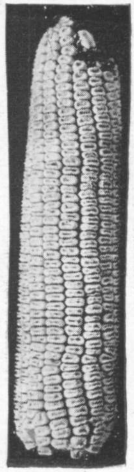

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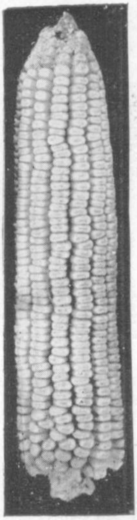

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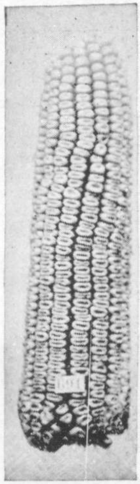

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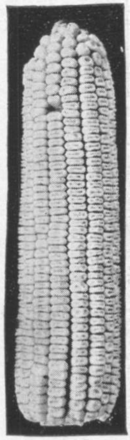

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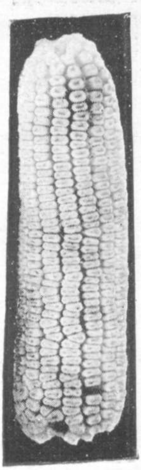

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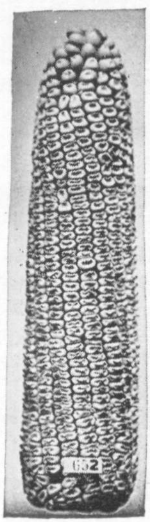

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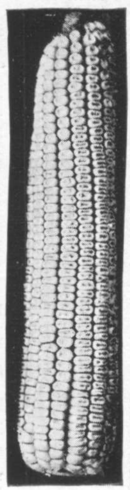

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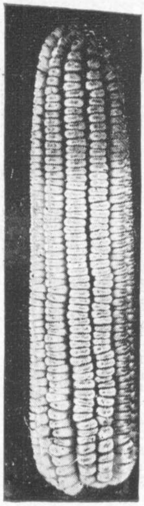

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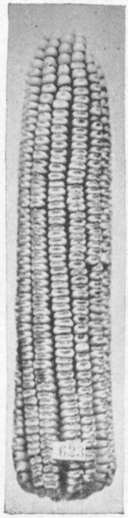

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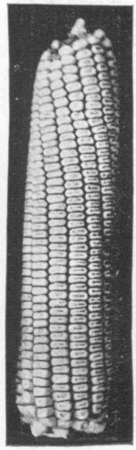

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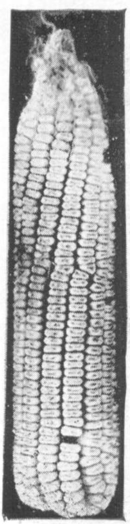

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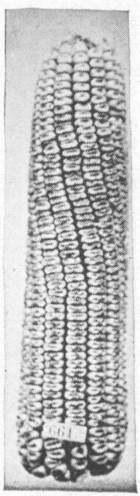

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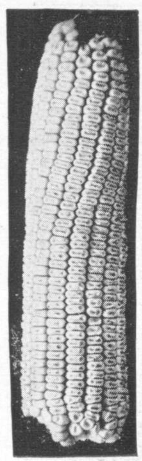

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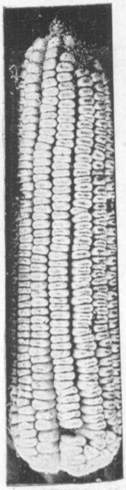

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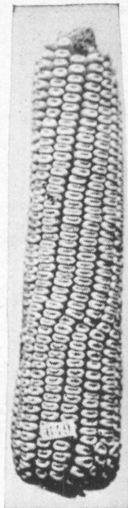

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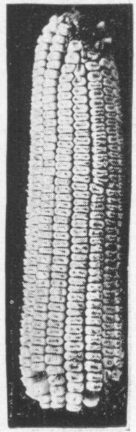

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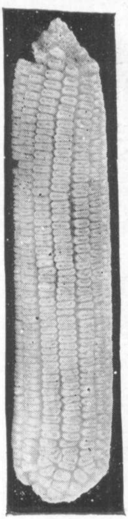

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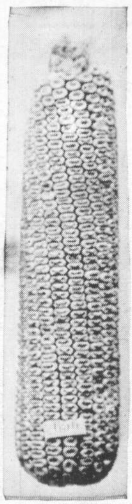

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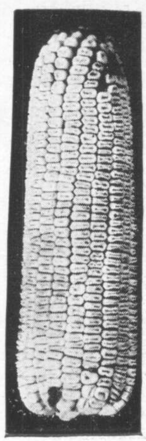

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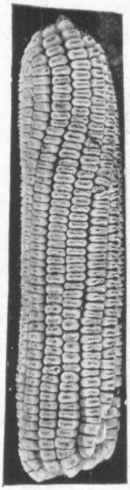
PLATE VII.



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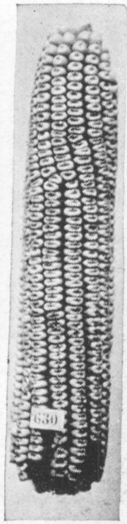

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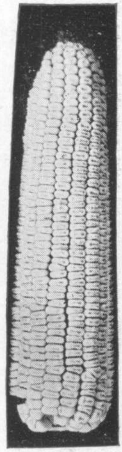

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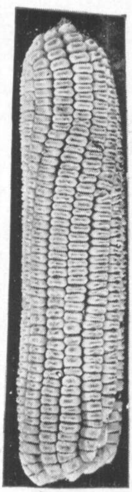

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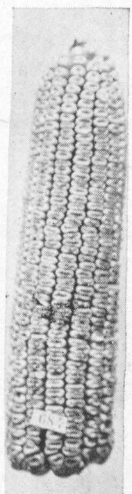

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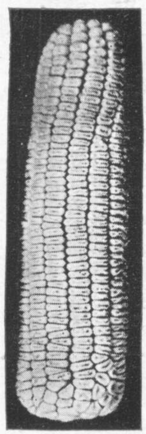

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BULLETIN NO. 143 JULY, 1908

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

Feeds Supplementary to Corn For Southern Pork Production

BY

DAN T. GRAY, J. F. DUGGAR, J. W. RIDEGWAY

OPELIKA, ALA:
THE POST PUBLISHING COMPANY
1908

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FEEDS SUPPLEMENTARY TO CORN FOR SOUTHERN PORK PRODUCTION.

By

D. T. Gray, J. F. Duggar, J. W. Ridgeway.

SUMMARY.

1. This bulletin records a summary of three years' work in swine production, in which 90 hogs have been used.

2. The object in presenting this bulletin is to get together the three years' work so as to make a comparison between finishing hogs upon corn alone and finishing them upon corn supplemented with either green crops or concentrates.

3. When corn was used alone as a ration for fattening hogs both the daily gains and the financial outcome were unsatisfactory. Money was lost in every case where corn was fed without a supplement.

4. When corn was supplemented with a partial ration of cotton seed meal the daily gains and the financial outcome were satisfactory. Four deaths occurred as a result of the use of cotton seed meal, *but these deaths did not occur while the animals were eating the meal. All of the deaths have occurred soon after the animals were taken off of cotton seed meal and placed upon a ration which contained no cotton seed meal.* This suggests the idea that cotton seed meal may be stimulating in its effects—similiar to the action of certain drugs—and when it is removed suddenly from the animals that death may occur through depression.

5. Tankage, a packing house by-product, proved to be an exceedingly satisfactory feed to supplement corn. In fact, it was almost as satisfactory as cotton seed meal, and it has the advantage over cotton seed meal in that there is no danger in feeding it.

6. When corn was supplemented with a ration of one-half cowpeas (the seed) the results were more satisfactory than when corn was used alone, valuing the cowpeas at

80 cents per bushel. The peas were used profitably until they reached a price of $1.05 per bushel.

7. As a whole, peanut pasture was found to be more useful than any other pasture tried. Notwithstanding the fact that the peanut pastures were not good two years out of the three they still gave excellent results. Pork was made at a good profit when peanut pasture was used in conjunction with corn.

8. Mature sorghum pasture has very little to recommend it as a feed for fattening swine. Both the gains and the financial outcome were unsatisfactory.

When the sorghum was cut and carried to the hogs the results were better than when the hogs were made to graze the crop.

9. The expense of extracting the juice from the sorghum and feeding the juice only prohibits its use in this way, although excellent daily gains were made. In no case was the juice found to be worth more than 1.8 cents a gallon as a feed for hogs.

10. Soy bean pasture ranked second to peanut pasture as a supplement to corn.

11. Chufa pasture was not found to be as good as either peanuts or soy bean pasture.

12. The average daily gains were as follows: corn alone, .69 of a pound; corn 2–3 of the ration plus cotton seed meal 1-3, 1.04 pounds; corn 9-10 plus tankage 1-10, 1.04 pounds; corn 1–2 plus cowpeas 1–2, .94 pounds: corn plus peanut pasture, 1.01 pounds; corn plus sorghum pasture, .37 pound; corn 2–3 plus cotton seed meal 1–3 plus peanut pasture, 1.00 pound; corn 2–3 plus cotton seed meal 1–3 plus sorghum pasture, .46 of a pound; corn plus chufa pasture, .72 of a pound; corn plus soy bean pasture, 1.02 pounds; corn 2–3 plus cotton seed meal 1–3 plus soiled (cut sorghum), .75 of a pound.

13. The cost of one hundred pounds gain in each case, when the cost of putting in and cultivating the pasture crops was not taken into consideration, was as follows: corn alone, $7.63; corn 2-3 plus cotton seed meal 1-3, $5.75;

corn 9–10 plus tankage 1–10, $5.18; corn 1–2 plus cowpeas 1-2, $5.11; corn plus peanut pasture, $2.28; corn plus sorghum pasture, $5.46, corn 2–3 plus cotton seed meal 1–3 plus peanut pasture, $1.97; corn 2–3 plus cotton seed meal 1–3 plus sorghum pasture, $4.85; corn plus chufa pasture, $3.81; corn plus soy bean pasture, $1.96; corn 2–3 and cotton seed meal 1–3 plus soiled sorghum, $3.39.

14. The cost of one hundred pounds gain in each case, when the cost of putting in and cultivating the pasture crops was counted against the gains, was as follows: corn alone, $7.63; corn 2-3 plus cotton seed meal 1-3, $5.75; corn 9–10 plus tankage 1–10, $5.18; corn 1–2 plus cowpeas 1-2, $5.11; corn plus peanut pasture, $3.20; corn plus sorghum pasture, $11.90; corn 2–3 plus cotton seed meal 1–3 plus peanut pasture, $2.14; corn 2–3 plus cotton seed meal 1–3 plus sorghum pasture, $7.79; corn plus chufa pasture, $8.89; corn plus soy bean pasture, $2.74; corn 2–3 plus cotton seed meal 1–3 plus soiled sorghum, $4.86.

15. When hogs have been grazing a green crop it usually pays to inclose and feed them in a dry lot for a short period after the crop is exhausted.

16. When corn was fed alone but 48 cents was realized upon each bushel of corn used. The way to secure a better price for the corn is to feed it in combination with some other feed.

17. When hogs sell for from 5 to 7 cents a pound live weight the farmer cannot afford to sell his corn for 70 cents a bushel.

INTRODUCTORY.

While Alabama produces a portion of the pork that her people consume she falls far short of meeting home demands. Much of the pork we use is made in Illinois, Iowa, Ohio, and other northern states. It costs the farmer as much, and perhaps more, in those states to produce a pound of pork than the same pound would cost if produced by the Alabama farmer; under present conditions our people pay those northern farmers a good profit upon their pork-making operations and in addition, pay heavy freight rates to get the meat transferred to the South. It is no uncommon sight to see the Alabama farmer hauling to his country home meat killed in Chicago. This meat costs from 10 to 12.5 cents at present prices—and it is a cheap quality of meat at that. The Alabama farmer could have made that pork upon his own farm for about one-half the above expense, and by the judicious use of supplementary feeds, could have the meat for at least one-third of what he must pay for it at the grocer's store. Besides getting the meat cheaper, thus saving his money, he would have upon his table first class hams, ribs, and chops instead of the poorer quality of side meat.

Object of Experiments.

These experiments were planned with a three-fold object in view:

1. To compare finishing hogs upon corn alone (the usual method followed in the South) with finishing them upon corn supplemented in some cases with a concentrated feed and in some cases with green crops.

2. To study the efficiency of different feeds, or combinations of feeds, in hardening the flesh of hogs after it has been rendered soft as a result of the animals grazing peanuts.

3. To study the effect of different feeds—with special reference to cotton seed meal—upon the strength, chemical composition, and histology of the bones.

The first object only is dealt with in this bulletin. The other two will receive consideration in a later report.

Animals Used.

This report is based upon three years' experimentation and can be considered only as a report of the progress of the work. Ninety hogs have been used during these three years, divided into numerous lots—six lots each year. While definite conclusions could not be drawn from the data collected through the use of so few animals in a single year's work, yet the test has been repeated in many respects the third year, so the conclusion drawn can be regarded as fairly accurate and trustworthy. The hogs used, while perhaps somewhat better in quality than the average hogs of the state, can be considered about equal to the animals which our best farmers keep upon their farms. They were picked up from neighboring farmers around Auburn, and all of the animals had some improved blood in them. This improved blood consisted largely of Poland-China or Berkshire blood; there were also a few Yorkshire grades. A few of the animals showed close kinship to the "razor backs." At the beginning of the test they averaged something like seventy pounds in weight, and probably averaged five months in age.

QUARTERS.

The pigs which were fed upon concentrates only were confined in dry lots which had a good open shed across one end which afforded them protection from both the hot sun and the cold rains. These lots were about 30 by 100 feet in size. The hogs which were running upon a pasture crop were confined upon these crops by means of a moveable fence (or hurdles); these lots were also afforded shelter from the hot sun by means of trees and bushes or by artificial structures. All the pigs in all cases were made comfortable. When the pigs were grazing a green crop, in some cases they were given the run of but a small area at a time, and the hurdles were then moved forward on a new area, but in other instances the whole area was fenced in and the animals given the privilege of running upon the whole area at one time. There is perhaps a smaller waste when but a small area is grazed at a time, but the labor in moving the fence is not inconsiderable if the areas are made too small.

DIVISION INTO LOTS.

Each year when the pigs were brought to the Animal Industry farm the whole lot was put under similiar conditions a sufficient length of time to establish uniformity, after which time, they were carefully divided into six lots as nearly equal as possible in quality, age, size, weight, sex and breed with previous condition and raising taken into consideration.

FEEDING.

All of the lots were fed twice daily throughout the entire tests, as nearly as possible at the same hour each day, so as to avoid producing restlessness among the pigs. With the exception of the year 1905–'06 the corn was ground and fed in a slop. When the corn was fed with other concentrates the two were always mixed together and fed as a slop. During the years 1905–'06 and 1906–'07 the cotton seed meal was always fermented, or soured, twenty-four hours before feeding, but during the last year, 1907-'08, it was taken directly from the sacks, mixed with the corn meal, and given to the hogs. Those rations which contained cotton seed meal were fed in a very thin slop—in fact so thin that the animals could drink the feed rather than eat it. It was soon learned that when the cotton seed meal was fed in an exceedingly thin slop that the pigs always maintained a keen appetite for the feed, no matter how long they were kept on the feed, but when the ration was placed before them in a dough state it would be but a few days until the whole pen would "go off feed".

All green crops used by the hogs were gathered by the hogs themselves, except in one case in 1905–'06 where sorghum was cut and carried to one lot confined in a pen in order that a comparison might be made with sorghum grazed and sorghum fed in a dry lot (soiled).

All the lots at all times had a mixture, consisting of salt, coal and lime, before them. It was very noticeable that those pigs upon corn alone ate much more of this mixture than did the other lots.

The quantity of food given those pigs which were confined in the lots was gauged by their appetites, the object being to give each lot all it would eat up clean and still retain the appetite. The lots which received a green ration in addition to the grain were not given a full grain ration. Such lots received a grain ration equal to two per cent of the total live weight of the lot; for instance, if a certain lot weighed 800 pounds the daily grain ration would have been 16 pounds. Thus the lots on pasture crops received what may be considered about half a full ration of concentrated food.

The Pasture Crops.

The sorghum crops were as good each year as they could be expected to be when grown upon poor sandy soils. The sorghum was grown in drills and cultivated. The yields, green weight, averaged about eight tons to the acre. The hogs were turned upon the pasture just about the time the juice began to sweeten—or about the time the heads began to turn black, when the sorghum plants were usually 5 or 6 feet high. It was hard work for the hogs to graze the sorghum as the juice was secured so slowly by them that they were never satisfied; so they put in pratically all their time riding down the stalks and chewing the cane; this is not conducive to rapid and economical gains. The peanut crops were not as good as the sorghum crops. In 1905–'06 there was practically a full stand and yield of peanuts. In 1906-'07 there was a very poor stand and not more than a 40 percent yield. In 1907–'08 the yield and stands were even poorer than the previous year. The poor stands and yields were largely due to the fact that labor could not be secured to work the crops after they were put in.

The chufa crop was an average crop, and the soy bean stand was not far below the average, but the yield was cut down somewhat on account of the extremely dry weather just at the time the beans were maturing, so that they finally yielded about 70 per cent of a normal crop. The hogs were turned upon the soy beans two weeks before the beans were matured enough to be eaten, so for the first two weeks the animals ate nothing but the leaves in addition to the corn they received; the records show that the animals made satisfactory gains even these first two weeks.

Periods.

Each year's work was divided into periods because the nature of the work required that it be thus divided, as one of the main points was to study the effect which different feeds might have upon the melting point of the lard when following other feeds, as peanuts. The first year's test, 1905–'06, was divided into two periods. The two following years' work were divided into three periods each. Each period varied in length from twenty-eight to fifty days, thus making each full experiment from ninety to one hundred and ten days in length.

Slaughter Data.

At the end of each period one animal from each lot was slaughtered and careful notes collected upon the dressed weights, appearance of the carcasses, the rapidity and the extent of the "setting", the appearance and weights of the internal organs, etc. Samples of fat were taken from each carcass and turned over to the chemist, Professor Hare, who made melting point determinations, and further studies to learn the effect of different feeds upon the fat of swine. The fifth, six, and seventh ribs were also taken from each animal slaughtered with a view to making a chemical and histological study of the effect of the various feeds upon the animal frame work.

Sales.

The animals were all sold to either the Auburn or Opelika butchers at five cents per pound live weight. If they could have been placed upon the Montgomery or New Orleans market they would have brought from six to seven and one-half cents per pound live weight. The majority of the pigs at the beginning of the test were purchased at a cost of five cents per pound, so under local conditions there was no margin of profit between the buying and the selling prices.

Values Placed Upon Feeds.

In working out the financial statement which follows, the following values were placed upon the feeds:

Corn	70 cts. per bushel,
Cowpeas	80 cts. per bushel,
Cotton Seed Meal	25 dollars per ton,
Tankage	40 dollars per ton.

As a rule there has been no expense charged against the gains made by the hogs as a result of putting in and working the green crops. This varies so much in different localities that figures would be of very little value. But to give an approximation of what it would cost to make a pound of pork when the crops are charged against the animals the cost has been worked out for the conditions existing here upon the station farm (see table 17 page 61). It has been considered, in this bulletin, that the cost of putting in and cultivating the crop was offset by the good done the soil by having the pigs graze over it and drop the manure. This is not merely an assumption; it has been experimentally proven that where hogs on a partial ration of concentrates have been permitted to graze over an acre of green crops, that the increase yield in the cotton crop following the next year alone was 195 pounds of seed cotton, and the second year's increase, due to the grazing two years before, was 183 pounds of seed cotton.

Discussion of the Experiment.

The feeding tests here reported were conducted at different times throughout the year 1905–'06, 1906–'07, 1907–'08. With the exception of the first year the general plan was to begin the work in August or the first part of September and carry some of the lots from 35 to 50 days upon various concentrated feeds and the other lots on sorghum, as sorghum comes on earlier in the summer than do the peanuts. During the year 1907-'08 both soy beans and sorghum were used as green crops during the first period. After the first period the peanuts were ready to use and the lots were transferred from the sorghum and the soy bean pastures to the peanut pasture. The peanut pasture was exhausted in from 28 to 35 days, after which time the lots were all brought in and fed in dry lots upon concentrates only, for a finishing period of 28 days. The following tabulated statement displays the plan of the work:

TABLE 1. *General Outline of the Experiments.*

1905–6

No. Lot	Ration and Date		
	Period 1,	Period 2 (60 days) Sept. 21–Nov. 10	Period 3 (35 days) Nov. 10–Dec. 15
1		Peanut pasture Corn	Corn only
2		Peanut pasture Corn	Corn 2-3 C. S. Meal 1-3
3		Peanut pasture Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
4		Sorghum juice Cowpeas 2-3 Corn 1-3	Sorghum Juice Cowpeas 1-3 Corn 2-3
5		Cowpeas 2-3 Corn 1-3	Cowpeas 1-3 Corn 2-3
6		Corn only	Corn only

1906–7

No. Lot	Period 1 (49 days) Aug. 8–Sept 26	Period 2 (28 days) Sept. 26–Oct. 24	Period 3 (35 days) Oct. 24–Nov. 28
1	Cut sorghum Corn 2-3 C. S. Meal 1-3	Peanut pasture, Corn	Corn only
2	Grazed sorghum Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
3	Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
4	Sorghum juice Corn 2-3 C. S. Meal 1-3	Chufa pasture Corn	Japan cane Corn 2-3 C. S. Meal 1-3
5	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
6	Corn only	Corn only	Corn only

1907–8

No. Lot	Period 1 (35 days) Sept 6–Oct. 11	Period 2 (28 days) Oct. 11-Nov. 8	Period 3 (28 days) Nov. 8–Dec. 6
1	Soy bean pasture Corn	Peanut pasture, corn Corn	Corn 2-3 Tankage 1-3
2	Grazed sorghum Corn 2-3 C. S. Meal 1-3	" " "	Corn 2-3 C. S. Meal 1-3
3	Grazed sorghum Corn	" " "	Corn
4	Corn 9-10 Tankage 1-10	Corn 9-10 Tankage 1-10	Corn 9-10 Tankage 1-10
5	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3	Corn 2-3 C. S. Meal 1-3
6	Corn only	Corn only	Corn only

PEANUT PASTURE TO SUPPLEMENT CORN.

In all cases where peanuts were used the hogs were grazed upon them, thus saving the expense of having them harvested. This method of harvesting a crop has the additional advantage of having the manure scattered upon the cultivated fields just where wanted without the expense of hauling it with wagon and team. The data in this bulletin covers three years' work with peanuts but the first year's work is the only one during which time there was an average crops of nuts, as noted elsewhere; the crops of both the years 1906-'07 and 1907-'08 were very poor ones due to the fact that labor could not be secured to work them.

TABLE 2. *Summary of the three years' work with Peanuts.*

Ration	No. Animals Used	Average Daily Gains	Initial weight of pigs	Grain required for 100 lbs. gain	Cost of grain for 100 lbs. gain
		Lbs.		*Lbs.*	
Corn alone	15	.69	73	611	$7.43
Corn Peanut pasture	32	1.01	81	148 Corn .45 acre peanuts	1.85

This table, while illustrating the great use to which peanut pasture can be put in saving corn, does not deal fairly with the nuts as far as the area which is required to produce 100 pounds is concerned; as noted above, the nuts were not a full crop two of the years. Usually the area required to produce 100 pounds gain will be cut down very materally from that shown in the above table, as may be seen in a following table, in which case the peanuts were practically a full crop—or an average crop. Even though in two years out of the three there were poor stands, still the nuts made a good showing. The table indicates that .45 of an acre of peanuts was equal in feeding value to 463 pounds of corn, and that the cost of concentrates required in making 100 pounds gain was reduced from $7.63 in the case of corn alone to $1.85 when the corn was supplemented with peanuts. In this table there has been no expense counted against the animals as a result of putting in and cultivating the green crops, as it has been experimentally proven that when a leguminous crop, like peanuts, is grown and grazed off by pigs, that the increased fertility, as measured by the succeeding year's crop of cotton, has sometimes more than paid for the expense of putting in the crop. (See page 74).

Money was lost in the case where corn alone was fed to pigs, the gains costing $7.63 per 100 pounds and could be sold for but $5.00 per 100 pounds at Auburn. Seventy cent corn calls for seven–cent hogs, live weight, if the feeder expects to come out even and realize 70 cents a bushel for corn.

The daily gains were much more satisfactory where the peanuts were grazed than when corn alone was fed. Hogs are never satisfied when fed corn alone. Corn alone does not meet the body requirements; it is lacking in protein and ash, so that when a young animal is compelled to eat corn alone he soon fails to make satisfactory gains, becomes restless, and puts in much of his time in rooting about the pen and trying to get out. A peanut–fed hog is always contented, as this feed meets the body requirements and he spends his spare time sleeping.

Bone samples have been saved from all of the animals and casual observation shows the bones of hogs which have been fed on corn alone to be much weaker and smaller than in the case where the corn was supplemented with other feeds.

During the year 1905–'06, in addition to having a peanut lot upon corn alone, there was another peanut lot which received, in addition to the peanut pasture, a two per–cent ration of corn and cotton seed meal, in the proportion of two-thirds corn and one-third cotton seed meal.

TABLE 3. *Corn versus Corn and Peanuts, versus Corn 2–3 plus Cotton Seed Meal 1–3.*

Ration	No. Animals used	Average Daily Gains	Initial weight of pigs	Feed required per 100 lbs. gain	Cost of grain for 100 lbs. gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	4	.67	65	560	$7.00
Corn Peanut pasture	8	.91	60	177 Corn .12 acres peanuts	2.22
Corn 2-3, C. S. Meal 1-3 Peanut pasture	4	1.00	59	107 Corn 51 C. S. Meal .08 acre peanuts	1.97

This is the year's work when there was a normal crop of peanuts and represents more accurately what can be expected from the use of peanuts than does the preceding table. All of the lots, even the corn lots, made very satisfactory gains for such small animals. The lot upon peanuts, with corn alone added, made 35.8 per cent better gains than did the lot upon corn alone, and when both corn and cotton seed meal were added to the peanuts the gains were 47.7 per cent better than that of the corn lot. The daily gains were increased by 35.8 and 47.7 percent respectively through the addition of peanut pasture or of peanut pasture and cotton seed meal to corn alone and at the same time the cost of producing 100 pounds of pork was decreased from $7.00 in the case of corn alone to $2.22 when corn and peanut pasture were used, and to $1.97 when both corn and cotton seed meal were used in connection with the peanut pasture.

This table also illustrates the fact that when corn is worth 70 cents per bushel a farmer must secure 7 cents per pound, live weight, for his hogs if he expects to come out even when corn alone is fed.

When some cotton seed meal was added to the corn rations of the hogs when running on peanuts, the daily gains were increased and the cost of one hundred gain was reduced from $2.22 to $1.97. No ill results followed the use of the cotton seed meal, but that is not a guarantee that evil results will never follow its use.

Tankage can be used to take the place of cotton seed meal when the farmer is afraid of losses from the use of cotton seed meal (as will be seen later), but tankage was found to be somewhat inferior to cotton seed meal for pork production.

Where corn alone was fed in addition to peanut pasture it was found that .12 of an acre of peanuts took the place of 382.5 pounds of corn, or one acre of peanuts was equal in feeding value to 56.9 bushels of corn. When both corn and cotton seed meal were fed in addition to peanut pasture one acre of peanuts was still more valuable than when corn alone was used. If the land upon which these peanuts were grown had been planted in corn instead of in peanuts it would have perhaps produced only fifteen to eighteen bushels of corn to the acre.

Sorghum.

Sorghum is a green crop well thought of in the South as a food for swine. Its chief advantage lies in the large yields and sureness, there being very few seasons in which it fails. But it must be remembered in planning a rotation of crops that sorghum is not a legume, and that the land will not be made better on account of its having been grown. Other things being equal, a leguminous crop should generally be grown for a hog feed, on account of its beneficial effects upon the soil. This bulletin comprises two years' work with sorghum. In some cases the grain fed in connection with the sorghum consisted of corn alone, in other cases of a ration made up of corn two-thirds and cotton seed meal one-third. Only a half grain ration was fed.

In all cases the hogs were not turned into the sorghum field until the juice began to sweeten, or until some of the heads began to turn black.

A test was also made to determine whether it would be profitable to cut the sorghum in the fields and carry it to the hogs when confined in pens.

TABLE 4. *Corn alone versus Corn and grazed Sorghum; Corn alone versus Corn 2–3 Cotton Seed Meal, 1–3 and grazed Sorghum*

Ration	No. Animals used	Average Daily Gains	Initial weight of pigs	Feed required for 100 lbs. gain		Cost of grain per 100 lbs. gain
		Lbs.	*Lbs.*	*Lbs.*		
Corn alone	6	.78	73	456		$5.70
Corn Grazed sorghum	6	.37	73	437 .57	Corn acre sorghum	5.46
Corn 2-3 C. S. Meal 1-3 Grazed sorghum	6	.51	74	206 103 .37	Corn C. S. Meal acre sorghum	3.86

While the pigs which were confined in dry lots and fed corn alone made much better gains than can usually be expected from the use of corn alone, those animals which received the half ration of corn plus sorghum pasture, made a very poor showing, the daily gain being but .37 of a pound per pig. Another lot of pigs, not mentioned in table 4, but treated similarly to the sorghum lot, with the exception that they had soy beans in the place of sorghum, made an average daily gain of 1.02 pounds.

In the case above it is seen that .57 of an acre of sorghum took the place of but 19 pounds of corn, which means that one acre of sorghum saved but 32 pounds of corn when the sorghum was supplemented by corn alone.

A feed consisting of corn and sorghum alone is a very poor feed for either fattening hogs, or for producing growth. Both are low in protein and ash and high in carbohydrates, neither feed furnishing enough protein or ash for hogs which are not completely matured before the finishing period begins. The sorghum might have made a better showing if the pigs used had been matured animals before the fattening period began.

When the ration of corn and sorghum was supplemented with a little cotton seed meal, as was the case with lot 3, the results were more satisfactory, but even with the use of cotton seed meal the results do not compare favorably with the results gotten from the use of either peanut or soy bean pasture as a supplement to corn. With the use of both corn and cotton seed meal 309 pounds of concentrates were required to make 100 pounds of gain, at a cost of $3.86. Data will be presented later on in the bulletin showing .37 of an acre of sorghum in lot three saved grain to the value of only $.56, or an acre of sorghum saved, in terms of concentrates, but $1.57.

In view of the fact that it is very hard work for pigs to graze sorghum, as the cane must be ridden down, and as it requires all of the hog's time—and more, too—to satisfy his appetite, since the juice is secured very slowly, it was thought that it might be profitable to place the hogs in a pen and carry the sorghum to them (soiling). Accordingly this test was tried in 1906-'07 with the following results:

TABLE 5. *Grazing Sorghum versus soiling Sorghum.*

Ration	No. Animals used	Average Daily Gains	Average Initial weight of pigs	Feed required per 100 lbs. gain	Cost of concentrates per 100 lbs grain
		Lbs.	*Lbs.*	*Lbs.*	
Corn 2-3 .... C. S. Meal 1-3....	5	1.18	85	212 Corn 106 C. S. Meal	$3.99
Corn 2-3 .... C. S. Meal 1-3... Grazed sorghum	5	.43	90	314 Corn 157 C. S. Meal .15 acre sorghum	5.90
Corn 2-3 .... C. S. Meal 1-3.... Soiled sorghum	5	.75	82	181 Corn 90 C. S. Meal .13 acre sorghum	3.39

Where a combination of corn and cotton seed meal was fed rapid and economical gains were made; this was invariably the case in these experiments no matter under what conditions fed. When cotton seed meal is fed properly the hog will either make rapid gains or die. As stated elsewhere there have been no deaths during these series of tests where the hogs received a large ration of cotton seed meal, but this is no guarantee that deaths may not occur next year.

The hogs (lot 2) which grazed the sorghum down made a poor showing,—in fact the sorghum was a detriment instead of a help in this case. Where the hogs had the sorghum carried to them, (lot 3) the data show that .13 of an acre saved but $.60, or a whole acre of green sorghum after being cut and hauled to the hogs was worth but $4.61.

Under the conditions in which sorghum was fed in these experiments it was found to be almost worthless as a supplement to either corn or to a mixed ration of corn and cotton seed meal. It would no doubt be more valuable when fed to larger hogs than were used here. As used in these tests it was not found to be adapted to hogs which were being fattened. Probably one of the chief reasons why it is not a profitable hog feed is that it requires too much work on the part of the hog to extract the juice, and this work prevents the hog from laying on fat. A hog receiving only a two-per-cent grain ration and green sorghum is never satisfied; he always wants to get out of the inclosure, and when he is not trying to get out he is either chewing the cane or rooting in the ground.

Sorghum has probably one valuable place as a hog feed—to help carry the brood sows through the summer months economically when the pastures become short. Sorghum is a bulky feed and is more suited to ruminants—animals with a system of stomachs, as that of the cow and the sheep—than to the hog. The hog makes no use of the leaves and the fibrous part of the stalk at all; his stomach is too small for such bulky roughage. He eats the juice only, and much of that even is lost while he is chewing the stalk.

It should be remembered that this bulletin reports no sorghum experiments in which the plant was grazed when young; in every case the sorghum was far enough advanced so that the juice was sweet to the taste. Some farmers report success with the plant when the hogs are turned into the field when it is about one foot in height, thus inducing them to eat the tender blades along with the immature juice.

Soy Beans.

Soy beans is another leguminous crop which has proven very satisfactory as a green crop with which to supplement corn in pork production. The hogs in this experiment were turned into the field two weeks before the beans were matured sufficiently to be eaten so that for the first two weeks the swine had only the leaves and the stalks to eat, in addition to the two per cent corn ration. The hogs did not touch the beans themselves for about fifteen days after being turned into the patch. The leaves, both dead and green ones, were eaten with relish. It might have paid better to have kept the hogs off the beans until the seed were ripened sufficiently to be eaten,—that is a point open for further experimentation.

Table 6. *Soy bean pasture as a supplement to Corn.*

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required per 100 lbs. gain	Cost of Concentrate per 100 lbs. gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	6	.78	73	456	$5.70
Corn .... Soy bean past'r	6	1 02	77	157 Corn .28 acres soy beans	1.96

Considering the beginning weights of the pigs, both lots made good gains, but the gains of the soy bean lot were much better than those of the corn lot. Running right by the side of the soy bean lot was a lot of pigs which were grazing sorghum, but otherwise treated the same in every respect, yet the sorghum lot made a daily gain of only .37 of a pound.

The corn required to make an hundred pounds gain was reduced from 456 pounds in the case of corn alone to 157 pounds when the corn was supplemented by the soy bean pasture, and the cost of producing the pork was reduced in the same proportion.

It was noticed that the pigs which grazed upon the soy beans were always contented; they spent the greater part of their time in lying down. The pigs just across the fence, which were grazing the sorghum, were never contented or at rest; it could plainly be seen that they wanted something in addition to the corn and sorghum.

The above table shows that .28 of an acre of soy beans was equal to 299 pounds of corn, or an acre was equal in feeding value to, or capable of taking the place of, 19.1 bushels of corn. As noted elsewhere, the crop of soy beans was not a good one, as the beans were cut short on account of extreme drought at the time of maturing. This crop is a very economical and easy one to put in and cultivate; it is good to use it as a catch crop after oats, thus saving the ground from lying idle during the summer months, and at the same time securing a crop equal to, and in many ways superior to a corn crop. In this way, the farmer secures two crops from the same land each year, cheapens pork production very greatly, and builds up the fertility of his soil rapidly. If the soil be good much better results can be secured than reported above, as the soil upon which this crop was grown was a poor sandy one.

TABLE 7. *Sorghum pasture versus Soy Bean pasture.*

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn .... Sorghum past'r	6	.37	73	437 Corn .57 acre sorghum	$5.46
Corn.. .... Soy bean past'r	6	1.02	77	157 Corn .28 acre soy beans	1.96

The soy bean pasture is far above the sorghum pasture both in the daily gains made and also to the economy of the gains. The daily gains were about three times as rapid when the bean pasture was used as when the sorghum pasture was used, and the cost of making one hundred pounds of gain was reduced from $5.46 in the case of sorghum to $1.96 when soy beans were used as a supplementary pasture.

The soy bean pasture also had a much greater carrying capacity than did sorghum pasture; that is an acre of soy beans will usually carry a certain number of hogs a much longer time than will an acre of sorghum.

COWPEAS (SEED) AS FOOD FOR HOGS.

TABLE 8. *Corn alone versus Corn* 1–2 *plus Cowpeas* 1–2.

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	4	.74	63	478 Corn	$5.97
Corn 1-2............... Cowpeas 1-2	4	.93	67	187 Corn 208 Cowpeas	5.11

Under the conditions as they existed in this test it was a profitable thing to supplement corn with cowpeas. Estimating cowpeas at 80 cents a bushel there was a saving of 86 cents for each hundred pounds of pork made through the use of the cowpeas.

Peas at the present writing (July, 1908) are not as cheap as they were in 1905–'06. Under the test as above reported peas would have been a profitable supplement to have added to the corn ration until they reached $1.05 per bushel, and then it would have been better to have fed corn alone at $.70 a bushel. When cowpeas are maintained at a high price they must be fed more sparingly than they were in this experiment.

In some previous work done at this Station* in testing the value of cowpeas as a feed for swine, one lot of hogs was fed upon a ration consisting of cowpeas alone. It was learned that when corn and cowpeas were fed separately and alone that they were practically equal in feeding value, but that when a ration was composed of one–half corn and one–half cowpeas the result due to feeding this mixture was much more satisfactory than when feeding either alone. The results were as follows:

TABLE 9. *Corn and Cowpeas separately versus Corn* 1–2 *plus Cowpeas* 1–2.

Ration	Average Daily Gains	Feed Required Per 100 lbs. Gain	Cost Per 100 lbs. Gain
	Lbs.	*Lbs.*	
Corn alone	.46	487	$6.09
Cowpeas alone	.59	481	6.41
Corn 1-2, Cowpeas 1-2	.62	433	5.60
Corn 1-2, Wheat brand**	.60	521	7.05

*Bulletin No. 82, 1897.
**Wheat bran valued at $30.00 per ton.

This table also points out the fact that cowpeas were very much more efficient than wheat bran as a feed for swine.

TANKAGE.

While tankage has not been used very extensively in the South as a hog feed, still it deserves a prominent place amoung the concentrated feeds which are usually brought to the feed pens from sources outside the farm. It is a by-product of the packing houses. It is very high in both ash and protein—just the two constituents in which corn is deficient—so it is an exceptionally good feed to use in conjunction with corn. It is somewhat similar to cotton seed meal in composition but has the advantage over cotton seed meal in that there is no danger in its use as a hog feed. It is a very rich feed, so should be used sparingly; in these tests it made up but one-tenth of the whole ration as a rule. The results secured through its use are tabulated below:

TABLE 10. *Corn alone versus Corn* 9-10, *Tankage* 1-10.

Ration	No. Animals Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	6	.60	73	574.7 Corn	$7.18
Corn 9-10 Tankage 1-10	6	1.04	69	352 Corn 39.2 Tankage	5.18

The tankage and corn meal were fed together as a rather thin slop. This feed is very palatable. When corn was reinforced by the use of tankage it was found, under the conditions as they existed in this test, that 39.2 pounds of tankage were equal to, or took the place of, 222 pounds of corn. The 39.2 pounds of tankage cost $.78; the 222 pounds of corn cost $2.78; thus a saving of $2 was realized upon each 100 pounds of pork produced by adding tankage to corn.

The test was carried on for 91 days, and it was noticed that those pigs which received corn alone made smaller and smaller gains as the experiment progressed, but the animals which received the tankage in addition to the corn made larger and larger gains as the time went on.

The corn lots would have tired of their ration long before they did had it not been for the fact that they always had all the salt, coal and lime before them that they wished to make use of.

It was thought that if the proportion of tankage were increased to more than one-tenth of the ration that enough corn might be saved to make up for the extra tankage used. This was tried in a short test where all the conditions of previous feeding favored the lot on the high proportion of tankage; that is, the lot of pigs which received the high tankage ration had just been taken off of a peanut pasture, which insured very rapid gains for at least a short time, while the lot which received the one-tenth ration of tankage had not been upon a pasture at all, but had been fed a uniform dry ration since the beginning of the test.

TABLE 11. *A one-tenth ration of Tankage versus a one-fifth ration of Tankage.*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn 9-10 .... Tankage 1-10	4	1.26	120	350 Corn 31.9 Tankage	$5.01
Corn 4-5 .... Tankage 1-5	4	1.83	142	274 Corn 67.3 Tankage	4.77

By the addition of 35.4 pounds of tankage to the ration for each hundred pounds gain a saving of 76 pounds of corn was secured. This additional tankage cost $.71 and the value of the corn saved as a result of the addition of the tankage amounted to $.96—or a saving of $.24 on each one hundred pounds of the pork was realized. But it must be remembered that the previous management of the hogs placed the heavy tankage lot at an advantage,—how much, it is impossible to say.

As tankage is a comparatively new feed to the Alabama farmer it is appropriate to present the following table, so there can be seen at a glance its composition as compared to our more common feeds:

TABLE 12. *Average composition of some common feeds.*

Name of Feed	Dry Matter in 100 lbs.	Digestible Nutriment in 100 lbs.		
		Protein	Carbohydrates	Ether Extract
Corn	93.0	31.7	15.3	4.3
Cowpeas	91.8	37.2	16.9	1.1
Oats	89.0	9.2	47.3	4.2
Cotton seed meal	85.2	18.3	54.2	12.2
Tankage	89.4	7.8	66.7	13.6

COTTON SEED MEAL.

The deaths that sometimes occur through feeding cotton seed meal deter the majority of farmers from using it as a feed for swine. There is no Southern feed to compare with it as a supplement to corn so far as fattening and finishing is concerned. But there is a risk to run, and the man who feeds it has this risk to shoulder. During the last three years this Station has had about fifty hogs upon cotton seed meal rations fed in various proportion with corn, and extending over periods from 28 to 188 days in length. Some of the meal has been fermented and some of it has been fed unfermented. During the first two years above reported the meal was fermented twenty four hours before being fed, then mixd with corn meal so as to make a thin slop of about the consistency of thick butter milk and given to the animals. The meal was fed sweet in 1907'08. No pigs were lost at all during the first and the last year's experimentation, but during the progress of the second year's work several pigs died that had previously been fed on fermented cotton seed meal. However, during the three years' work not a pig died *while he was actually eating* the cotton seed meal; the deaths occured immediately, or within a few days, after a lot of pigs which had been upon a ration of two-thirds corn and one-third cotton seed meal plus sorghum pasture, had been taken out and put upon a peanut pasture plus a corn ration only. That is, the deaths occured—four of them—from one to eight days after the *cotton seed meal ration had been discontinued.* The animals all died with the characteristic symptoms of cotton seed meal poisoning.

Aside from the deaths that may occur, cotton seed meal is a good feed, as will be shown later. It has even now one safe place at least in our swine feeding operations, namely, to be used in a short finishing period when hogs have been taken off of a pasture crop. The following table presents in a tabulated form the average of two year's work with cotton seed meal when both the corn lot and the cotton seed meal lot were fed without any pasture crop.

TABLE 13. *Corn alone versus Corn 2-3, Cotton Seed Meal 1-3*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	11	.65	78.5	590	$7 38
Corn 2-3 .... C. S. Meal 1-3........	11	1.00	77.	303 Corn 157 C. S. Meal	5.75

Not a pig in this particular experiment died while being fed either fresh or fermented cotton seed meal; on the other hand they made good gains, maintained their health throughout, and always had keen appetites for the next feed. Considering the size of the pigs the gains were very satisfactory when the cotton seed meal was used, and the increase in weight was made very much more economically than was the case in the corn lot. The tests show that 151 pounds of cotton seed meal are equal to, or took the place of, 287 pounds of corn; or one pound of cotton seed meal when fed in combination with corn meal in the above proportion was equal to 1.9 pounds of corn. When fed thus the cotton seed meal becomes a highly valuable and cheap feed—provided no deaths occur as a result of its use.

The above tests extended over a period of 102 days.

TABLE 14. *Corn alone versus Corn 1–3 plus Cotton Seed Meal 1–3 versus Corn 9–10 plus Tankage 1–10*

Ration	No. Pigs Used	Average Daily Gains	Average Initial Weight of Pigs	Feed Required Per 100 lbs. Gain	Cost of Concentrates Per 100 lbs. Gain
		Lbs.	*Lbs.*	*Lbs.*	
Corn alone	6	.60	73	574.4 Corn	$7.18
Corn 2-3 C. S. Meal 1-3	6	1.03	69	263.8 Corn 131.9 C. S. Meal	4.95
Corn 9-10 Tankage 1-10	6	1.04	69	352.4 Corn 39.2 Tankage	5.18

In the proportion as fed above the cotton seed meal was more efficient than the tankage in saving corn, a result possibly due to the larger proportion of meal. The cotton seed meal also made 100 pounds of pork a little cheaper than did the tankage, as one hundred pounds live weight was made for $4.95 when the cotton seed meal was used, but the same one hundred pounds increase in weight cost $5.18 when the tankage was used.

No deaths occurred in either lot, but there was some danger of deaths in the cotton seed meal lot while there was no danger at all of any deaths in the tankage lot.

There was pratically no difference between the two rations so far as daily gains were concerned, both feeds making extremely satisfactory gains.

These tests extended over a period of 91 days.

General View of Results of Three Years' Feeding Experiments.

The following table is a summary by periods of the feed fed, the average daily gains, the feed required for one hundred pounds gain, and the cost of one hundred pounds gain each year. Each period is tabulated separately. It should be noted that while this is expressed by periods that some of the lots ran through all three of the periods without a change in feed. Lots five and six during the first two years continued through all three periods without a change. Lots four, five and six were all fed in dry lots and no changes at all were made in their ration:

Table 15.—Summary of rations, gains, feed required for One Hundred pounds gain, and cost of one hundred pounds gain for the three years

1905---06

No. Lot	PERIOD I (...........) RATION	Average daily gains	Feed required per 100 lbs gain: Concentrates	Feed required per 100 lbs gain: Green Areas	Cost of concentrates per 100 lbs gain	PERIOD II (Sep. 21—Nov. 10, '05) RATION	Average daily gains	Feed required per 100 lbs gain: Concentrates	Feed required per 100 lbs gain: Green Areas	Cost of concentrates per 100 lbs gain	PERIOD III (Nov. 10—Dec. 15, '05) RATION	Average daily gains	Feed required per 100 lbs gain: Concentrates	Feed required per 100 lbs gain: Green Areas	Cost of concentrates per 100 lbs gain
		Lbs	Lbs	Acs	$		Lbs	Lbs	Acs			Lbs	Lbs	Acs	
1						Peanut pasture Corn	.84	191 Corn	.087	$2.38	Corn only	.71	587 Corn		$ 7.34
2						Peanut Pasture Corn	.98	164 Corn		2.05	Corn 2-3 C. S. Meal 1-3	.83	342 Corn 171 C.S.Meal		6.41
3						Peanut Pasture Corn 2-3 C. S. Meal 1-3	.99	107 Corn 53 C.S.Meal	.08 Acr	1.93	Corn Meal 2-3 C. S. Meal 1-3	.77	384 Corn 192 C.S.Meal		7.20
4						Sorghum Juice Cowpeas 2-3 Corn 1-3	1.11	207 Cowpeas 103 Corn		4.03	Sorghum juice Corn 2-3 Cowpeas 1-3	1 01	380 Corn 190 C.S.Meal	059†	7.23
5						Cowpeas 2-3 Corn 1-3	.91	264 Cowpeas 132 Corn		5.18	Corn 2-3 Cowpeas 1-3	.90	360 Corn 180 Cowpeas		6.90
6						Corn only	.67	560 Corn		7.00	Corn only	.66	554 Corn		6.92
						1906—07									
	Period 1 (Aug. 8—Sep. 26, '06					Period II (Sep. 26—Oct. 24, '06					Period III (Oct. 24—Nov. 28, '06				
1	Soiled Sorghum Corn 2-3 C. S. Meal 1-3	.75	181 Corn 90 C.S.Meal	.13	$3.30	Peanut Pasture Corn	1.56	196 Corn	.24	$ 2.43	Corn only	1.60	573 Corn	1800 pounds Japanese Sugar Cane	7.16
2	Grazed Sorghum Corn 2-3 C.S.Meal 1-3	.43	314 Corn 157 C.S.Meal	.15	5.88	Peanut Pasture Corn	1 16				Corn 2-3 C S Meal 1-3	1.25	221 Corn 110 C.S.Meal		4.15
3	Corn 2-3 C. S. Meal 1-3	.94	250 Corn 125 C.S.Meal		4.68	Peanut Pasture Corn	.96				Corn 2-3 C. S. Meal 1-3	.91	393 Corn 196 C.S Meal		7.36
4	Sorghum Juice Corn 2-3 C. S. Meal 1-3	.91	155 Corn 77 C.S.Meal	.19‡	2.90	Chufa Pasture Corn	.72	305 Corn	.41	3.81	Japan cane Corn 2-3 C. S. Meal 1-3	.97	206 Corn 103 C.S.Meal		3.86
5	Corn 2-3 C. S. Meal 1-3	1.18	212 Corn 106 C.S.Meal		3.97	Corn 2-3 C S Meal 1-3	.96	366 Corn 183 C.S.Meal		6.86	Corn 2-3 C. S. Meal 1-3	.54	605 Corn 202 C.S.Meal		11.33
6	Corn only	.76	483 Corn		6.03	Corn only	.89	516 Corn		6.45	Corn only	.42	1195 Corn		14.93

	1907—08														
	Period I (Sept. 6—Oct. 2, 07					Period II (Oct. 2—Nov. 8, 07)					Period III (Nov. 8—Dec. 5, '07				
1	Soy Bean Pasture Corn	1.02	162 Corn	.28	$2.02	Peanut Pasture Corn	1.04	195 Corn	.24	$ 2.25	Corn 4-5 Tankage 1-5	1.83	371 Corn 68 Tankage		3.73
2	Grazed Sorghum Corn 2-3 C. S. Meal 1-3	.51	206 Corn 103 C.S.Meal	.37	3.86	Peanut Pasture Corn	1.14				Corn 2-3 C. S. Meal 1-3	1 33	334 Corn 117 C.S.Meal		4.39
3	Grazed Sorghum Corn	.37	336 Corn	.57	5.57	Peanut Pasture Corn	.96				Corn only	1.35	353 Corn		4.44
4	Corn 9-10 Tankage 1-10	.93	332 Corn 57 Tankage		4.89	Corn 9-10 Tankage 1-10	.93	480 Corn 43 Tankage		5.66	Corn 9-10 Tankage 1-10	1.26	354 Corn 39 Tankage		5.20
5	Corn 2-3 C. S. Meal 1-3	1.01	336 Corn 118 C.S.Meal		4.42	Corn 2-3 C.S. Meal 1-3	1.08	246 Corn 123 C.S.Meal		4.61	Corn 2-3 C. S. Meal 1-3	.91	378 Corn 189 C.S.Meal		7.09
6	Corn only	.78	462 Corn		5.77	Corn only	.53	621 Corn		7.76	Corn only	.46	838 Corn		10.47

† 490 lbs Sorghum Juice.
‡ 983 lbs Sorghum Juice.
† 435 lbs Sorghum Juice. This area represents the average for both periods. The cane from which the juice was extracted was the large Florida.

As a general thing both the rapid gains and the cheap gains were made when the hogs received some kind of pasture crop in addition to the corn. The best kind of green crops were the leguminous crops, peanuts and soy beans. As far as these experiments show, sorghum has but little value to recommend it as a green crop for finishing hogs— unless abundance of labor should permit the crop to be economically cut and hauled to the animals. Pigs when no larger than those used in these tests cannot graze it to any advantage.

Chufas proved more satisfactory than sorghum.

Table No. 15, in a way also shows the relative stands or yields of peanuts during the three years. The first year but .08 of an acre was required to make 100 pounds of gain, as against .89 of an acre for the third year, or the yield the first year was about ten times as great as that of the third year.

One acre of the various green crops carried 10 hogs (fed a half ration of concentrates) for the following length of time:

One acre of peanuts carried 10 hogs (Av. 3 years) 53 days.
One acre of sorghum carried 10 hogs (1906–'07) 153 days.*
One acre of sorghum carried 10 hogs (1907–'08) 46.6 days†.
One acre of chufas carried 10 hogs (1906–'07) 32.3 days.
One acre of soy beans carried 10 hogs (1907–'08) 34.4 days.

Since grain was fed with each crop the length of time that an acre was pastured does not indicate the relative value of an acre of the several crops.

It must be remembered that in all of the above cases the hogs received in addition to the green crop, some corn. If the corn had not been fed, of course, it would have required larger areas of green crops to get the same results. By taking an average of the three years' work it is seen that peanut pasture has a greater carrying capacity than any of the other green crops used.

*Sorghum was cut and carried to the hogs which were fed in a dry lot.

†Sorghum grazed.

Shall Hogs Which Have Been Grazed Upon Green Crops be Finished in a Dry Lot Upon Grain?

The majority of the farmers of the State who make use of green crops for fattening hogs sell the hogs directly upon the market when the crop is exhausted without finishing them upon grain for a short time in a dry lot. A study of period 3 (table 15) will throw some light upon this practice; it will help to determine whether it is profitable to feed in a dry lot for a few days upon grain alone. There are some contradictions when the three years' work are compared. The work of the first year favors selling hogs directly off the green crops; that is, the finishing period of thirty five days of dry lot feeding was a losing proposition in all cases for this year. In fact the hogs which had been fed in a dry lot throughout the entire test went through the finishing period more economically than did those hogs which had grazed peanuts for fifty days previous to the finishing period. But during the last two years' work those hogs which had been previously grazed upon a green crop made their gains in the third period more cheaply than did those which had never been given the run of a pasture crop.

During the second year's third period money was lost in the case of two lots, 1 and 3, (previously pasturing peanuts) the gains when feeding in dry lots costing from $7.16 to $5.39 per hundred, and these gains could be sold for only $5.00 per hundred on the local market. If these hogs could have been put upon some of the larger markets in the South there would probably have been some profit even in these two lots. In all lots in 1907–'08, where the hogs were finished for a period of twenty eight days after taking off of peanuts, the subsequent period of dry lot feeding was found to be exceedingly profitable. During this year's work the lots which had previously been upon peanuts made unusually large gains, and made these gains economically. While the results are not all in agreement, yet they seem to indicate that it is more often profitable to finish hogs upon dry feeds rather than to sell directly from pastures.

In all three years' work cotton seed meal was found to be a very valuable feed with which to supplement corn for finishing hogs after they had been grazed upon a green crop,—in fact the most valuable of any so far tried. That is, these finishing gains can be made more cheaply through the use of cotton seed meal combined with corn than by the use of corn alone, or corn supplemented with tankage. Cotton seed meal is an excellent feed for fattening purposes. On the average the data show that corn and cotton seed meal can be used very profitably as a short finishing feed. In other words it is usually advisable to combine corn and cotton seed meal and to dispose of some of the corn on the farm by feeding during a short finishing period, say 20 days, after the hogs have been taken off of the peanut pasture, because usually more than 70 cents a bushel can be realized upon the corn by this practice. It might not be a wise thing to keep the hogs upon this feed for as long as twenty-eight days, as deaths may occur from feeding the cotton seed meal for this length of time. In these tests no animals have died from feeding cotton seed meal for 28 days during the finishing period. It will be perfectly safe to use the cotton seed meal for at least twenty days.

There is another advantage to be gained by finishing hogs for a short period after taking them off of green crops, namely, better prices can be realized for them when placed upon the market. The hog looks better, and is actually worth more to the consumer or packer, as he is fatter and will dress out a higher per cent of good marketable meat than if he had been sold directly from the pasture. The corn-fed hog has a decided advantage in all the Southern markets.

In this connection the point should not be overlooked how extremely expensive the gains become along about the last month of feeding when hogs are being fattened upon corn alone, running from $7.00 a hundred in one case to about $15.00 per hundred increase in live weight in another case.

When hogs have been grazed upon peanuts, and certain other green pastures, there is yet another advantage to be gained in feeding them upon dry feeds a short time before selling. It is well known that peanuts soften the meat very much, so that it is not as acceptable to many butchers and to the packers as the animals that have been fed upon grain alone. This soft meat can be hardened very materially, if the hogs are fed upon grains only for a short period after the peanuts are exhausted. Corn is good; corn in combination with cotton seed meal is better than corn alone, as the addition of some cotton seed meal to the ration renders the meat hard more rapidly than when corn alone is used.

Summary of Average Results for Three Years.

In table number sixteen is brought together the summary, or average, of the experimental work for three years. The average shows that large gains and cheap gains go with the use of green crops and that the best green crops are the legumes. The table also demonstrates strikingly that small gains and the high priced gains go with the use of corn exclusively. Every supplement used with corn cheapened the gains, no matter whether it was a pasture supplement or another concentrate—except when the cost of putting in and cultivating the crops was charged against the gains, when sorghum and chufa pastures were found to be of no advantage.

In comparing lots 2 and 3 there seems to be an apparent contradiction to the data presented heretofore; that is table No. 14 taught that cotton seed meal produced gains more economically than did the tankage, while in this table the cheaper gains seem to have been made with tankage. This is due to the fact that the data for lot 2 in the present table are a summary of two years' work, while in table 14 only the last year's test was used, so that a direct comparison could be made between the cotton seed

Table 16. Average total summary of 1905–'06; 1906–'07; 1907–'08.†

No. Lot	Ration	No. Pigs in Test	Average Daily Gains	Feed Required Per 100 lbs. Gain: Concentrates	Feed Required Per 100 lbs. Gain: Pasture Areas	Cost of Concentrates Per 100 lbs. Gain
			Lbs.	*Lbs.*	*Acre*	
1	Corn only	15	.69	611 Corn		$7.63
2	Corn 2-3 C. S. Meal 1-3	11	1.04	303 Corn 157 C. S. Meal		5.75
3	Corn 9-10 Tankage 1-10	6	1.04	352 Corn 38 Tankage		5.18
4	Corn 1-2 Cowpeas 1-2	4	.94	187 Corn 207 Cowpeas		5.11
5	*Corn Peanut pasture	32	1.01	183 Corn	.44	2.28
6	*Corn Meal 2-3 C. S. Meal 1-3 Peanut pasture	4	1.00	107 Corn 51 C. S. Meal	.08	1.97
7	Corn Sorghum past'r	6	.37	437 Corn	.57	5.36
8	Corn 2-3 C. S. Meal 1-3 Sorghum past'r	11	.46	259 Corn 129 C. S. Meal	.26	4.85
9	Corn Chufa pasture	3	.72	305 Corn	.41	3.81
10	Corn Soy bean past'r	6	1.02	158 Corn	.28	1.96
11	Corn Meal 2-3 C. S. Meal 1-3 Soiled sorghum	5	.75	181 Corn 90 C. S. Meal	.13	3.39

*Lots 5 and 6 are not comparable. It would seem, on the face, that the addition of cotton seed meal to the corn and peanut ration worked wonders, but this cannot be compared to lot 5 as lot 5 takes in all the years, (and the last two years had very poor stands), while the data in lot 6 were obtained only in 1905 when the stand of peanuts was extra good.

†Cost of putting in and cultivating the pasture crops not taken into consideration.

meal and the tankage. Table 14 is more reliable on this single point than the present table.

The results from the use of the chufa pasture has not been discussed so far, as so few animals were used that any conclusions drawn could not be relied upon absolutely. But, looking at lot 9, it is seen that the daily gains made upon the chufa pasture, while not as good as those made upon soy bean and peanut pastures, are much better than those made when sorghum was used. It is also seen that the chufa pasture saved corn.

Cost of Gains When Manural Value and Expense of Putting in and Cultivating the Crops are Considered.

In the above table there has been no expense charged against the hogs on account of putting in and cultivating the pasture crops. Neither has there been any credit given to the soil by reason of there having been grown upon it leguminous crops. The manure dropped by the animals while grazing the crops has not been credited to the soil.

Of course there is no figure which will express the exact cost of putting in a crop under all conditions, as conditions vary with different localities. Neither are there any exact figures to tell just how much good will come to the soil as a result of growing a leguminous crop; this varies with different soils and with many other conditions. So the following estimate is based upon the approximate average cost of putting in crops upon the Station farm, and the fertilizing value of a leguminous crop is based upon work done here and reported in previous bulletins.

The cost of putting in and cultivating each acre of the various crops, counting labor at eighty cents a day and one man with one mule at one dollar a day, was approximately as follows:

PEANUTS:

To one bushel seed	$ 1.90
To commercial fertilizer	1.50

To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	1.00
To cultivating three times	1.20
To hoeing one time	.80
To rent or interest	2.00
Total cost of each acre	$9.60
By assumed increase in next year's crop due to fertilizer effect of peanuts and grain fed (partly based on Alabama Bulletins 120 and 137)	$ 7.50
Net cost of one acre peanuts	$ 2.10

SOY BEANS:

To one bushel seed	$ 2.20
To commercial fertilizer	1.50
To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	1.00
To cultivating four times	1.60
To hoeing one time	.80
To rent or interest	2.00
Total cost of each acre	$10.30
By assumed increase in next year's crop due to fertilizing effect of peanuts and grain fed	$ 7.50
Net cost one acre soy beans	$ 2.80

SORGHUM:

To one-half bushel seed	$ .75
To commercial fertilizer	5.00
To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	.75
To cultivating four times	1.60
To rent or interest on land	2.00
Total cost of each acre	$11.30

(No credit for soil improvement)

CHUFAS:

To one peck of seed	$ 1 00
To commercial fertilizer	5.00
To breaking the land	1.00
To harrowing the land	.20
To putting down the seed and fertilizer	1.00
To cultivating four times	1.60
To hoeing one time	.80
To rent or interest on land	2.00
Total cost of each acre chufas	$12.60

(No credit for soil improvements).

Counting the expense of putting in and cultivating the green crops as above, the cost of making one hundred pounds gain on the hogs in each one of the lots was as follows:

TABLE 17.

Lot 1—Corn alone	$ 7.63
Lot 2—C. S. Meal 1–3 Corn 2–3	5.75
Lot 3—Corn 9–10 Tankage 1–10	†5.18
Lot 4—Corn 1–2 Cowpeas 1–2	5.11
Lot 5—Corn Peanut pasture	*3.20
Lot 6—Corn 2–3 C. S. Meal 1–3 Peanut pasture	*2.14
Lot 7—Corn Sorghum pasture	11.96
Lot 8—Corn 2–3 C. S. Meal 1–3 Sorghum pasture	†7.79
Lot 9—Corn Chufa pasture	†8.98
Lot 10—Corn Soy Beans	2.74
Lot 11—Corn 2–3 C. S. Meal 1–3 Soiled sorghum	†4.86

When all expenses are *charged against putting in these green crops,* it is seen that sorghum makes a very poor showing, even inferior to corn when fed alone. Looked at from every point of view it seems that mature sorghum (pastured) has no place as a feed for finishing swine. It seems that it might, under certain conditions where labor can be contracted and secured cheaply, be a profitable

*Lots 5 and 6 not to be compared; see foot note to Table 16.
†Data for one year only.

thing to grow sorghum and cut it when ripe and carry it to the hogs. In lot II, where it was so handled economical gains were made; but the labor of cutting the sorghum and carrying it to the hogs has not been included in the estimate. The hogs made very much more economical use of the sorghum as far as the sorghum itself was concerned, when it was cut and fed to them in a dry lot than when they were permitted to graze it, that is, the waste was not so great in soiling sorghum.

The chufa pasture also made a very poor showing, but the gains were somewhat cheaper than when the sorghum pasture was used. Neither sorghum nor chufas are legumes.

The greatest profits were made when a leguminous crop was used to supplement the corn. In fact, in all cases where either peanuts or soy beans were used profits were realized even if no credit be given for the improvement of the soil. The results in lot 6 more nearly represents what the farmer can expect from the use of peanuts than those with lot 5, as lot 6 represents only one year's experiment, when there was a good stand of the nuts, while lot 5 is an average of all the three years' work, which includes two years of very poor crops.

TABLE 18. *Financial Statement.* (*Summary* 1905–'06 1906–'07, 1907–'08.)††

No. Lot	Ration	No. Pigs Used	Initial Cost of Whole Lot	Cost of Grain Given each Lot	Total Cost of the Hogs Plus the Concentrates	Selling Price Whole Lot at 5 cts per lb.	Profit on Whole Lot	Profit Per Pig After Charging Corn Against them at 70 cts per bu.	Price Actually Realized for each Bu. Corn
1	Corn only........	15	$ 56.30	$59.60	$111.50	$ 97.90	$—18.00	$—1.20	$ .48
2	Corn 2-3 .... C. S. Meal 1-3..	11	42.20	54.15	96.35	90.65	— 5.70	— .51	.59
3	Corn 9-10 .... Tankage 1-10..	6	20.85	24.49	45.35	44.35	— .99	— .16	.66
4	Corn 1-2.. .... Cowpeas 1-2	4	13.50	16.13	29.63	27.00	— 2.63	— .65	.47
5	Corn .... Peanut past'r..	32	142.20	26.10	168.20	199.00	30.80	.96	†1.53
6	Corn 2-3 .... C. S. Meal 1-3 Peannt past'r..	4	11.85	3.95	15.80	21.80	6.00	1.50	†2.30
7	Corn .... Graz'd sorgh'm	6	21 95	4.26	26.21	25.85	.36	.06	.64
8	Corn 2-3 . . ... C. S. Meal 1-3 Graz'd sorgh'm	11	45.00	10.46	55.46	55.75	.29	.03	.72
9	Corn .... Chufa past'r...	3	16.40	2.33	18.73	20.05	1.32	.44	1.10
10	Corn .... Soy bean past'r	6	23.20	4.26	27.46	34.00	6.54	1.09	1.80
11	Corn 2-3 .... C. S. Meal 1-3 Soiled sorgh'm	5	20.70	5.05	25.75	30.00	4.25	.85	*1.58

*Labor of cutting and hauling is not included.
‡And the other feeds as ffuoted on page 6.
†Lots 5 and 6 are not comparable; see note to Table 16.
††Taking no account of the cost of growing the pasture crops.

From the financial statement in table 18 it is seen that when corn is worth 70 cents a bushel, cotton seed meal $25.00 per ton, tankage $40.00 a ton, and cowpeas 80 cents a bushel, some of the lots made good profits, while other lots were fed at a financial loss. That is, some of the lots of hogs returned more than the market price for the feeds used while some of the lots did not make gains economical–

ly enough so that the usual market prices for corn and the other grains used could be realized. By the use of certain combinations of feeds it was a very profitable thing to do to dispose of the corn by means of feeding hogs; more was made by thus disposing of it than if it had been sold directly upon the market at 70 cents a bushel; when the corn was fed incorrectly, or not judiciously, money was lost by feeding it to the hogs.

Lot 1, the corn lot, made the greatest loss of any of the pens; lot 6 made the largest profits. The corn lot lost $1.20 per pig. This was a very heavy loss for the pigs weighed but 130 pounds each. From a financial standpoint it proved to be advisable to supplament the corn ration with cotton seed meal and tankage.

The ration of corn one-half plus cowpeas one-half was not as profitable as when corn was supplemented with the cotton seed meal or tankage, there being a loss upon each pig of $.65 when fed on cowpeas and corn. It is but fair to state that under present conditions, and in fact since 1905, the financial showing in lot 4, where corn and cowpeas were fed would not be as good as the above data represent, for when the test was made the cowpeas were purchased for 80 cents a bushel, and have been so figured in the financial statement, but it has been impossible to purchase them for the above price since that date.

Where pasture crops were used in combination with grain good profits were made possible—that is, more than 70 cents a bushel was realized upon corn from the feeding operations. This last table does not include the cost of putting in and cultivating the green crops, neither does it take into consideration the value to the land in having the pigs graze upon it. But if the manurial value be eliminated altogether and the pigs be charged with the cost of putting in and tending the crops it is still found that excellent profits were made when peanuts and soy bean pastures were used, but when chufa and sorghum pastures were used money was lost. The legumes made the best showing by far. In fact, when the cost of putting in the crops is charged against the hogs the sorghum lots lost more money than did the lots upon corn alone.

This table again emphasizes the fact that money cannot be made by finishing hogs through the use of corn alone. The farmer cannot expect to sell his corn for 70 cents a bushel through hogs when the hogs have nothing else to eat except the corn—that is, he cannot do it when the hogs sell at five cents per pound live weight. The farmer could not afford to feed corn alone, no matter how high hogs might sell, for much more could be made out of the corn by combining it with some other feeds, either green or concentrated.

The last column in table 18 brings out some valuable points; here we find tabulated the prices which were obtained for each bushel of corn fed. In lot 1, where corn alone was fed, but $.48 per bushel was realized by feeding the corn to the hogs. When corn was supplemented with cotton seed meal and tankage the corn was sold through the hogs for $.59 and $.66 respectively. That is, through feeding tankage with corn the value of the corn was increased 18 cents a bushel. The greatest value was gotten from the corn when it was fed in connection with the leguminous crops, peanuts and soy beans; in these cases the prices received for the corn varied from $1.53 per bushel up to $1.80 per bushel. Much more was made out of the corn when it was fed in connection with a leguminous crop than would have been made had it been sold directly upon the market.

Profits Realized When Hogs Were Sold at Varying Prices.

The preceding table represents the profits and losses just as they actually occured at Auburn under the local market conditions. The hogs were bought for 5 cents a pound live weight and sold for 5 cents, upon the local market after being fed for from 84 to 112 days. If the hogs could have been placed upon Montgomery, Mobile, Birmingham, or New Orleans markets they would have brought from 6 to 7 1-2 cents per pound on foot. So to illustrate what would have been made or lost under these varying conditions the following table is attached:

TABLE 19. *Profits realized when hogs are sold at various prices.*†

No. Lot	Ration	Profits per Pig when bought at 5c per lb. and sold at:- (after feeding from 84-112 days)					
		5 cts.	5½ cts.	6 cts.	6½ cts.	7 cts.	7½ cts.
1	Corn alone	—1.20	$—.55	$ .11	$ .75	$1.41	$2.06
2	Corn 2-3 C. S. Meal 1-3	—.51	.31	1.13	1.95	2.78	3.60
3	Corn 9-10 Tankage 1-10	—.16	.57	1.32	2.05	2.79	3.53
4	Corn 1-2 Cowpeas 1-2	—.65	.02	.69	1.33	2.04	2.72
*5	Corn Peanut pasture	.96	1.58	2.21	2.83	3.45	4.07
*6	Corn 2-3 C. S. Meal 1-3 Peanut pasture	1.50	2.04	2.58	3.12	3.66	4.20
7	Corn Grazed sorghum	.06	.48	.92	1.35	1.78	2.21
8	Corn 2-3 C. S. Meal 1-3 Grazed sorghum	.04	.54	1.04	1.58	2.12	2.62
9	Corn Chufa pasture	.44	1.10	1.76	2.42	3.08	3.76
10	Corn Soy bean pasture	1.09	1.65	2.21	2.77	3.33	3.89
11	Corn 2-3 C. S. Meal 1-3 Soiled sorghum	.85	1.45	2.05	2.65	3.30	3.95

†Cost of putting in crop not taken into account.
*Lots 5 and 6 are not comparable.

TABLE 20. *Prices realized upon each bushel of corn when hogs were sold at various prices.*

No. Lot	Ration	Price Actually Realized for Corn per Bushel when the Hogs were bought at 5 cts. and sold at					
		5 cts.	5½ cts.	6 cts.	6½ cts.	7 cts.	7½ cts.
1	Corn alone	$ .48	$ .60	$ .72	$ .84	$ .96	1.08
2	Corn 2-3 .... C. S. Meal 1-3........	.59	.77	.95	1.13	1.38	1.49
3	Corn 9-10 .... Tankage 1-10	.66	.77	.88	.99	1.10	1.21
4	Corn 1-2 .... Cowpeas 1-2	.47	.71	.95	1.19	1.43	1.67
*5	Corn .... Peanut pasture	1.53	2.03	2.53	3.03	3.53	4.03
*6	Corn 2-3 .... C. S. Meal 1-3........ Peanut pasture	2.33	2.92	3.51	4.10	4.65	5.28
7	Corn 2-3 .... Sorghum pasture	.64	1.06	1.48	1.90	2.32	2.74
8	Corn 2-3 .... C. S. Meal 1-3 ...... Sorghum pasture	.72	1.28	1.48	2.40	2.96	3.52
9	Corn .... Chufa pasture	1.10	1.71	2.32	2.93	3.54	4.15
10	Corn .... Soy bean pasture	1.80	2.36	2.93	3.48	4.04	4.60
11	Corn 2-3 .... C. S. Meal 1-3........ Soiled sorghum	1.58	2.20	2.82	3.44	4.06	4.68

*Lots 5 and 6 are not comparable.
†Cost green crop not considered.

If the hogs could have been sold at 6 cents a pound instead of at 5 cents a pound, every lot, even the corn lot would have been fed at a profit. Even when sold at 5 1-2 cents a pound all lots except the corn lot were profitably fed.

In these tests when the hogs were bought at five cents per pound and fattened and sold at five cents per pound, but 48 cents was realized per bushel for corn when corn was fed alone. This is about 22 cents a bushel less than could be secured for the corn if it had been sold directly upon the market. But when pigs were bought at five cents a pound and sold at seven cents a pound 96 cents was realized upon each bushel of corn even when nothing but corn alone was used.

But in every case where corn was fed in combination with some other feed a better price was secured for the corn, when neither the manurial value nor the cost of putting in the crop were considered; that is, corn was made more efficient by the addition of the various supplements. For instance in lot 5, where peanut pasturage was the supplement, $1.53 was realized upon each bushel of corn (not counting cost of pasture crops) when hogs were bought at five cents and sold at the same price, and $3.53 was realized upon each bushel of corn when they were bought at five cents and sold at seven cents per pound live weight.

This table brings out the point distinctly that when hogs sell as they have been selling in the South for the last few years that the farmer cannot afford to sell his corn upon the market at 70 cents per bushel, or even at $1.00 per bushel. The best and most profitable way to sell corn is to combine it with some other feed and sell it through hogs or some other live stock.

Slaughter Data.

In many parts of the State the local butchers quote the dressed weights of the hogs two cents higher than the live weight. For instance upon the Auburn market for the last three years the farmers have been given the choice of selling their hogs either at 5 cents a pound live weight or 7 cents a pound dressed weight. These quotations have stood inflexible, no reference at all being made to either the degree of fatness or to the conformation or type of the animals offered.

TABLE 21. *Should the farmer sell his hogs at five cents live weight or seven cents dressed weight?*

Ration	No. Pigs	Average Live Weight at Killing Time	Average Dressed Weight	Per Cent. Dressed Weight to Live Weight	Value each Pig at 5 cts. Live Weight	Value each Pig at 7 cts Dressed Weight
Corn only	12	131	96	73.28	$6.50	$6.72
Corn 2-3 C. S. Meal 1-3	9	181	130	71.82	9.05	9.10
Corn 9-10 Tankage 1-10	5	158	116	73.42	7.90	8.12
Corn Peanut pasture	5	131	100	76.33	6.55	6.00

While the above table does not include all the data that has been collected from the slaughtered animals, sufficient facts are presented to bring out the point that when hogs are fat enough to kill out about 72 per cent dressed weight that it makes pratically no difference whether they are sold at 5 cents a pound live weight or 7 cents a pound dressed weight. This table does not take into consideration the expense of killing the hog, which must be charged against the hog when he is delivered dressed, neither does it take into account the value of the internal fat and the other organs which go to the farmer when the contract calls for dressed animals. In most instances the value of the internal organs will just about pay for the expense of killing.

The point is brought out that when a hog is excessively fat, which means that he will dress about 80 per cent, it is more profitable to the farmer to sell him at 7 cents dressed weight than to sell him at 5 cents live weight. It would, of course, be more profitable from the butcher's stand-point to buy him on the basis of live weight. That is, the fatter the hog the greater should be the difference between the live weight and the dressed weight quotations, so that all parties concerned may be treated with fairness.

Then, on the other hand, the type of hog, which is represented by the razor back, the small hammed, narrow backed, long legged kind, will lose the owner more money when they are sold at 7 cents dressed weight than when they are sold at 5 cents a pound live weight, because this type dresses out a small proportion of saleable parts. That is, the nearer the hog comes to representing the razor back type the smaller should the net quotations be over the live weight quotations.

The butcher who does not take these things into consideration is not treating his customers fairly. The man who raises hogs of correct type and takes pride in finishing them to prime condition is being discriminated against when the butcher has an arbitrary price like the above. Before a just value can be placed upon a bunch of hogs they must be seen, so that both type and the degree of fatness can be taken into consideration.

Some General Considerations in Swine Production.

It is sometimes claimed that pork production cannot be made a profitable business in the South since corn has advanced in prices. It is often said that the farmer can buy his pork cheaper than he can make it. But is must be remembered that pork has advanced in price as well as corn, that the cheapest side meat now costs from 10 to 12.5 cents a pound, and that hams and shoulders cost from 15 to 20 cents a pound. Corn has advanced in price more rapidly than has pork, but the South is in a position to change her feeding methods when corn, as a sole feed, gets out of reach. The Southern hog prices are higher than at either the St. Louis or Chicago markets. At the present writing, prices all over the South are substantially higher than they are in Chicago. All conditions here are encouraging for hog production; we can grow the corn, we have the best markets, as far as prices are concerned, in America; and we can grow many kinds of pasture crops, the crops which cheapen pork production more than any other feed.

It is generally considered that there is no other feed equal to corn for pork production,—this is true, provided the corn is used judiciously. If it be fed alone for any length of time there are few feeds which are poorer than corn, as the preceding experiments strikingly demonstrate, but if it be fed in combination with other feeds its use is to be highly commended, and it can be used to great economical advantage, too, even though it sells upon the market for 70 cents a bushel.

The hog is not adapted to living on corn alone, and when we require it of him we are forcing him to do a thing which is not consistent with his nature. Man likes a mixture of feeds or a change in diet; so do the lower animals. The hog in its wild state is not compelled to live upon one feed alone. When wild and free to make its own choice he is omniverous, feeding upon roots, nuts, fish, grass, fruit, snakes, and in fact, but few feeds can be mentioned that he will not eat if he be given the opportunity. Our domesticated hogs have inherited the tendency to select their foods from a variety of substances, and when we enclose them in a pen and feed but one feed we can feel assured that we are not allowing them to reach their highest possibilities.

Probably those who claim that pork cannot be produced in the South at a profit mean that it cannot be produced on corn alone at a profit; if so, that is entirely correct. Experimental data show that pork cannot be profitably raised and finished upon corn alone when corn sells for 70 cents a bushel. The following table, made up from data collected from all parts of the United States, clearly demonstrates the fact that the man who tries to finish hogs on corn alone is following a losing business;

Table 22. Corn alone for fattening hogs.

Station	No. Pigs	Length Exp.	Average Daily Gains	Lbs. Feed to make 100 lbs. Gain	Cost 100 lbs. gain when Corn is:— 40 cts.	50 cts.	60 cts.	70 cts.
		Days	*Lbs.*					
Texas	10	83	.46	762	$ 5.44	$ 6.80	$ 8.15	$ 9.52
Texas	10	83	.43	868	6.20	7.75	9.30	10.85
Tennessee	3	60	1.00	460	3.88	4.10	4.93	5.75
Tennessee ...	3	60	1.00	416	2.97	3.72	4.46	5.20
Tennessee	7	......	.50	410	2.93	3.6[illegible]	4.39	5.12
Alabama	3	60	......	806	5.76	7.20	8.63	10.07
Alabama	3	35	......	670	4.79	5.98	7.18	8.37
Alabama	3	56	.40	621	4.43	5.54	6.65	7.76
Alabama	15	96	.69	611	4.36	5.45	6.55	7.64
Indiana	3	70	1.56	432	3.09	3.86	4.63	5.40
Indiana	4	127	.67	520	3.72	4.65	5.57	6.50
Oklahoma	4	126	.62	470	3.36	4.19	5.03	5.87
Iowa	6	49	2.08	461	3.29	4.12	4.95	5.74
Wis. (4 trials)..	35	......	1.69	459	3.28	4.09	4.87	5.74
Wis. (4 trials)..	35	......	1.41	499	3.57	4.45	5.35	6.24
Average			......	564	4.01	5.4	6.04	7.02

The average farmer under ordinary conditions will not miss the average far. And the average of the preceeding table points out the fact that when corn is worth 70 cents a bushel that the cost of each pound of gain will be just about 7 cents, when corn is selling at 60 cents a bushel each pound of gain put on will cost 6 cents, when corn is worth 50 cents a bushel each pound of gain will cost 5 cents, and when corn is worth only 40 cents a bushel pork can be made for only 4 cents a pound. The table shows that when 70–cent corn is fed to 5–cent hogs that the feeder is losing 20 cents per bushel on his corn. To come out even in Alabama 70–cent corn must go along with 7–cent pork if the owner is to strike even on feeding corn alone. As a general thing the farmers do not get 7 cents for their hogs. If corn were worth but $.40 per bushel, as it is in some of the Western States, it would be a very profitable thing to raise corn and feed it to 5 and 6–cent hogs; good money could be made out of it, as the farmer would then be selling his $.40 corn by means of hogs at from $.50 to $.60 per bushel. But even in the corn belt States it is more profitable to supplement the corn with other concentrates or green crops,—a practice followed by the best Northern farmers.

The data recorded in this bulletin point the way to cheaper pork production in Alabama. If we are to make the most that there is to be made from pork, and at the same time build up and maintain our soils, we must make a liberal use of green crops. Alabama can grow green crops almost the year round as indicated by the following table:

Table 23. Succession of green crops suitable for hog grazing:

Crop	Time to Plant	Amount Seed Per Acre	No. days from planting time until grazing time
For fall planting.			
Alfafa	Sep't. 1 to Oct. 15	15 to 25 lbs.	90 to 120
Burr clover	Sep't. 1 to Oct. 1	15 to 20 lbs. cleaned seed 36 lbs. in burr	90 to 120
Oats	Sep't. 1 to Nov. 1	1½ to 3 bu.	90 to 120
Rape	Sep't. 20 to Oct. 15	4to 6 lbs. drilled 5 to 10 lbs. broadcast	60 to 75
Rye	Sep't. 1 to Nov. 1	1½ to 2 bus.	90 to 120
Vetch	Sep't. 1 to Oct. 15	1 bu.	90 to 120
For spring and summer planting.			
Alfafa	Feb. 25 to April 1	15 to 25 lbs.	75 to 90
Chufas	Mar. 15 to June 1	3 to 4 pks.	120 to 150
Cowpeas	May 1 to July 10	½ bu. drilled 1½ bu. broadcast	75 to 90
Japan clover	Mar. 1 to Mar. 15	24 lbs.	60 to 75
Oats	Feb. 1 to Mar. 20	1½ to 3 bus.	75 to 90
Peanuts	May 1 to June 30	1 to 2 bu. unhulled	90 to 120
Rape	Mar. 1 to Mar. 31	4 to 6 lbs. drilled 9 to 10 lbs. broadcast	60 to 75
Sorgum	April 1 to June 30	1½ to 2 bus.	60 to 90
Soy beans	April 1 to June 30	½ bu, drilled 1½ bu. broadcast	90 to 120

Through the use of these crops the expense of carrying the brood sows and boars through the year can also be greatly reduced. Many of these crops would keep the sows in a fat condition without the use of any grain at all,—and it is the grain that costs the money in Alabama.

Another point is too often overlooked, but is of great moment to Southern soil maintenance, and should be considered in all cases where live stock is handled—the relation of live stock to soil fertility. The farmer who keeps live stock has a fertilizer factory upon his own farm. Stock will improve the soil to such an extent that poor soils can within a few years be made to produce a bale of cotton to the acre.

Producing hogs is an excellent method by which soils can be maintained and built up. In 1898 the Arkansas Station grazed hogs upon areas of peanuts, chufas, and soy beans. The two years following 1898 the land was planted in cotton and data was collected to determine what effect this grazing might have upon cotton yields. The results per acre were as follows:

Table 24. Fertilizing effect of crops grazed by hogs:

	Seed Cotton 1899	Seed Cotton 1900	Average yield seed cotton 1889-1900	Average per cent. increase in seed cotton due to grazing and growing the crop	Value of increase per acre each year (lint 11c. seed 60c)
Cotton following peanuts grazed by hogs.........	1771	1134	1452.5	61.1	$22.81
Cotton following soy beans grazed by hogs.......	1588	1020	1304.0	44.6	16.35
Cotton following chufas grazed by hogs	1200	981	1090.	20.9	7.68
Cotton following corn not grazed	1005	798	901.5	....	......

The effect upon the soil of growing a legume and then grazing it off with hogs is remarkable; for instance in the case of soy beans and peanuts the increased yield of cotton was 44.6 per cent and 61.1 per cent respectively. The effects of growing these crops and grazing them off does not stop with the cotton crop grown the first year following the grazing; the data show that the increase over the corn lot was still considerable in the second year.

Of course, in the case where peanuts and soy beans were used the increased cotton yields were not due entirely to the grazing; part of the benefits were due to the fact that the crops were legumes, thus placing nitrogen in the soil for the use of subsequent crops. But with chufa pasture we have a case in hand where the increased cotton yields could have been due to nothing except the grazing and the supplementary grain fed, as the chufa plant is not a legume. In this case the increased cotton yields for the average of the two years following the chufas, which had been grazed off, was 20.9 per cent over the cotton crops which had followed a corn crop without being grazed off by the hogs. That is, a farmer can expect to get more cotton when it is planted on an area where hogs have grazed or where peanuts, soy beans, or other legumes have been grown than he can secure from an area where hogs have not been grazed.

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OF THE

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AUBURN.

THE SAN JOSE SCALE AND LIME-SULFUR WASH

BY

W. E. HINDS,

Entomologist

Opelika, Ala.:
The Post Publishing Company,
1909

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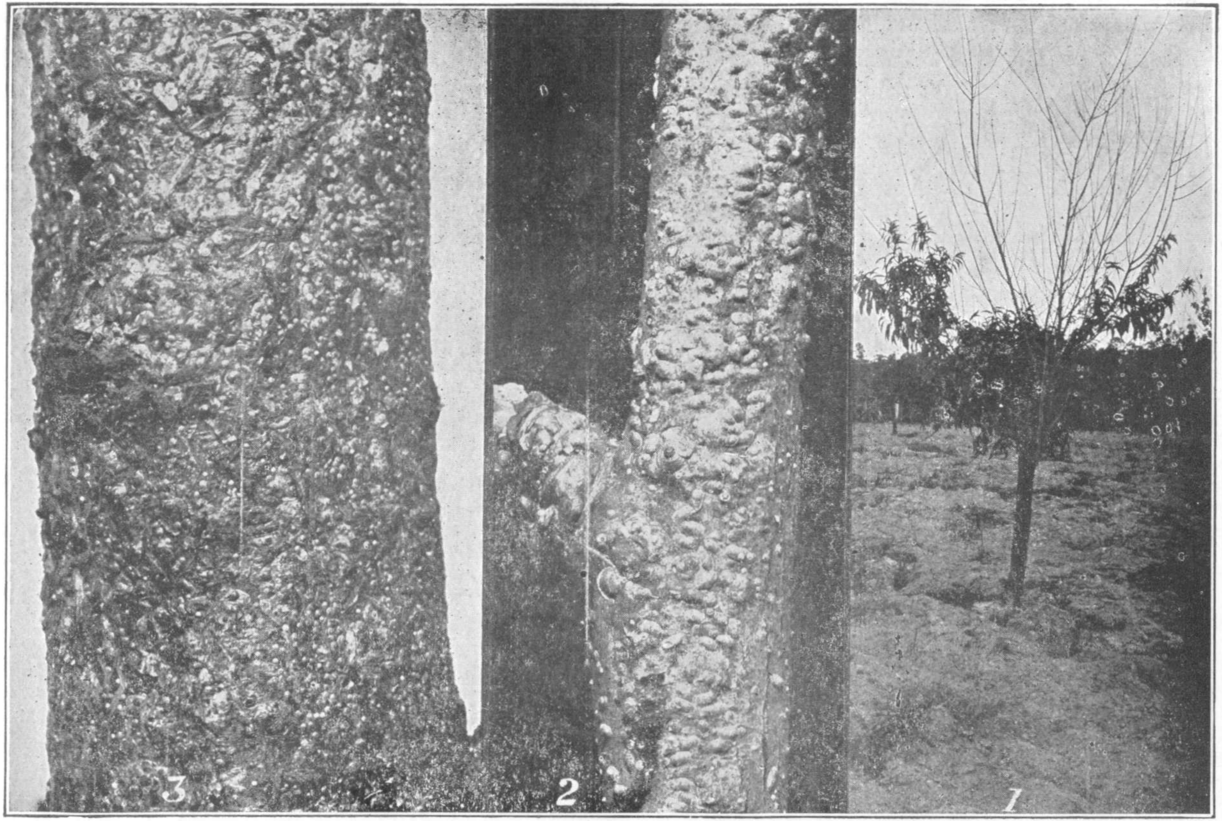

THE SAN JOSE SCALE AND ITS WORK.

[Fig. 1.—Peach tree with top killed by the scale. Fig. 2.—Peach twig, moderately infested, showing male and female scale. Fig. 3.—Peach limb badly infested with scale. Fig. 2, enlarged 4 times; fig. 3, enlarged twice.] (After Quaintance, U. S. D. A. Year Book, 1905.)

THE SAN JOSE SCALE AND LIME-SULFUR WASH

BY

W. E. HINDS, PH. D.

Entomologist to Alabama Experiment Station.

ORCHARD INTERESTS OF ALABAMA.—The culture of orchard fruits, particularly peach, plum, pear and apple, is already a very important factor in the agricultural prosperity of Alabama. As nearly as we are able to estimate from the data available there are about 8,000,000 trees of these four kinds now growing in this State. Soil climate and market conditions are exceedingly favorable to a large increase in the growth of these fruits. The extension of the present important movement for the production of a greater diversity of crops, the substitution of other, and more profitable, crops for cotton and the adoption of improved methods for the culture of all crops grown will undoubtedly result in a great increase in fruit growing within the next few years. The growth of these fruits for wholesale commercial shipments and for the supply of the home markets as well, should increase largely as a profitable business proposition.

DANGER FROM SAN JOSE SCALE.—The principal difficulty to be met in maintaining present and in increasing future fruit culture is the necessity for controlling the insect enemies which, if left uncontrolled, may partially, or entirely, destroy the crops of fruit or even the life of the trees themselves. The most important insect affecting the four species of trees mentioned is the San Jose scale (pronounced "San Hosay") known scientifically as *Aspidiotus perniciosus* Comst. This is the most deadly enemy of fruit-growing known. The name itself means "most injurious scale" and it was well chosen.

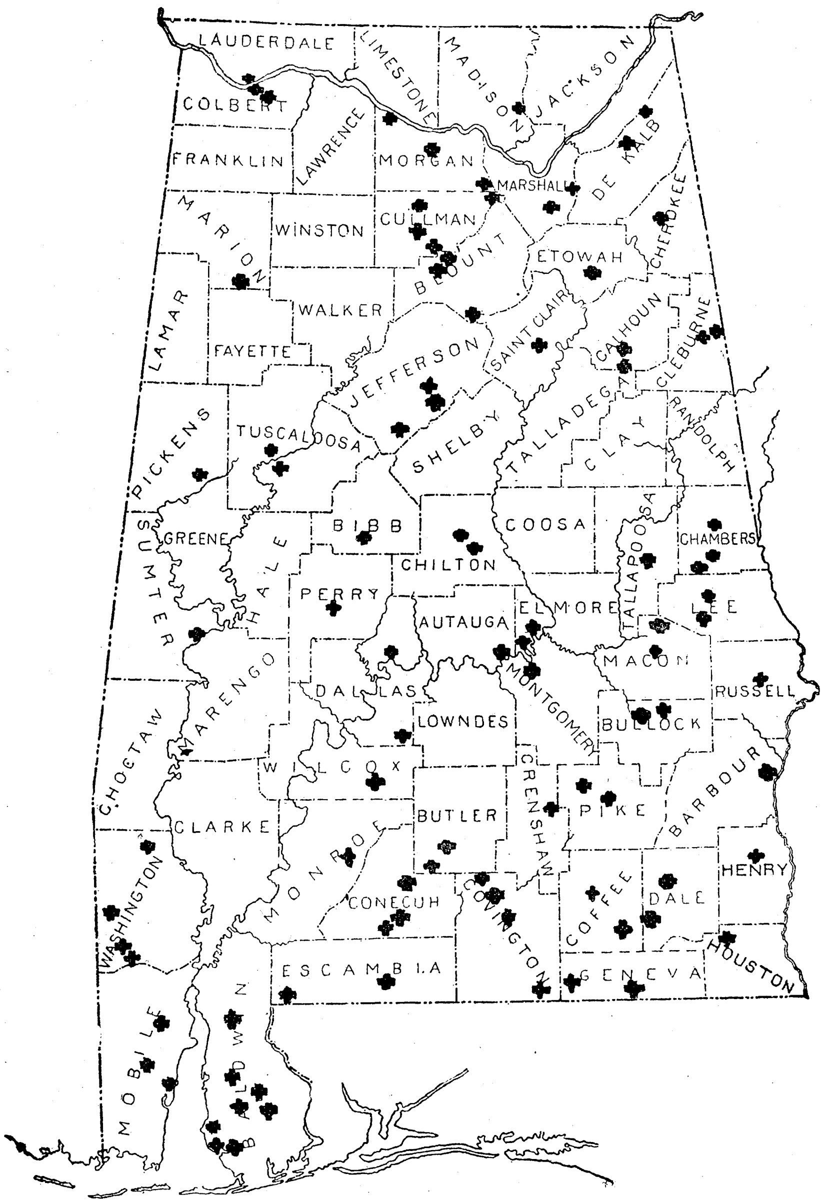

FIG. I. *Present known distribution of San Jose Scale in Alabama.*

Introduction and Spread of the Pest.—This insect is not a native of the United States but appears to have been brought here from China where it occurs commonly upon native food plants. It was introduced into the San Jose Valley, California, about 1870 and the name of that locality where it was first found has been adopted as the common name of the scale. From California the species was brought on nursery stock into the eastern states shortly before 1893. It has since been spread by nursery stock shipments until it now occurs in nearly every State in the Union. During recent years, however, most of the States have passed strict laws requiring the inspection of nurseries for the occurrence of the scale and the fumigation of stock so as to kill any scales which might possibly exist there before the stock can be legally sold and distributed. The nurserymen have co-operated heartily in this effort to prevent the further spread of the pest so that now the buyer of fruit trees is very effectually protected against the planting of already infested trees. Orchards may be started today much more safely than they could ten years ago.

Occurrence of the Scale in Alabama.—The known extent of its occurrence in this State is indicated upon the accompanying map (Fig. 1.). Without doubt it exists in many other places from which it has not yet been reported. Very frequently its presence in an orchard is not detected until some of the trees begin to die whereupon the cause of their death is sought for. A characteristic type of peach tree dying from this scale is shown in Plate I, fig. 1. The dying of the trees does not usually begin until some two or three years after the actual introduction of the scale and it has thus an opportunity to spread unchecked through the orchard.

What is the Scale.—The San Jose scale is a minute, inconspicuous insect which does not, to the untrained observer, appear to be a living creature. The body of the living insect is concealed beneath the circular, waxen scale which it forms for its protection. The largest scales are smaller than an ordinary pin-head in diameter and are quite flat (See Pl. I, figs. 2 and 3). The scales are hardly more than 1-25 inch across and many of them are smaller still. Beneath the scale the body of the insect may be found as a small, immovable, yellow body (if still alive) which if crushed seems to be filled with a rather thin, yellow, oily liquid. The young of this species are born alive and their powers of reproduction are so remarkable that a tree bearing but few live scales in the Spring may become quite heavily infested by Fall and will then be liable to severe injury during the following season unless some method of destroying the scales is used during the winter.

Close observation with the naked eye shows that the scales are marked with rings of light and dark gray around a nearly black center. When very abundant they give a general ashy-gray appearance to the entire bark which is noticeable at some distance from the tree.

NATURE OF THE INJURY.—On living infested branches, especially on growth two or more years old, the surface becomes irregularly pitted or has depressions in spots where the scales are most abundant. The injury is of two kinds. Much sap is abstracted by the myriads of sucking insects, but more important than this is the effect which these scales have of causing a thickening of the cell walls which are penetrated by their slender mouth parts. This thickening checks the flow of sap in the branches, and this means the ultimate starvation of the parts of the branch beyond. The San Jose produces a distinctive red stain around the point of attack, either upon infested fruit or just under the scale in the bark. This appears upon lightly scraping off the outer bark.

NECESSITY FOR TREATMENT.—So serious is the injury of which this scale is capable that untreated, infested trees are certain to be killed within a very few years. The LIFE OF THE ORCHARD IS AT STAKE and the plain conclusion is evident that it is far more expensive to allow the trees to be destroyed than it would be to control the scale which can positively be done so as to continue the life of the orchard and the production of profitable crops. The average annual cost per tree for treatment depends mainly upon its size and ranges, for peach trees, from one-half cent to three cents, averaging between one and two cents. The man who will allow his total investment in trees, land and labor through three or four years to be absolutely destroyed for lack of an additional expense of a cent or two per tree each year, cannot be considered as conducting his work upon anything like business principles.

BEST METHOD OF TREATMENT.—The fight against the San Jose scale has developed several methods of treatment which are of positive value. Three points require consideration in determining which of these methods is best and should therefore be used. 1. Safety. 2. Efficiency. 3. Economy. The method which has been shown to best fulfill these conditions is "A WINTER SPRAYING WITH LIME-SULFUR WASH." In spite of numerous efforts to replace this Lime-Sulfur with some other material more easily prepared or less objectionable to handle in application, the fact remains that this is conceded by the great majority of orchardists, as well as by entomologists, to be the best treatment yet found.

It may be applied with safety at any time while the trees are in a dormant condition. A single thorough spraying with a properly prepared wash insures the control, if not the extermination, of the scale and is safer and more reliable than is any other treatment. The cost of treatment, varying in localities and with number of trees to be treated, need not exceed from one to thirt cents per tree according to their kind and size

SEASON FOR MAKING THE APPLICATION.—The safest and most effective time for treating trees for scale is during the dormant period, that is, between the time the leaves drop in the fall and the time the buds start in the spring. Experimental work has shown that a single treatment with Lime-Sulfur made in November or December is less effective than is a single treatment made in February or March, and that two treatments, one in the Fall and another just before the buds start, are but slightly more effective than is the later treatment alone. The exact time for spraying after January 1st may be decided by convenience as related to other work and by the continuance of the dormant condition of the buds.

A solution strong enough to kill the scale may be applied to the bark without injury at any time during the summer. It may be applied by painting or swabbing it onto the trunks and largest branches to check the summer development of the scale, but such a solution will destroy all foliage touched by it, and cannot therefore be sprayed on as in winter.

At about one-fifth of the strength recommended, however, it is thought by some that Lime-Sulfur can be sprayed upon even peach foliage which is fairly matured as at fruiting time, and that at that strength it will be a very effective agent in the prevention and control of the brown rot of peaches which is now one of the most serious problems in peach production in Alabama.

PREPARATION ON THE ORCHARD FOR TREATMENT.—This is a matter of considerable importance and the exact measures to be applied to each tree depend largely upon the degree of its infestation.

Slightly infested trees should be pruned before being treated as is best for their fruiting regardless of the presence of the scale. With heavily infested and badly injured trees, the pruning should be much more thorough. Trees which are nearly dead should be cut out and, in a young orchard, replaced if desired by new ones. All dead branches should be removed. Branches still alive but which have made very little growth during the preceding season should be strongly cut back, in some cases leaving them as mere "stubs" a foot or two long from the main trunk. If the cuts are more than three-fourths of an inch in diameter their surfaces should be painted over with White Lead. If there is still life enough in the tree a new top may be formed out of several of the best and most vigorous shoots thrown out from these "stubs." In many cases it may be possible to control the scale and to thus renew the top of badly injured trees, so as to have them again of good size and bearing more fruit in two or three years than would young trees if put in their places. This is entirely a question of orchard management for the quickest and best production of fruit. It is certain that the scale may be controlled so the age and condition of the tree, etc., must decide the question whether it should be pruned and kept or cut out. It is advisable to burn removed trees and branches to get them out of the way and to prevent further spread of insect pests from them to living trees. The scale is not liable to spread if the trees and prunings are not burned but other injurious insects which may breed in the dead wood may spread from them, particularly to scale injured trees and thus cause the death of trees which might otherwise be saved from the scale.

Adjacent thickets or trees of wild plums or cherry, etc., should be cut and burned. Beside the trees mentioned many others are liable to attack by this scale. The following are some of those occurring commonly: Crab apple, apricot, persimmon, several kinds of walnut and of poplar, osage orange, chestnut, sumac, catalpa, cedar, several of the willows, ash, elm, pecan, orange, lemon, strawberry, gooseberry, currant, etc.

THE LIME-SULFUR TREATMENT.—This wash has been very extensively used in California during the past twenty years. In the eastern United States since about 1900 it has been recognized as the best agent for destroying San Jose scale. Its effectiveness depends upon a chemical combination of the lime and sulfur which is brought about practically only under high temperatures. In a general way, if the chemicals are pure, we may reckon upon using practically equal portions of lime and of sulfur. In practice, however, it has been found better to use a somewhat larger quantity of lime, since commercial rock lime varies somewhat in purity and is cheap. The excess of lime simply forms a whitewash which shows plainly the trees that have been treated. An excess of sulfur would remain undissolved in the solution. While this would do no harm, its presence would do no good and it might be considered as a needless item of waste. Both lime and sulfur are effective for some insects and fungi when used separately, but when combined they act far more efficiently. The principal object in making the wash is to produce economically a safe and thoroughly effective spraying solution.

In planning for making and using this wash a number of practical points require consideration for best results.

ESTIMATION OF QUANTITIES OF CHEMICALS NEEDED.—Naturally this is a difficult matter for the man who has never used anything of the kind. The first consideration is the number and the average size of the trees to be treated. If the scale is known to occur anywhere in an orchard, the only safe thing to do is to spray all trees in it, and the treatment should include at least all of our fruit trees which shed their leaves in the Fall. The amount of spray required will obviously depend directly upon the size of the tree. We may take average three to four–year–old peach trees as our standard and estimate that such trees will require about one–half gallon of spray each for thorough work, and no other kind of work is worth while. Each gallon of spray solution will therefore treat two medium–sized trees, while large trees may require two gallons each. In this way an approximate estimate may be made of the number of gallons of spraying solution to be prepared.

The question of formula must be next considered. As a result of a vast amount of experimental and practical work, it appears that the following formula is safe, efficient and economical:

Rock lime	20 lbs.
Flowers of Sulfur or Sulfur Flour	15 lbs.
Water to make	50 gallons

In ordering our chemicals therefore we reckon upon 20 lbs. of lime and 15 lbs. of sulfur for every 50 gallons of spraying solution which we have estimated to be needed. Emphasis should be laid upon the ultimate economy of using only the best and purest chemicals obtainable, regardless of their slightly greater initial cost.

LIME.—This means always freshly burned rock lime or quick lime. The test of quality is the slaking. Good limes should not contain more than ten per cent of impurities. Poor limes may contain 25 per cent of impurities. It is partly on account of these varying percentages of impurities that more lime than sulfur is used in the formula given. A good lime will slake readily and form an even creamy solution with little sediment or coarse matter which is waste.

Much first-class lime is produced in Alabama, particularly that made in the vicinity of Calera. The addresses of several manufacturers may be found in the Appendix on page 20.

The best grade of lime is shipped and handled in barrels. This is the best form in which to buy it, and the cost should not exceed about $1.00 per barrel or 1c per pound for our spray formula. In nearly every town may be found someone who handles a good grade of lime.

SULFUR.—The sulfur used must be very finely powdered to combine readily and completely with the lime in the making of the wash. Two forms of sulfur to be found on the market are perfectly pure and answer this need equally well. The "Flowers of Sulfur" is the finest form and is largely used, but may cost slightly more than does "Sulfur Flour" or "Flour Sulfur" as it is called. The choice between these two depends upon availability and price. Either should be obtainable at about five cents per pound in lots of fifteen pounds or more. If not obtainable at a satisfactory price through local druggists, sulfur may be secured through the wholesale drug firms listed in the Appendix page 20, and from other firms probably as well. Crystalline Sulfur should not be used under any circumstances, since it is so coarse that it will not combine completely with the lime even with prolonged boiling. The result is a direct waste of sulfur and a wash solution that is liable to contain too little sulfur to be efficient, thus wasting all the chemicals, the labor of application and possibly, too, the life of the trees through ineffective treatment.

PREPARATION OF THE WASH.—For this work some facility for boiling the solution is essential. Where it is to be made on a small scale, and even in the treatment of several thousand trees where only one barrel pump is to be supplied, the cooking may be done quite conveniently in two large cast iron kettles, one of which may hold about 20 to 25 gallons, while the other should hold 40 gallons. The smaller kettle can be used in heating water while the lime and sulfur are being boiled in the larger one. For treatment of from 5,000 to 10,000 trees it is better to have larger kettles holding 75 to 80 gallons and mounted in a brick frame work or furnace. The cooking should be done when possible near a convenient water supply, but it is better to haul the water than the wash. For more than 10,000 trees it will be far better to cook the wash by steam supplied directly from a portable boiler or some such source. the cooking may then be done in barrels placed side by side and preferably upon an elevated platform. The essential point is that the boiler supply about one horse power for each barrel to be boiled with about 30% surplus power for the pumping and heating of water, etc. Wherever possible the water supply and the cooking barrels should be elevated sufficiently to utilize gravity in the flow of the liquids into the cooking barrels and from them into the spray tanks.

The kettle method of preparation will be described particularly as it may be more commonly employed in this State. Much latitude is permissible in the details of the preparation for the cooking. The essential points are to secure the complete and rapid slaking of the lime and the mixture of the sulfur with the lime solution without the lumping of the sulfur. To avoid this the sulfur should always be mixed to a thin paste with hot water before being poured into the large boiling kettle. If this be done it makes little difference in the final result whether it be added before, after or during the slaking of the lime. The following method is as good as any and easy to follow:

For each 50-gallon lot of spray solution to be prepared mix 15 lbs. of fine sulfur to a thin paste in hot water in some convenient receptacle. Heat about 12 to 15 gallons of water in the 40-gallon kettle and while it is heating add the sulfur paste taking care to break up any lumps that may exist. Then add, lump by lump, the 20 lbs. of best rock lime. By the time the lime is all slaked the solution should be boiling hot. Add about 10 gallons more of hot water and continue the boiling steadily for about one hour. During this time the mixture must be stirred almost constantly to keep it from burning and to insure the complete solution of the sulfur. When properly prepared there should be no residue of sulfur after this cooking. The wash will appear as a rather thick, reddish brown, or dark orange-colored liquid. It gives off a strong odor of sulfur and is caustic in its action. Impurities in the lime may vary the color of the liquid, as does also the excess amount of lime but a variation in color need not affect its efficiency if the wash has been properly stirred and boiled.

From the boiling kettle the wash goes to the spraying barrel into which it should be strained through a brass strainer having about 20 meshes per inch. See fig. 2. This may be purchased or made at home. The strainer should remove all impurities which might clog the nozzles and delay the work in spraying. Never strain the wash through burlap bagging as the lint from the bagging will soon clog the pump. In the barrel the wash may be finally diluted with cold, but preferably with hot, water to make the required 50 gallons of spraying solution. The amounts of lime and sulfur may be varied, still keeping the proportion between them, in preparing larger or smaller quantities of the wash as may be needed. In general it is better to spray the wash while it is still

Fig. 2.

warm or quite hot. It works easier in the pump and by the time the spray reaches the tree it is cooled so that there is no danger of its doing injury. It is generally considered as desirable to use the wash upon the day it is prepared but this does not seem to be absolutely necessary. Undiluted wash standing till cold will crystalize but the crystals may be again dissolved by reheating thoroughly and the wash is then probably just as good for use as ever.

SPRAYING OUTFIT.—While it is possible to apply the wash by painting or swabbing it onto the trunks and larger branches. the smaller branches and twigs cannot be thoroughly treated in this way and this method of application is so wasteful of time and materials that it will be found more economical as well as efficient to do the work with a "bucket pump" such as may be bought for about $6.00. This may serve fairly for the treatment of from 25 to 50 trees if they are small but for large trees, or more of them, every orchardist should have a "barrel pump." These may be had in different sizes and full de-

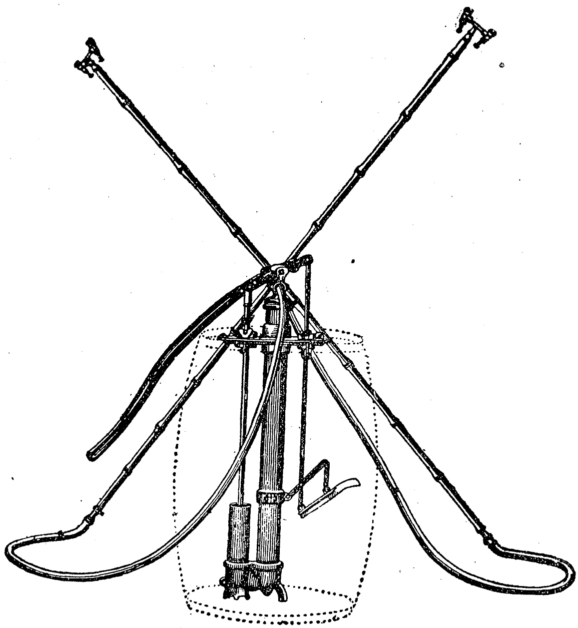

Fig. 3.

scriptions may be found in the catalogs of the various dealers whose addresses are given in the Appendix on page 20–21.

In selecting an outfit for Lime-Sulfur work it is essential that all of the working parts of the pump be of brass and that there be no leather packings or valves. The caustic action of the wash soon corrodes copper and destroys leather but affects brass only slowly. The best apparatus is the cheapest in this case. The most economical outfit for the average orchardist is a barrel pump that is powerful enough to carry two lines of hose with strong pressure for four nozzles. (See fig. 3).

The barrel in which the pump is mounted may well be an ordinary 50-gallon oil barrel such as may be obtained in any town and the mounting of the pump is a simple operation. The hose should be one-half inch in diameter, inside measure, and of at least four-ply stock. Such hose may be secured of some of the firms mentioned at from 12 to 15 cents per foot. The best hose is not liable to burst under the pressure from the pump and will last much longer than cheaper grades. The length of hose usually furnished by manufacturers with their pumps is too short for satisfactory use. About 25 feet is a good working length for each line as it allows the sprayers more range and insures more rapid and more thorough work which more than offsets the slight extra cost for the longer hose. Each line should be provided with an extension rod from 6 to 12 feet long according to the size of the trees to be treated. There should be two "cut-offs" for each line of hose: one between the pump and the hose and the other between the hose and the extension rod. These save time and liquid and it is more economical to have them than to work without them.

The kind of nozzle to be used is a very important matter. That throwing the best spray is known as the "double Vermorel." There are several types of this nozzle made by various manufacturers which accomplish very similar results. One of these is shown in fig. 4. The

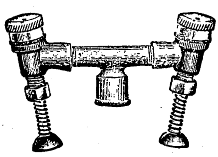

Fig. 4.

nozzle should be provided with plungers to clean them when they become clogged as is liable to happen occasionally even if the wash has been properly strained. The nozzle caps for Lime-Sulfur work should have an opening of 1-16 inch and extra caps should be kept on hand to replace old ones when they become worn so that they throw too coarse a spray. The pressure from the pump should be kept *strong* and especially when four nozzles are being supplied care must be exercised to see that the pumper does not take his work too easily. The barrel outfit may be carried through the orchard in any kind of a one-horse wagon or on a drag. The driver does the pumping while a man is needed on the ground for each line of hose.

A thoroughly good outfit such as has been described will cost about $25.00 and with proper care it should last for a number of years. It will serve equally well in the application of all arsenical poisons for leaf and fruit feeding insects or for those attacking many of the garden or field crops. It may also be used for whitewashing. Altogether such an outfit is one of the most profitable pieces of equipment that any orchardist can own. Its intelligent use will go farther toward the production of *profits* with almost any crop than can any equal expenditure made in other ways without the spraying.

Information regarding "power sprayers" may be had from the catalogs of manufacturers and suggestions regarding them will be gladly given anyone upon application to the Entomologist, Alabama Experiment Station, Auburn, Ala.

SPRAYING SUGGESTIONS.—While much in regard to spraying can be learned only from experience, there are many suggestions that may be of aid to the beginner.

Only the most careful work is worth doing at all. Care should be taken to cover the twigs and small branches as thoroughly as the larger branches and trunks. If the tree is completely dormant, heavy drenching with the wash will not injure it and it is better to use more spray than is really needed than to use too little to do the work thoroughly. Do not undertake to spray when the prospects are for an immediate storm or severe cold spell since if these should occur before the wash has dried thoroughly on the trees the work will have to be repeated to be effective. Good work cannot be done when a strong wind is blowing. Select fair, calm weather for the work whenever possible or else make a second treatment when it is calm or when the wind is blowing from the opposite direction to that during the first spraying. The spray solution must be continually agitated during the spraying and a properly constructed pump will accomplish this.

The disagreeable effects of getting the wash on the skin may be reduced by rubbing the hands and face with vaseline before spraying. Rubber coats and gloves are, of course, the best protection for the sprayers but if not available old clothes should be worn so that they may be discarded after the work is finished. Cheap canvas work gloves are a satisfactory protection for the hands. The mules, or horses, and the harness may well be protected by blankets made of old burlap sacks.

After the days work is over the remaining solution should be drawn or emptied out and clear water run through the pump, hose and nozzles to leave them in clean condition and reduce the corrosive injury to the outfit which would otherwise be as great through a night of standing as through a day of use. This cleaning should be particularly thorough at the end of each seasons work or when the apparatus is to be stored for any length of time. All working parts should be kept thoroughly oiled. These measures of care will reduce the expenses for repairs and improve the ease and quality of the work done.

GENERAL USEFULNESS OF LIME-SULFUR WASH.—Its superior power of controlling the San Jose scale is but one of the many advantages of this wash. It adheres to the trees for a long time and its good effects are continued through several months after the application. It acts both as an insecticide and also as a fungicide.

As an insecticide it is effective for nearly all of the scale insects oscurring upon fruit trees. It destroys the winter eggs of the plant lice which attack the leaves and twigs of apple so abundantly in the Spring. It also controls the "pear-tree Psylla" and the "pear-leaf blister mite" as well as the ,'silvering mite" of the peach and the "peach-twig borer."

At the same time as a fungicide it is exceedingly effective against the "peach-leaf curl" and the "brown rot," also for the "apple scab" and "pear scab" and other fungous diseases of fruits.

These fruit pests cannot all be reached at the same time with any other of the numerous methods of treatment which are sometimes substituted for the Lime-Sulfur for controlling the San Jose scale. No other insectitude now known can equal in range of usefulness and in economy a single thorough application of Lime-Sulfur wash to fruit trees just before the buds start in the Spring.

Manifestly these important considerations in favor of Lime-Sulfur far outweigh all contrary ones based upon the inconvenience in its preparation and the disagreeableness of handling and applying it. To obviate the objections to the preparation of the wash any one who desires may now buy it in a concentrated solution ready to dilute directly with water for spraying. It is sold by several of the manufacturers of insecticides whose addresses are given in the Appendix on page 21–22. This might be particularly desirable for the man who needs but little of the wash. The commercial article has shown up favorably in experimental tests but apparently has no superiority in effect over the home-made article which, of course, costs somewhat less.

DETERMINATION OF SPECIMENS AND SPECIAL ADVICE.—Specimens suspected of being San Jose scale, and any other insects attacking fruits, trees, garden and field crops, etc., may be submitted to the Entomologist, Alabama Experiment Station, Auburn, Ala., for determination. They should be mailed in a tight, strong box bearing plainly on the outside the name and address of the sender and separate from the letter of advice which should describe as fully as possible the nature and extent of the injury which the insect seems to be doing. The Entomologist will gladly and freely give any suggestions possible for combating insect pests thus brought to his attention.

APPENDIX

INSECTICIDE MATERIALS AND SPRAYING APPARATUS: ADDRESSES OF DEALERS AND MANUFACTURERS.

Believing that much of the failure to adopt recommendations for spraying treatment for insect and fungus pests is due to a lack of definite knowledge as to just where reliable materials and equipment may be secured, we give below the addresses of some of the many firms manufacturing or dealing in insecticide materials and apparatus. In doing this we do not mean to imply that other dealers do not make or handle just as reliable and satisfactory goods. Those listed may be depended upon and are as accessible as possible to the people of Alabama.

Lime Works.

Newala Lime Works, Calera, Ala.
Calera Lime Works, Calera, Ala.
Keystone Lime Works, Calera, Ala.
Longview Lime Works, Calera, Ala.

Wholesale Sulfur Dealers.

Durr Drug Co., Montgomery, Ala.
Greil Bros., Montgomery, Ala.
Jacob's Pharmacy, Wholesale Department, Atlanta, Ga.
Mobile Drug Co., Mobile, Ala.

Spraying Machinery.

Morrill and Morley, Benton Harbor, Mich. (Local agency G. W. Barnett Hardware Co., Montgomery, Ala.)

Goulds Mfg. Co., Seneca Falls, N. Y. (Goods handled by Beck & Gregg Hardware Co., Atlanta, Ga.; Alabama Machinery & Supply Co., Montgomery, Ala.)

The Deming Co., Salem, Ohio. (No local agency so far as we know.)

Frost Insecticide Co., Arlington, Mass. (No local agency.)

Dayton Supply Co., Dayton, Ohio. (Agency with Macon Implement Co., Macon, Ga.; Alabama agencies are being established also.)

F. E. Myers & Bro., Ashland, Ohio. (Agencies with Barney-Cavenaugh Hardware Co., Mobile, Ala.; Selma Hardware Co., Selma, Ala.; and Alabama Machinery & Supply Co., Montgomery, Ala.)

INSECTICIDE MANUFACTURERS AND DEALERS.

Graselli Chemical Co., Birmingham, Ala. (Make and sell Lime-Sulfur solution, Arsenate of Lead, Bordeaux mixture, etc.)

Bowker Insecticide Co., 43 Chatham St., Boston, Mass. (Sell a number of kinds of specially prepared insecticides.)

Frost Insecticide Co., Arlington, Mass.

Rex Co., Omaha, Nebraska. (Sell Lime-Sulfur solution and Arsenate of Lead particularly.)

Thomsen Chemical Co., Baltimore, Md. (Sell Lime-Sulfur solution.)

Fred. L. Lavanburg, 100 William St., New York, N. Y. (For Paris Green and Arsenate of Lead particularly.)

Merrimac Chemical Co., 33 Broad St., Boston, Mass. (Makers of Swift's Arsenate of Lead.)

Adler Color & Chemical Co., New York, N. Y. (Make Paris Green, Arsenate of Lead, etc.)

Acme Color Works, 100 William Sreet, New York, N. Y. (Paris Green, etc.)

A. B. Ansbacher & Co., New York, N. Y. (Paris Green, etc.)

F. W. Devoe & Co., New York, N. Y. (Paris Green, etc.)

Leggett & Brother, New York, N. Y. (Various insecticides.)

Sherwin-Williams Co., Newark, N. J. (Paris Green.)

American Horticultural Distributing Co., Martinsburg, W. Va. ("Target Brand" insecticides.)

B. G. Pratt Co., 11 Broadway, New York, N. Y. (Scalecide.)

BULLETIN NO. 145 FEBRUARY, 1909

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN.

Local Fertilizer Experiments With Cotton

~~in 1895, 1896, 1897 and 1898~~

IN 1905, 1906, 1907 AND 1908

BY

J. F. DUGGAR, Director.

Opelika, Ala.:
The Post Publishing Company,
1909

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LOCAL FERTILIZER EXPERIMENTS WITH COTTON IN 1905, 1906, 1907, AND 1908.

BY J. F. DUGGAR.

For a number of years this Station has conducted numerous local fertilizer experiments, furnishing material and instructions to farmers agreeing to make the tests.

The number of local fertilizer experiments with cotton, of which reports were received, was as follows: In 1905, ten; in 1906, thirteen; in 1907, ten; and in 1908, twenty-two. This does not include a number of experiments begun and not successfully completed. In all of these years fertilizer experiments were also made on corn and other crops, the results of which will be published later.

The chief object of these local fertilizer experiments or soil tests has been to ascertain the best fertilizer or combination of fertilizers for cotton, growing on each of the principal soils of Alabama.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiments and blank forms for reporting results, were also furnished.

The following list gives the name and address of each experimenter who has reported the results of fertilizer experiments made under our direction during the past four years, with page of this bulletin where the results may be found.

COUNTY.	POST OFFICE	NAME.	DATE.	PAGE
Autauga	Prattville	J. W. Young	1905-6	49-52
Barbour	Louisville	J. D. Veal	1906	69
Blount	Tidmore	Jno. W. Staab	1905	39-42
Bullock	Union Spr'gs	F. B Haynes	1908	78
Bullock	Three Notch	A. M. Cope	1906	68-69
Bullock	Suspension	O. M. Hill	1906	78
Chambers	Fredonia	E. W. Smartt	1905	78
Chilton	Verbena	G. H. Caffey	1907-8	49-50
Chilton	Verbena	J. H. Willoughby	1905-6-8	47-49
Conecuh	Betts	R. H. Betts	1905-6-7	75-76
Cullman	Cullman	L. A Fealy	1906	39-42
Cullman	Joppa	O. G. Roberts	1906-7-8	39-40
Fayette	Newtonville	J. B. Gibson	1906-7-8	45-47, 78
Franklin	Russellville	T. J. Willis	1905-6	29-30
Geneva	Geneva	M P. Metcalf	1905	69-70
Greene	Eutaw	W. W. Morgan	1908	48
Henry	Headland	W. F. Covington	1907-8	73
Henry	Columbia	T. Z. Atkeson	1908	71-73

County	Post Office	Name	Date	Page
Lauderdale	Florence	W. A. Parish	1905-6	30-31
Lauderdale	Florence	J. W. Haddock	1907-8	30-32
Lawrence	Hillsboro	F. T. Nealy	1905	35
Lee	Auburn	Ala. Expt. Station	1905-6	59
Lee	Auburn	Jno Jackson	1908	57-58
Lee	Bee Hive	T. W. Cox	1905-6	58
Macon	Notasulga	S. C. Jackson	1905	61-64
Macon	Shorter	Y. Swearington	1906	61-65
Macon	Society Hill	Robt. Floyd	1806-7	66
Macon	Hurtsboro	A. R. Floyd	1908	66
Madison	Huntsville	H. D. N. Wales	1905	33-35
Marengo	Faundsdale	W. C. McNight	1905	53-54
Marion	Hamilton	6th Dist. Agr. School	1906	39-42
Morgan	Hartselle	J. O. Burleson	1907-8	35-36
Montgom'ry	Montgomery	J. M. Jones	1906-7	54
Montgom'ry	Montgomery	T. M. Oliver	1907	52-56
Montgom'ry	Naftel	W. C. Naftel	1905	78
Pickens	Gordon	D. W. Davis	1906	78
Tallapoosa	Notasulga	M. E. Parker	1907	59
Tallapoosa	Notasulga	E. B. Jackson	1907	61-63
Tallapoosa	Notasulga	J. W. Parker	1907	61-62
Walker	Cordova	J. L. Alexander	1908	39-44
Winston	Nauvoo	W. M Omary	1908	39-43

The directions stated that land employed for this test should be level and uniform, not manured in recent years, not in cowpeas the preceding year, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity of standard treatment for all plots (except as to kind of fertilizer used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled before planting.

The Rainfall.

The following data are taken from the records of the Alabama section of the Weather Bureau, and show the average rainfall for the state:

	INCHES RAINFALL.				
	1905	1906	1907	1908	
January	5.26	4.66	2.20	4.28	......
February	7.24	2.39	5.04	6.30	......
March	3.70	9.26	2.94	4.77	......
April	3.69	1.03	6.26	5.84	......
May	5.51	4.63	7.94	5.34	.....
June	4.56	3.45	2.85	2.75	.....
July	4.56	8.50	5.00	4.72	.....
August	5.30	3.78	3.50	3.44	.....
September	2.51	8.44	5.50	2.42	.....
October	4.39	3 54	1.44	1.76	.....
November	1.78	2.50	6.15	1.52	...
December	6.46	4.19	6 01	5.02	.....
Average	55 38	56 56	54.66	48.16	....
Average yearly normal	.....	......	....	....	51

THE FERTILIZERS USED.

The following prices are used, as representing approximately the average cash price in local markets during the last few years:

	Per Ton.
Acid phosphate (14 per cent. available)	$14.00
Cotton seed meal	25.00
Kainit	15.00

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the price given above.

In each experiment two plots were left unfertilized, these being plots 3 and 8. When these yields differed widely the experiment was classed as inconclusive. The increase on plots 4 to 7 is calculated on the assumption that the graduation in fertility is uniform from plot 3 to plot 8. The following table shows what kinds and amounts of fertilizers were used on certain plots; the number of pounds of nitrogen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos.

PRICE ASSUMED FOR SEED COTTON.

The price assumed is $14.00 per ton for seed, and 10 cents per pound for lint, a price found by averaging prices of 9, 11, 11, and 9 cents per pound respectively, for the crops of 1904, '5, '6, '7, and '8. This is equal to 3.8 cents per pound of seed cotton turning out 33 1/3 per cent. of lint. Deducting 6/10 cents per pound as the average cost of picking and ginning, and we have left 3.2 cents as the net value per pound of the increase of seed cotton due to fertilizers. This latter is the figure used in all financial calculations.

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

Plot No.	FERTILILERS: Amount per acre.	FERTILILERS: KIND	MIXTURE CONTAINS: Nitrogen	MIXTURE CONTAINS: †Available phosphoric acid	MIXTURE CONTAINS: Potash.	COST OF FERTILIZERS: Per ton	COST OF FERTILIZERS: Per acre
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*		
1	200	Cotton seed meal......	13.58	5.76	3.54	$25.00	$2.50
		*In 100 lbs. c. s. meal.**	**6.79**	**2.88**	**1.77**		
2	240	Acid phosphate........	......	36.12	.....	14.00	1.68
		In 100 lbs. acid phos.	......	**15.05**	.....		
4	200	Kainit...............	......	......	24.60	15.00	1.50
		In 100 lbs. kainit.	......	......	**12.30**		
5	200	Cotton seed meal.....	13.58	41.88	3.54	18.99	4.28
	240	Acid phosphate......					
		In 100 lbs above mixt.	**3.09**	**9.52**	**.80**		
6	200	Cotton seed meal.....	13.58	5.76	28.14	19.50	4.00
	200	Kainit...............					
		In 100 lbs. above mixt.	**3.39**	**1.44**	**7.03**		
7	240	Acid phosphate......	......	......	.....	14.45	3.18
	200	Kainit...............					
		In 100 lbs. above mtxt	......	**8.21**	**5.59**		
9	200	Cotton seed meal....					
	240	Acid phosphate......	13.58	41.88	28.14	17.81	5.68
	200	Kainit..............					
		In 100 lbs above mixt.	**2.12**	**6.54**	**4.39**		
10	200	Cotton seed meal....					
	240	Acid phosphate......	13.58	41.88	15.84	18.24	5.93
	100	Kainit..............					
		In 100 lbs above mixt.	**2.59**	**7.75**	**2.93**		

*Average of many analysis.

†Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by $1\frac{3}{14}$

FRANKLIN COUNTY, 5 MILES NORTH-WEST OF RUSSELLVILLE.
T. J. WILLIS, 1905-6, (See Table, p. 30.)

Dark gray sandy soil, with light colored clay subsoil.

These tests were made on a hilltop which had been in cultivation about 10 years. The forest growth was hardwoods.

It is evident that this soil responded freely to every fertilizer, whether applied singly, by twos, or all three together.

In both years a complete fertilizer (plots 9 or 10) was the most profitable application, closely followed in yield and profit by a mixture of acid phosphate and cotton seed meal. On plot 9 the complete fertilizer increased the yield by 1000 and by 792 pounds of seed cotton. After deducting the cost of the fertilizer (p 29) this left profits of $26.32 and $19.66 per acre. Phosphate was most effective, cotton seed meal next, and kainit least, but still useful.

	1905 Lbs.	1906 Lbs
Average yield of seed cotton, unfertilized	352	376
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	192	24
To acid phosphate plot	172	120
To kainit plot	204	144
To acid phosphate and kainit plot	167	176
Average increase with cotton seed meal	184	116
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	664	456
To cotton seed meal plot	644	552
To kainit plot	739	600
To cotton seed meal and kainit plot	702	632
Average increase with acid phosphate	687	560
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	94	16
To cotton seed meal plot	106	136
To acid phosphate plot	169	160
To cotton seed meal and acid phosphate plot	164	216
Average increase with kainit	133	132

Experiment at Russellville (Franklin Co.) and near Florence (Lauderdale Co.) 1905-6-7-8

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	T. J. WILLIS Russellville 1905: Yield of seed cotton per acre	T. J. WILLIS Russellville 1905: Increase over unfertilized plot	T. J. WILLIS Russellville 1906: Yield of seed cotton per acre	T. J. WILLIS Russellville 1906: Increase over unfertilized plot	J. W. PARISH Florence 1905: Yield seed cotton per acre	J. W. PARISH Florence 1905: Increase over unfertilized plot	W. A. PARISH Florence 1906: Yield of seed cotton per acre	W. A. PARISH Florence 1906: Increase over unfertilized plot	J. W. HADDOCK Florence 1907: Yield of seed cotton per acre	J. W. HADDOCK Florence 1907: Increase over unfertilized plot	J. W. HADDOCK Florence 1908: Yield of seed cotton per acae	J. W. HADDOCK Florence 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal....	520	192	400	24	608	336	408	232	672	72	910	460
2	240	Acid phosphate.....	992	664	832	456	664	392	368	192	1032	432	650	200
3	....	No fertilizer........	327	......	376	......	272	....	176	....	600	....	450	....
4	200	Kainit.............	432	94	392	16	608	308	352	179	1424	848	800	340
5	200 200	Cotton seed meal.. Acid phosphate...	1184	836	952	576	1184	857	608	438	1840	1288	1550	1080
6	200 200	Cotton seed meal.. Kainit...........	656	298	536	160	960	606	320	153	1256	728	1010	530
7	240 200	Acid phosphate... Kainit...........	1200	833	992	616	920	539	456	293	....	....	710	220
8	....	No fertilizer........	376	......	376	......	408	....	160	....	480	....	500	....
9	200 240 200	Cotton seed meal.. Acid phosphate... Kainit...........	1376	1000	1168	792	816	408	544	384	1208	728	1100	600
10	200 240 100	Cotton seed meal.. Acid phosphate... Kainit...........	1408	1032	896	520	824	416	528	368	872	392	980	480

LAUDERDALE COUNTY, 10 MILES WEST OF FLORENCE.

W. A. PARISH, 1905–6. (See Table, p. 30.)

In 1905 *stiff light gray soil with red subsoil; in* 1906 *darker soil, with red clay subsoil.*

Both fields had been cleared for 30 or 40 years. The original forest trees are said to have been post oak, red oak, black oak, and hickory. Every fertilizer considerably increased the yield in both years. In both years the largest increase, 857 pounds and 438 pounds of seed cotton respectively, was afforded by plot 5, fertilized with a mixture of cotton seed meal and phosphate. This represents a net profit of $23.14 and $9.73 per acre. In 1904 a test made by Mr. Parish on gray soil with reddish subsoil showed an average increase attributable to cotton seed meal of 249 pounds of seed cotton per acre; an increase deu to acid phosphate of 584 pounds; and an increase due to kainit of 212 pounds of seed cotton. This indicated a need for the complete fertilizer, while the later tests gave good results without kainit.

It seems that this soil needs chiefly phosphoric acid, but that this should usually be supplemented by nitrogen. The soil on which both Mr. Parish and Mr. Haddock made their experiments was that known locally as "The Barrens," and described in soil survey reports as "Clarksville Silt Loam."

	1904	1905	1906
Average yield of seed cotton per acre, unfertilized	452	340	168
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	284	336	232
To acid phosphate plot	269	465	246
To kainit plot	237	298	—26
To acid phosphate and kainit plot	208	—131	91
Average increase with cotton seed meal	249	242	138

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	696	392	192
To cotton seed meal plot	681	521	206
To kainit plot	494	231	114
To cotton seed meal and kainit plot	465	—198	231
Average increase with acid phosphate	584	236	188

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	334	308	179
To cotton seed meal plot	287	270	—79
To acid phosphate plot	132	147	101
To cotton seed meal and acid phosphate plot	71	—449	—54
Average increase with kainit	212	69	37

LAUDERDALE COUNTY, 10 MILES WEST OF FLORENCE.

J. W. HADDOCK, 1907-8. (See Table, p. 30.)

Gray soil, with red subsoil.

This field had been cleared about 40 years, and was of the same character as soil used in Mr. Parish's experiment. The stand was uniform. The results both years agree with Mr. Parish's experiments in showing that the most effective fertilizer was a mixture of acid phosphate and cotton seed meal, the phosphate being more important. It is curious and inexplicable that kainit when applied alone gave a large increase, but when combined with either or both of the other fertilizers it gave little or no increase. These tests, though presenting some figures that cannot be understood, confirmed the conclusions drawn from Mr. Parish's tests, namely, that acid phosphate is most important, that it should be supplemented by cotton seed meal, and that potash is generally unnecessary.

	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	540	475
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	72	460
To acid phosphate plot	856	880
To kainit plote	—120	190
To acid phosphate and kainit plot		380
Average increase with cotton seed meal	269	478
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	432	200
To cotton seed meal plot	121	620
To kainit plot		—120
To cotton seed meal and kainit plot	0 0	70
Average increase with acid phosphate	576	193
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	848	340
To cotton seed meal plot	656	70
To acid phosphate plot		20
To cotton seed meal and acid phosphate	—560	—600
Average increase with kainit	315	—43

Madison County, 5 Miles West of Huntsville.

H. D. N. Wales, 1905. (See Table, p. 35.)

Red soil, with red subsoil.

This worn red lime soil responded freely only to applications of cotton seed meal. Other tests made in Madison County indicate a general need on such soils for both nitrogen and phospahte. Results from potash have been variable, the majority of the tests showing that little or no potash is needed.

	Lbs.
Average yield of seed cotton per acre, unfertilized	376
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	144
To acid phosphate plot	96
To kainit plot	144
Average increase with cotton seed meal	128
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	88
To cotton seed meal plot	40
To kainit plot	—32
Average increase with acid phosphate	24
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	72
To cotton seed meal plot	72
To acid phosphate plot	—48
Average increase with kainit	24

Experiments in Madison, Lawrence and Morgan Counties.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	HUNTSVILLE: Yield of seed cotton per acre	HUNTSVILLE: Increase over unfertilized plot	HILLSBORO: Yield of seed cotton per acre	HILLSBORO: Increase over unfertilized plot	HARTSELLE Red land: Yield of seed cotton per acre	HARTSELLE Red land: Increase over unfertilized plot	HARTSELLE Gray land: Yield of seed cotton per acre	HARTSELLE Gray land: Increase over unfertilized plot
	Lbs		Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	520	144	272	48	798	112	780	210
2	240	Acid phosphate	464	88	264	40	776	120	1140	370
3	....	No fertilizer	376	....	224	....	656	....	570	....
4	200	Kainit	448	72	247	21	744	94	680	126
5	200 240	Cotton seed meal ... Acid phosphate	560	184	496	265	744	100	1210	672
6	200 200	Cotton seed meal ... Kainit	592	216	424	190	712	74	980	350
7	240 200	Acid phosphate .... Kainit	416	40	456	219	632	1	900	394
8	....	No fertilizer	376	....	240	....	624	....	490	....
9	200 240 200	Cotton seed meal ... Acid phosphate .... Kainit	....	....	744	504	864	240	1070	580
10	200 240 100	Cotton seed meal ... Acid phosphate .... Kainit	....	....	616	376	752	128	1010	520

LAWRENCE COUNTY, 1 MILE EAST OF HILLSBORO.

F. T. NEALY, 1905. (See Table above.)

Gray sandy loam soil, with yellow subsoil.

This field had been cleared about 70 years of its growth of hardwoods. It had grown up in weeds during the four years preceding this experiment. Rains were almost continuous throughout the season, making cultivation almost impossible. Under these unfavorable conditions a complete fertilizer was the most effective and profitable.

	Lbs.
Average yield of seed cotton per acre, unfertilized	232
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	48
To acid phosphate plot	225
To kainit plot	161
To acid phosphate and kainit plot	285
Average increase with cotton seed meal	180
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	40
To cotton seed meal plot	217
To kainit plot	198
To cotton seed meal and kainit plot	314
Average increase with acid phosphate	192
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	21
To cotton seed meal plot	142
To acid phosphate plot	179
To cotton seed meal and acid phosphate plot	239
Average increase with kainit	145

MORGAN COUNTY, 4 MILES WEST OF HARTSELLE.

J. O. BURLESON, 1907–8. (See Table, p. 35.)

In 1907, *soil, red, lime table land; Subsoil, red. The original growth was hickory, removed about* 80 *years before.*

The soil was the ordinary lime soil of the Tennessee Valley Region. A complete fertilizer afforded the largest yield. Apparently the greatest need was for nitrogen.

In 1908, *typical sandy mountain land, dark gray soil with red subsoil.*

The original growth was shortleaf pine and hardwoods, and the land had been in cultivation about 10 years. The largest increase was afforded by a mixture of cotton seed meal and acid phosphate. The chemical chiefly needed by this soil was acid phosphate.

	Lbs.	Lbs.
Average yield of seed cotton per arre, unfertilized.	640	530
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	112	210
To acid phosphate plot	—20	402
To kainit plot	—20	—20
To acid phosphate and kainit plot	239	230
Average increase with cotton seed meal	78	206
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	120	370
To cotton seed meal plot	—12	462
To kainit plot	—93	268
To cotton seed meal and kainit plot	166	230
Average increase with acid phosphate	45	333
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	94	126
To cotton seed meal plot	—38	140
To acid phosphate plot	—119	24
To cotton seed meal and acid phosphate plot	140	—92
Average increase with kainit	19	50

CULLMAN COUNTY, 2 MILES SOUTH WEST OF JOPPA.

O. G. ROBERTS, 1906–7–8. (See Table, p. 39.)

Gray sandy upland with yellow clay subsoil.

The original growth was short leaf pines and hardwoods, characteristic of the Mountain Plateau Region. This field had been cleared for about 24 years.

In all three years the largest profit was made on plot 5 by using a mixture of cotton seed meal and acid phosphate. In every case there was no advantage in adding kainit to the other two chemicals. This inefficiency of potash in these tests is further borne out by the fact that, of the two complete fertilizers, the one with the smaller amount of potash each year afforded the larger yield. These results also agree with the results of Mr. Burleson's tests on similar gray plateau soil.

	1906. Lbs.	1907. Lbs.	1908. Lbs.
Average yield of seed cotton per acre unfertilized ..	248	360	312
Increase in seed cotton when cotton seed meal was added:			
To unfertilized plot	200	22	144
To acid phosphate plot	174	218	132
To kainit plot	190	58	166
To acid phosphate and kainit plot	—17	43	164
Average increase with cotton seed meal	137	85	152
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	288.	174	292
To cotton seed meal plot	262	370	280
To kainit plot	342	121	112
To cotton seed meal and kainit plot	135	114	110
Average increase with acid phosphate	257	195	199
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	75	182	156
To cotton seed meal plot	65	210	178
To acid phosphate plot	129	129	—24
To cotton seed meal and acid phosphate plot	—62	—46	8
Average increase with kainit	52	119	80

Fertilizer Experiments in Blount, Cullman, Marion, Winston and Walker Counties.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	JOPPA 1906: Yield of seed cotton per acre	JOPPA 1906: Increase over unfertilized plot	JOPPA 1907: Yield of seed cotton per acre	JOPPA 1907: Increase over unfertilized plot	JOPPA 1908: Yield of seed cotton per acre	JOPPA 1908: Increase over unfertilized plot	TIDMORE 1905: Yield of seed cotton per acre	TIDMORE 1905: Increase over unfertilized plot	CULLMAN 1906: Yield of seed cotton per acre	CULLMAN 1906: Increase over unfertilized plot	HAMILTON 1906: Yield of seed cotton per acre	HAMILTON 1906: Increase over unfertilized plot	NAUVOO 1908: Yield of seed cotton per acre	NAUVOO 1908: Increase over unfertilized plot	CORDOVA 1908: Yield of seed cotton per acre	CORDOVA 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal...	416	200	438	22	472	144	[568]	[372]	544	152	288	32	490	90	1460	320
2	240	Acid phosphate....	504	288	590	174	620	292	276	80	588	196	310	64	595	195	1560	420
3	....	No fertilizer........	216	....	416	....	328	....	196	......	392	......	256	......	400	......	1140	......
4	200	Kainit	304	75	576	182	476	156	264	70	553	136	312	49	480	81	1270	120
5	200 240	Cotton seed meal . Acid phosphate ..	664	462	764	392	736	424	380	188	904	[464]	632	362	790	392	1500	340
6	200 200	Cotton seed meal . Kainit	520	265	582	232	626	322	376	186	832	368	456	180	605	208	......	......
7	240 200	Acid phosphate .. Kainit	648	417	630	303	564	268	220	33	800	312	544	262	550	154	1630	450
8	....	No fertilizer........	280	....	304	....	288	....	184	......	512	......	288	......	395	......	1190	......
9	200 240 200	Cotton seed meal Acid phosphate .. Kainit	680	400	650	3450	720	432	372	188	872	360	592	304	820	425	1560	370
10	200 240 100	Cotton seed meal. Acid phosphate .. Kainit	720	440	684	380	726	438	352	168	912	400	528	240	860	465	1800	610

Blount County, 2 Miles North of Tidmore.

John W. Staab, 1905. (See Table, p. 39.)

Mulatto, fine sandy loam, with reddish yellow subsoil.

The rainfall was heavy. Apparently plot 1 was on richer land than the other plots. The chief need was for nitrogen. Phosphate and kainit were of little value.

On the other hand, in a similar experiment made by Mr. Staab the preceding year on apparently the same character of land, the increase in yield of seed cotton per acre averaged for cotton seed meal 215 pounds, for acid phosphate 282 pounds, and for kainit 77 pounds.

	Lbs.
Average yield of seed cotton, unfertilized	190
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	
To acid phosphate plot	108
To kainit plot	116
To acid phosphate and kainit plot	155
Average increase with cotton seed meal	126
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	80
To cotton seed meal plot	
To kainit plot	—37
To cotton seed meal and kainit plot	2
Average increase with acid phosphate	15
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	70
To cotton seed meal plot	
To acid phosphate plot	—47
To cotton seed meal and acid phosphate plot	00
Average increase with kainit	8

CULLMAN COUNTY, 1 MILE SOUTH OF CULLMAN.

L. A. FEALY, 1906. (See Table, p. 39.)

Gray sandy loam, with yellow loam subsoil.

On this upland field, long in cultivation, a mixture of acid phosphate and cotton seed meal gave the largest yield; but this result may have been due to the fact that this plot occupied the lowest position in the field. On this account it is impossible to determine whether potash was needed on this soil.

In 1904 on similar land Mr. Fealy made a test in which the average increase from cotton seed meal was 180 pounds, from acid phosphate 176 pounds, and from kainit 98 pounds.

	Lbs.
Average yield of seed cotton, unfertilized	452
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	152
To acid phosphate plot	268
To kainit plot	232
To acid phosphate and kainit plot	48
Average increase with cotton seed meal	175
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	196
To cotton seed meal plot	312
To kainit plot	176
To cotton seed meal and kainit plot	—8
Average increase with acid phosphate	169
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	136
To cotton seed meal plot	216
To acid phosphate jlot	116
To cotton seed meal and acid phosphate plot	—104
Average increase with kainit	91

MARION COUNTY, HAMILTOON.

SIXTH DISTRICT AGRICULTURAL SCHOOL, 1906. (Table, p. 39.)

Sandy land with yellow clay subsoil.

For 3 or 4 years preceeding the experiment this land had been uncultivated and occupied by weeds.

The largest and most profitable yield was afforded by plot 5, fertilized with cotton seed meal and acid phosphate. A test made on the same farm in 1903 (Ala. Station Bulletin No. 131) showed a need for a complete fertilizer, in which, however, potash was less effective than either nitrogen or phosphate.

	Lbs.
Average yield of seed cotton per acre, unfertilized	272
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	32
To acid phosphate plot	298
To kainit plot	131
To acid phosphate and kainit plot	42
Average increase with cotton seed meal	126
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	64
To cotton seed meal plot	330
To kainit plot	213
To cotton seed meal and kainit plot	124
Average increase with acid phosphate	183
Increase of seed cotton per acre when kainit was added:	
Averge yield of seed cotton per acre, unfertilized	397
To unfertilized plot	49
To cotton seed meal plot	148
To acid phosphate plot	198
To cotton seed meal and acid phosphate plot	—58
Average increase with kainit	84

Winston County, 3 Miles North East of Nauvoo.

W. M. Omary, 1908. (See Table, p. 39.)

Gray sandy soil with a reddish clay subsoil; "coal land."

This field had been in cultivation only about 6 years; the original growth is stated to have been short leaf pine.

While a complete fertilizer afforded the largest yield, yet the increase on plot 5, receiving only cotton seed meal and phosphate, was almost as large and the profit on plot 5 was even greater than on plot 9.

	Lbs.
Average yield of seed cotton per acre, unfertilized	397
Increase of seed cotton where cotton seed meal was added:	
To unfertilized plot	90
To acid phosphate plot	197
To kainit plot	127
To acid phosphate and kainit plot	271
Average increase with cotton seed meal	171
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	195
To cotton seed meal plot	302
To kainit plot	73
To cotton seed meal and kainit plot	217
Average increase with acid phosphate	197
Incraese of seed cotton per acre when kainit was added:	
To unfertilized plot	81
To cotton seed meal plot	118
To acid phosphate plot	—41
To cotton seed meal and acid phosphate plot	33
Average increase with kainit	48

Walker County, 3 Miles South of Cordova.

G. L. Alexander, 1908. (See Table, p. 39.)

Gray sandy upland with red clay subsoil.

This field had been cleared for about 40 years. Evidently the land had been kept in a high state of fertility.

The stand was uniform.

It is clear that the chief need of this soil was for acid phosphate. There was no need for potash. The figures for nitrogen are confusing, probably due to the relatively productive condition of this land. Apparently plot 10 was on richer soil than the other plots.

Average yield of seed cotton per acre, unfertilized	1165
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	320
To acid phosphate plot	—80
To acid phosphate and kainit plot	—80
Average increase with cotton seed meal	54
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	420
To cotton seed meal plot	20
To kainit plot	330
Average increase with acid phosphate	257
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	120
To acid phosphate plot	30
To cotton seed meal and acid phosphate plot	30
Average increase wtih kainit	60

Fayette County, 1 1-2 Miles West of Newtonville.

J. B. Gibson, 1906-7. (See Table, p. 46.)

Dark sandy soil with red clay subsoil.

This level upland field, on which the original growth was oak and short leaf pine, has been cleared about 18 years.

There was an increase with either cotton seed meal, acid phosphate, or kainit, whether these were used separately or in every possible combination. Apparently the greatest need was for acid phosphate.

	1906. Lbs.	1907. Lbs.
Average yield of seed cotton, unfertilized	560	348
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	784	576
To acid phosphate plot	24	86
To kainit plot	72	54
To acid phosphate and kainit plot	216	92
Average increase with cotton seed meal	274	202
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	880	640
To cotton seed meal plot	120	150
To kainit plot	128	129
To cotton seed meal and kainit plot	268	167
Average increase with acid phosphate	349	272
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	720	611
To cotton seed meal plot	8	89
To acid phosphate plot	—32	100
To cotton seed meal and acid phosphate plot	160	106
Average increase with kainit	214	227

Fertilizer Experiments in Fayette and Greene Counties.

Plot No	FERTILIZER: Amount per acre	FERTILIZER: KIND	NEWTON-VILLE 1906: Yield of seed cotton per acre	NEWTON-VILLE 1906: Increase over unfertilized plot	NEWTON-VILLE 1907: Yield of seed cotton per acre	NEWTON-VILLE 1907: Increase over unfertilized plot	CLINT'N 1908: Yield of seed cotton per acre	CLINT'N 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	1304	784	912	576	768	144
2	240	Acid phosphate	1400	880	976	640	760	136
3	....	No fertilizer	520	......	336	......	624	....
4	200	Kainit	1256	720	952	611	672	49
5	200	Cotton seed meal	1456	904	1072	726	696	74
	240	Acid phosphate						
6	200	Cotton seed meal	1360	792	1016	665	687	08
	200	Kainit						
7	240	Acid phosphate	1432	848	1096	740	622	14
	200	Kainit						
8	....	No fertilizer	600	......	360	......	616	....
9	200	Cotton seed meal	1664	1064	1192	832	680	64
	240	Acid phosphate						
	200	Kainit						
10	200	Cotton seed meal	1600	1000	1272	912	704	88
	240	Acid phosphate						
	100	Kainit						

GREENE COUNTY, 6 MILES NORTH OF CLINTON.

W. M. MORGAN, 1908. (See Table above.)

Dark soil with clay foundation.

The original growth, consisting chiefly of short leaf pine, was removed about nine years before the test was made. The two crops preceding the experiment consisted of cotton. No fertilizer very greatly increased the yield. From Mr. Morgan's notes it may be inferred that the land is in poor mechanical condition, much inclined to bake, and that on all plots there was much shedding of forms, but no rust.

	Lbs.
Average yield of seed cotton per acre, unfertilized	620
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	144
To acid phosphate plot	—62
To kainit plot	19
To acid phosphate and kainit plot	50
Average increase with cotton seed meal	38
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	136
To cotton seed meal plot	—70
To kainit plot	—35
To cotton seed meal and kainit plot	—4
Average increase with acid phosphate	7
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	49
To cotton seed meal plot	—76
To acid phosphate plot	—122
To cotton seed meal and acid phosphate plot	—10
Average increase with kainit	—40

Chilton County, 2 Miles West of Verbena.

J. H. Willoughby, 1905–6–7–8. (See Table, p. 49.)

Gray sandy soil with a red subsoil.

Every year this test was made on soil that had been long in cultivation. In each of the four years the complete fertilizer (plot 9) afforded a larger yield than the mixture of any two fertilizers. In every test the complete fertilizer afforded the largest net profit. When the chemicals were used separately or by twos their effect was variable, but when all 3 were combined each chemical in this mixture increased the yield more than enough to pay its cost.

	1905 Lbs.	1906 Lbs.	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre unfertilized	408	256	628	550
Increase of seed cotton when cotton seed meal was added:				
To unfertilized plot	384	104	64	230
To acid phosphate plot	104	85	60	142
To kainit plot	96	21	—36	—18
To acid phosphate and kainit plot	272	62	279	256
Average increase with cotton seed meal	214	68	60	153
Increase of seed cotton per acre when acid phosphate was added:				
To unfertilized plot	168	128	32	50
To cotton seed meal plot	—112	109	156	—38
To kainit plot	16	36	—101	—142
To cotton seed meal and kainit plot	192	77	214	132
Average increase with acid phosphate	66	87	75	1
Increase of seed cotton per acre when kainit was added:				
To unfertilized plot	136	206	158	186
To cotton seed meal plot	—152	123	186	—62
To acid phosphate plot	—16	114	25	—6
To cotton seed meal and acid phosphate plot	152	91	244	108
Average increase with kainit	30	133	153	57

Verbena (Chilton County) Experiments by J. H. Willoughby and G. H. Caffey.

Plot No.	Fertilizer: Amount per acre	Fertilizer: Kind	Verbena W. 1905: Yield of seed cotton per acre	Verbena W. 1905: Increase over unfertilized plot	Verbena W. 1906: Yield of seed cotton per acre	Verbena W. 1906: Increase over unfertilized plot	Verbena W. 1907: Yield of seed cotton per acre	Verbena W. 1907: Increase over unfertilized plot	Verbena W. 1908: Yield of seed cotton per acre	Verbena W. 1908: Increase over unfertilized plot	Verbena C. 1907: Yield of seed cotton per acre	Verbena C. 1907: Increase over unfertilized plot	Verbena C. 1908: Yield of seed cotton per acre	Verbena C. 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	752	384	376	104	640	64	820	230	888	144	790	160
2	240	Acid phosphate	536	168	400	128	736	32	640	50	653	91	710	80
3	....	No fertilizer..........	368	......	272	......	704	......	590	......	744	......	630	......
4	200	Kainit	520	136	472	206	832	158	760	186	904	196	650	40
5	200 240	Cotton seed meal .... Acid phosphate	672	272	472	213	736	92	750	192	848	177	910	320
6	200 200	Cotton seed meal .... Kainit	648	232	380	227	736	122	710	168	848	214	740	170
7	240 200	Acid phosphate ..... Kainit	584	152	488	242	640	57	570	44	700	103	680	130
8	....	No fertilizer	448	......	240	......	552	......	520	......	560	......	530	......
9	200 240 200	Cotton seed meal .... Acid phosphate ..... Kainit	872	424	544	304	888	336	810	300	1024	464	860	303
10	200 240 100	Cotton seed meal .... Acid phosphate ..... Kainit	760	312	456	216	856	304	800	290	952	392	810	280

CHILTON COUNTY, 1–2 MILE SOUTH OF VERBENA.
G. H. CAFFEY, 1907–8. (See Table, p. 49.)

Rather stiff, dark, sandy soil, with a red clay subsoil.

This piece of high upland was cleared 60 or 70 years ago of its original growth of longleaf pine, oak, hickory, and dogwood. The results for the two years suggest that the fertilizer which pays best one season is not necessarily the one most effective in a different season. In 1907 there was need for a complete fertilizer, in which the most effective constituent was nitrogen, closely followed by potash; phosphate was also helpful when used in combination, with *both* of the other constituents.

In 1908, on the contrary, kainit was of practically no value nitrogen being most important, followed by phosphate. A mixture of cotton seed meal and phosphate gave the greatest profit.

In 1907 the complete fertilizer on plot 9, costing $5.68 per acre, increased the yield of seed cotton by 464 pounds per acre, worth at 3.2 cents, $14.85. This leaves a net profit of $8.17 due to the complete fertilizer. Likewise in 1908 the increase on plot 5, with meal and phosphate costing $4.28, afforded a net profit of $5.96.

	1907 Lbs.	1908 Lbs.
Average yield of seed cotton unfertilized	652	580
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	144	160
To acid phosphate plot	268	240
To kainit plot	18	130
To acid phosphate and kainit plot	361	200
Average increase with cotton seed meal	198	183

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	—91	80
To cotton seed meal plot	33	160
To kainit plot	—93	90
To cotton seed meal and kainit plot	250	160
Average increase with acid phosphate	25	123

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	196	40
To cotton seed meal plot	70	10
To acid phosphate plot	194	50
To cotton seed meal and acid phosphate plot	287	10
Average increase with kainit	187	28

AUTAUGA COUNTY, 2 MILES EAST OF PRATTVILLE.
J. W. YOUNG, 1905–6–7. (See Table, p. 52.)

Reddish sandy soil with a red clay subsoil.

The stand each year was good and uniform. Results were somewhat obscured by unfavorable weather conditions in 1905 and by the September storm and the occurrence of early frost in 1906. Evidently the chief need of the soil, long in cultivation, was for nitrogen. Phosphoric acid was also needed. A mixture of cotton seed meal and acid phosphate, (plot 5), in all cases gave a profitable increase. In a complete fertilizer in 1905 and 1906 kainit increased the yield to the extent of 112 and 77 pounds of seed cotton respectively; but when used alone or in combination with either one of the other fertilizers, kainit was usually unprofitable, and it was also without effect in the complete fertilizer in 1907.

Autauga and Montgomery (Sandy Land) Experiments.

	FERTILIZER		Pratt-ville 1904		Pratt-ville 1905		Pratt-ville 1906		MONT-GOMERY Red sandy	
Plot No.	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	816	184	936	296	912	156	744	112
2	240	Acid phosphate	752	120	800	160	816	60	664	32
3	....	No fertilizer	632	....	640	....	756	.....	632	....
4	200	Kainit	640	24	680	34	780	12	552	66
5	200 240	Cotton seed meal Acid phosphate	760	160	840	187	888	109	720	116
6	200 200	Cotton seed meal Kainit	752	168	760	101	892	102	752	1620
7	240 200	Acid phosphate Kainit	744	176	696	30	708	93	643	73
8	....	No fertilizer	552	....	672	....	812	.....	560	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	824	272	936	264	880	68	824	264
10	200 240 100	Cotton seed meal Acid phosphate Kainit	768	216	856	184	800	12	840	280

	1905	1906	1907
	Lbs.	Lbs.	Lbs.
Average yield of seed cotton, unfertilized	592	656	784
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	184	296	156
To acid phosphate plot	40	27	49
To kainit plot	144	67	90
To acid phosphate and kainit plot	96	234	151
Average increase with cotton seed meal	116	156	112

Increase of seed cotton per acre when acid phospahte was added:			
To unfertilized plot	120	160	60
To cotton seed meal plot	—24	—109	—47
To kainit plot	152	—4	—105
To cotton seed meal and kainit plot	104	163	—34
Average increase with acid phosphate	88	53	—32

Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	24	34	12
To cotton seed meal plot	—16	—195	—54
To acid phosphate plot	56	—130	—153
To cotton seed meal and acid phosphate plot	112	77	—41
Average increase with kainit	44	—53	—59

MARENGO COUNTY, 2 MILES SOUTH OF FAUNSDALE.

W. C. MCKNIGHT, 1905. (See Table, p. 54.)

Yellowish, gravelly, prairie upland.

The largest increase and the only plot showing any decided profit from fertilizers was plot 10, which received 550 pounds of a complete fertilizer.

	Lbs.
Average yield of seed cotton per acre, unfertilized	414
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	62
To acid phosphate plot	170
To kainit plot	48
To acid phosphate and kainit plot	210
Average increase with cotton seed meal	122
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	—82
To cotton seed meal plot	56
To kainit plot	—42
To cotton seed meal and kainit plot	120
Average increase with acid phosphate	13
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	—20
To cotton seed meal plot	56
To acid phosphate plot	20
To cotton seed meal and acid phosphate plot	30
Average increase with kainit	21

Fertilizer Experiments in Marengo and Montgomery Counties on prairie or lime soils.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	FAUNSDALE: Yield of seed cotton per acre	FAUNSDALE: Increase over unfertilized plot	MONTGOM'RY Prairie: Yield of seed cotton per acre	MONTGOM'RY Prairie: Increase over unfertilized plot	MONTGOM'RY Prairie: Yield of seed cotton per acre	MONTGOM'RY Prairie: Increase over unfertilized plot	MONTGOM'RY Prairie: Yield of seed cotton per acre	MONTGOM'RY Prairie: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	516	62	492	120	256	78	643	143
2	240	Acid phosphate	372	82	648	276	320	14	483	15
3	....	No fertilizer	454	....	372	....	334	....	498	....
4	200	Kainit	418	20	558	183	580	233	590	119
5	200 240	Cotton seed meal Acid phosphate	540	118	528	149	402	42	578	134
6	200 200	Cotton seed meal Kainit	434	28	528	146	694	322	663	246
7	240 200	Acid phosphate Kainit	328	62	648	268	690	306	593	203
8	....	No fertilizer	374	....	388	....	396	....	363	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	522	148	694	310	672	276	853	490
10	200 240 100	Cotton seed meal Acid phosphate Kainit	638	264	726	338	618	220	723	360

MONTGOMERY COUNTY, 6 MILES SOUTH EAST OF MONTGOMERY. WESLEY N. JONES AND SONS, 1906–7–8.

Black prairie soil in 1906; *reddish prairie soil in* 1907; *chocolate or "mulatto" prairie soil in* 1908.

In 1906 on black or dark gray prairie upland soil, the greatest increase, 338 pounds of seed cotton per acre, and the largest profit, was afforded by the complete fertilizer applied to plot 10. Apparently the chief need that year was for acid phosphate, though kainit was also helpful.

In 1907 the greatest increase was afforded by a mixture of cotton seed meal and kainit, closely followed by the plot receiving acid phosphate and kainit. In this test kainit was the only profitable fertilizer and was effective whether used alone or in combination with either acid phosphate or kainit. The poor results on plots 1 and 2 and 5 appear to be partly due to the slightly poorer stand on those plots.

In 1908 a complete fertilizer was the most profitable; in this potash was most important, nitrogen next. Acid phosphate was ineffective when used alone or with meal, but profitable when combined with both kainit and meal, making a complete fertilizer.

In the 3 tests on this typical prairie soil, the most profitable fertilizer was in two cases a complete fertilizer and in one case kainit.

	1906 Lbs	1907 Lbs	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	380	365	431
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	120	—78	145
To acid phosphate plot	—127	66	149
To kainit plot	—37	89	127
To acid phosphate and kainit plot	42	—30	187
Average increase with cotton seed meal	—1	12	152
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	276	—14	—15
To cotton seed meal plot	29	120	—11
To kainit plot	85	73	84
To cotton seed meal and kainit plot	164	—46	144
Average increase with acid phosphate	130	33	50
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	183	233	119
To cotton seed meal plot	26	400	101
To acid phosphate plot	—8	320	218
To cotton seed meal and acid phosphate plot	161	234	356
Average increase with kainit	91	297	199

MONTGOMERY COUNTY, 7 MILES EAST OF MONTGOMERY.
THOS. W. OLIVER, 1907. (See Table, p. 52.)

Red sandy soil 4 to 6 in deep; red clay subsoil.

The field had been cleared perhaps 70 years before. The original growth was reported as short leaf pine and oak.

The season was unfavorable, the spring being very wet and the late summer very dry and hot.

A complete fertilizer, especially the one on plot 10, was the most profitable.

	Lbs.
Average yield of seed cotton per acre, unfertilized	596
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	112
To acid phosphate plot	84
To kainit plot	228
To acid phosphate and kainit plot	191
Average increase with cotton seed meal	154
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	32
To cotton seed meal plot	4
To kainit plot	139
To cotton seed meal and kainit plot	102
Average increase with acid phosphate	69
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	—66
To cotton seed meal plot	50
To acid phosphate plot	41
To cotton seed meal and acid phosphate plot	148
Average increase with kainit	43

LEE COUNTY, EXPERIMENT STATION FARM.

Results of fertilizer experiments in 1905 and 1906 are reserved for another publication. Expressed briefly the results showed that on gray sandy soil (Norfolk sandy loam), the greatest increase was from potash, next from nitrogen, and the least from phosphate. The latter fact may be due to an accumulation of phosphoric acid brought about by fertilization with acid phosphate each year.

LEE COUNTY, 2 MILES WEST OF AUBURN.

JOHN JACKSON, 1908. (See Table, p. 58.)

Gray sandy loam, long in cultivation.

The largest increase, 500 pounds per acre, was afforded by plot 9, on which was used 640 pounds per acre of a complete fertilizer. This represents, at 3.2 cents per pound of seed cotton, a net profit of $10.32 per acre above the cost of fertilizer. It should be added that the increased crop as measured by the scales was very much greater than the appearance of the plants would suggest to the eye.

Every one of the three constituents of the complete fertilizer was profitable in this mixture.

Average yield of seed cotton, unfertilized	560
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	190
To acid phosphate plot	10
To kainit plot	—140
To acid phosphate and kainit plot	320
Average increase with cotton seed meal	95
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	100
To cotton seed meal plot	—80
To kainit plot	—118
To cotton seed meal and kainit plot	350
Average increase with acid phosphate	63

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	290
To cotton seed meal plot	—40
To acid phosphate plot	80
To cotton seed meal and acid phosphate plot	390
Average increase with kainit	180

Fertilizer Experiments in Lee County.

Plot No.	FERTLIZER: Amount per acre	FERTLIZER: KIND	AUBURN J. Jackson: Yield of seed cotton per acre	AUBURN J. Jackson: Increase over unfertilized plot	BEEHIVE: Yield of seed cotton per acre	BEEHIVE: Increase over unfertilized plot	BEEHIVE: Yield of seed cotton per acre	BEEHIVE: Increase over unfertilized plot
	Lbs.		*Lbs*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal	800	190	428	156	280	96
2	240	Acid phosphate	710	100	424	152	304	120
3	....	No fertilizer	610	....	272	....	184	....
4	200	Kainit	980	290	484	202	304	123
5	200 240	Cotton seed meal Acid phosphate	680	110	552	260	560	382
6	200 200	Cotton seed meal Kainit	700	150	692	392	400	525
7	240 200	Acid phosphate Kainit	710	180	608	297	444	273
8	....	No fertilizer	510	....	320	....	168	....
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1010	500	624	304	640	472
10	200 240 100	Cotton seed meal Acid phosphate Kainit	750	240	560	240	560	392

LEE COUNTY, 4 MILES SOUTH OF LOACHAPOKA, AT BEEHIVE.

T. W. Cox, 1905-6.

Coarse sandy soil with yellow sandy subsoil.

This piece of upland had been in cultivation for many years. In 1905 rust was severe on all plots. The stand of plants was uniform. On this very poor coarse sandy soil plot 6, fertilized with meal and kainit, gave the largest yield and the most profit in 1905, in which year every fertilizer was useful when applied alone or by twos.

In 1906 plot 9, receiving 640 pounds of complete fertilizer, afforded the largest yield and the greatest net profit. The latter test agrees with Mr. Jackson's in showing the need of a complete fertilizer on the coarse gray sandy soils of this region.

	1905 Lbs.	1906 Lbs.
Average yield of seed cotton per acre, unfertilized	296	176
To unfertilized plot	156	96
To acid phosphate plot	108	260
To kainit plot	190	2
To acid phosphate and kainit plot	7	201
Average increase with cotton seed meal	115	140

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152	120
To cotton seed meal plot	104	287
To kainit plot	95	150
To cotton seed meal and kainit plot	—88	247
Average increase with acid phosphate	66	201

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	202	123
To cotton seed meal plot	236	129
To acid phosphate plot	145	153
To cotton seed meal and acid phosphate plot	44	90
Average increase with kainit	157	124

TALLAPOOSA COUNTY, 8 MILES WEST OF NOTASULGA.

M. E. PARKER, 1905-6. (See Table, p. 61.)

Gray sandy upland; yellowish subsoil.

This field was on representative long-leaf pine land, and had been in cultivation about 20 years. The five crops preceding that of 1905 were cotton fertilized with 200 pounds of guano per acre.

In 1905 cotton rust was severe and a complete fertilizer was most profitable, (plot 9 and 10); this year every fertilizer, whether applied alone, by twos, or all three together greatly increased the yield.

In 1906 the test was conducted on land that had been in oats the year before. This was a rainy season on this farm. Plot 10, with a complete fertilizer gave the largest increase and greatest profit, while plot 9, receiving a complete fertilizer with double this amount of potash, dropped lower in yield. There is no question of the effectiveness of phosphate and meal. But the results with kainit are here contradictory, this fertilizer making a satisfactory increase when used alone and also when used in the complete fertilizer on plot 10; but in other combinations kainit failed to increase the yield to any notable extent.

	1905 Lbs.	1906 Lbs.
Average yield of seed cotton per acre, unfertilized	500	621
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	320	127
To acid phosphate plot	128	104
To kainit plot	40	—26
To acid phosphate and kainit plot	160	88
Average increase with cotton seed meal	162	73
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	264	183
To cotton seed meal plot	72	166
To kainit plot	16	—35
To cotton seed meal and kainit plot	136	79
Average increase with acid phosphate	122	100
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	336	224
To cotton seed meal plot	56	71
To acid phosphate plot	88	0
To cotton seed meal and acid phosphate plot	120	—16
Average increase with kainit	150	70

Fertilizer Experiments in Tallapoosa and Macon Counties.

Plot No.	FERTILIZER		W. NOTA'GA M. E. Parker 1905		W. NOTA'GA M. E. Parker 1906		W. NOTA'GA J. W. Parker 1907		W. NOTA'GA E. B. Jackson 1907		W. NOTA'GA E. B. Jackson 1908		W. NOTA'GA S. C. Jackson 1905		SHORTER Swearington 1906	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal....	840	320	748	127	520	104	272	80	680	280	368	72	256	40
2	240	Acid phosphate.....	784	264	810	189	480	64	256	64	500	100	384	88	264	48
3	....	No fertilizer	520	......	621	......	416	......	192	......	400	......	296	......	216	......
4	200	Kainit..............	848	336	845	224	512	123	216	25	530	112	368	75	544	325
5	200 240	Cotton seed meal.. Acid phosphate...	896	392	914	293	632	270	296	106	500	84	552	262	464	244
6	200 200	Cotton seed meal.. Kainit............	872	376	819	198	584	249	312	124	650	236	520	233	768	546
7	240 200	Acid phosphate... Kainit............	840	352	810	189	568	260	304	118	550	138	344	60	640	416
8	....	No fertilizer	480	......	......	......	280	......	184	......	410	......	280	......	224	......
9	200 240 200	Cotton seed meal.. Acid phosphate... Kainit............	992	512	898	277	656	376	400	216	680	270	536	256	768	544
10	200 240 100	Cotton seed meal.. Acid phosphate... Kainit............	1000	520	1026	405	576	296	416	232	720	310	536	256	768	544

TALLAPOOSA COUNTY, 8 1–2 MILES WEST OF NOTASULGA.
J. W. PARKER, 1907. (See Table, p. 61.)

Gray sandy land; yellowish subsoil.

This typical piece of long-leaf pine upland had been cultivated for many years.

The complete fertilizer on plot 10 was the most profitable, affording a net profit of $6.35 per acre, (376 lbs. at 3.2 cents, less $5.68).

June and July were very dry. Rust and shedding were severe on plots 5, 9 and 10; plots 4 and 7 retained their foliage remarkably well.

	Lbs.
Average yield of seed cotton per acre, unfertilized	348
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	104
To acid phosphate plot	206
To kainit plot	126
To acid phosphate and kainit plot	116
Average increase with cotton seed meal	138
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	64
To cotton seed meal plot	166
To kainit plot	137
To cotton seed meal and kainit plot	127
Average increase with acid phosphate	124
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	123
To cotton seed meal plot	145
To acid phosphate plot	196
To cotton seed meal and acid phosphate plot	106
Average increase with kainit	143

TALLAPOOSA COUNTY, 6 MILES WEST OF NOTASULGA.
E. B. JACKSON, 1907–8. (See Table, p. 61.)

Gray sandy upland; yellowish subsoil.

This experiment was made on typical long-leaf pine land, which had been in cultivation for many years. The stands of cotton were good and uniform. There are no records to the presence or absence of cotton rust.

In both years a complete fertilizer was most effective and most profitable. However in a complete fertilizer, 100 pounds of kainit per acre (plot 10) was more advantageous than double this amount, (plot 9.)

	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	188	405
Increase of seed cotton when cotton seed meal was added:		
To unfertilized plot	80	280
To acid phosphate plot	42	—16
To kainit plot	99	124
To acid phosphate and kainit plot	98	132
Average increase with cotton seed meal	80	130
Increase of seed cotton per acre when acid phosphate was added:		
To unfertilized plot	64	100
To cotton seed meal plot	26	—196
To kainit plot	93	26
To cotton seed meal and kainit plot	92	34
Average increase with acid phosphate	69	—9
Increase of seed cotton per acre when kainit was added:		
To unfertilized plot	25	112
To cotton seed meal plot	44	—44
To acid phosphate plot	54	38
To cotton seed meal and acid phosphate plot	110	186
Average increase with kainit	58	73

MACON COUNTY, 6 MILES WEST OF NOTASULGA.
S. C. JACKSON, 1905. (See Table, p. 61.)

Gray sandy pine woods soil with yellowish subsoil.

The original growth was long–leaf pine. The field had been in cultivation for many years. A mixture of acid phosphate and cotton seed meal (plot 5) was sufficient to give the largest yield and greatest profits.

Mr. Jackson noted that on plots receiving the complete fertilizer there were some spots where the plants died, probably from cotton wilt. This may explain why the complete fertilizer did not give a better yield.

	Lbs.
Average yield of seed cotton per acre, unfertilized	288
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	72
To acid phosphate plot	174
To kainit plot	158
To acid phosphate and kainit plot	204
Average increase with cotton seed meal	152
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	88
To cotton seed meal plot	190
To kainit plot	—15
To cotton seed meal and kainit plot	31
Average increase with acid phosphate	73
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	75
To cotton seed meal plot	161
To acid phosphate plot	—28
To cotton seed meal and acid phosphate plot	2
Average increase with kainit	52

MACON COUNTY, 9 MILES WEST OF TUSKEGEE.
YANCEY SWEARINGTON, 1906. (See Table, p. 61.)

Gray sandy soil with yellow loam subsoil.

This field was cleared of its growth of long leaf pine about 60 years ago. The stand was good on all plots. It is notable that the complete fertilizer on plot 6 nearly quadrupled the yield on the unfertilized plots. This complete fertilizer afforded the largest yield and the greatest profit. but was closely followed in yield and profit by plot 6, receiving a mixture of cotton seed meal and kainit. In this test kainit was the most useful single fertilizer, a fact which was probably due to its effect in restraining rust, as indicated by Mr. Swearington's careful observations. By July 10 plot 5 was ruined by rust. Plots 4 and 6 suffered least from rust and were the last to show it. The rust was considered worse on plots 9 and 10 than on plot 5. Apparently rust was worse and earlier on plots receiving phosphate.

Mr. Swearington draws the following conclusion from this test:

"Our lands need more liberal use of potash."

	Lbs.
Average yield of seed cotton per acre, unfertilized	220
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	40
To acid phosphate plot	196
To kainit plot	221
To acid phosphate and kainit plot	184
Average increase with cotton seed meal	160
Increase of seed cotton per acre when acid phosephate was added:	
To unfertilized plot	48
To cotton seed meal plot	204
To kainit plot	91
To cotton seed meal and kainit plot	54
Average increase with acid phosphate	99

Increase of seed cotton per acre when kainit was added:
To unfertilized plot 325
To cotton seed meal plot 506
To acid phosphate plot 368
To cotton seed meal and acid phosphate plot 356

Average increase with kainit 389

Fertilizer Experiments near Society Hill, Macon County.

Plot No.	Fertilizer: Amount per acre	Fertilizer: Kind	R. S. Floyd 1906: Yield of seed cotton per acre	R. S. Floyd 1906: Increase over unfertilized plot	R. S. Floyd 1907: Yield of seed cotton per acre	R. S. Floyd 1907: Increase over unfertilizee plot	A. B. Floyd 1908: Yield of seed eotton per acre	A. B. Floyd 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal ...	512	160	472	168	420	30
2	240	Acid phosphate	464	112	832	192	580	30
3	....	No fertilizer........	352	......	640	......	450	.....
4	200	Kainit	432	90	720	49	750	296
5	200 240	Cotton seed meal . Acid phosphate ...	552	220	1112	410	520	62
6	200 200	Cotton seed meal. Kainit	448	125	728	-4	610	148
7	240 200	Acid phosphate .. Kainit	424	111	856	94	550	84
8	....	No fertilizer........	304	......	792	......	470	.....
9	200 240 200	Cotton seed meal. Acid phosphate .. Kainit	616	312	1168	376	990	520
10	200 240 100	Cotton seed meal. Acid phosphate .. Kainit	554	280	1224	432	900	430

MACON COUNTY, 5 MILES SOUTH WEST OF SOCIETY HILL.
R. S. AND A. B. FLOYD, 1906–7–8.

Soil in 1907 *dark sandy loam; in* 1906 *and* 1908 *gray sandy soil; yellow subsoil in all experiments.*

All these tests were made on land that had been long in cultivation. The original growth is reported as probably short-leaf pine and hardwood.

On gray sandy soil in 1906 and again in 1908 the complete fertilizer was by far the most effective and most profitable application. In both of these years rust was prevalent but least severe on the plots receiving kainia. On the other hand, in 1907, a year in which no rust troubled any plot, a mixture of cotton seed meal and phosphate on plot 5 gave the greatest increase, kainit being practically without effect.

In both years when rust prevailed, plot 10, receiving 200 pounds of kainit in its complete fertilizer, yielded more than plot 10, where only half as much kainit was used in the complete fertilizer.

	1906 Lbs.	1907 Lbs.	1908 Lbs.
Average yield of seed cotton per acre, unfertilized	328	716	460
Increase of seed cotton when cotton seed meal was added:			
To unfertilized plot	160	—168	—30
To acid phosphate plot	108	218	32
To kainit plot	35	—53	—148
To acid phosphate and kainit plot	201	282	436
Average increase with cotton seed meal	126	70	73
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	112	192	30
To cotton seed meal plot	60	578	92
To kainit plot	21	45	—212
To cotton seed meal and kainit plot	187	380	372
Average increase with acid phosphate	95	299	71
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	90	49	296
To cotton seed meal plot	—35	164	178
To acid phosphate plot	—1	—98	54
To cotton seed meal and acid phosphate plot	92	—34	458
Average increase with kainit	37	20	247

BULLOCK COUNTY, 9 MILES EAST OF UNION SPRINGS.
A. M. COPE, 1906. (See Table, p. 69.)

Gray sandy soil with porous yellow sandy subsoil.

The original growth of short-leaf pine had been cleared many years before. The stand of cotton was very uniform There was need of a complete fertilizer. Of the two complete fertilizers the one containing the larger amount of kainit per acre was more profitable. The need for nitrogen and for phosphate was somewhat greater than for potash.

The increase from the complete fertilizer on plot 9 was 760 pounds per acre, thus affording a net profit of $18.61 above the cost of fertilizer and above the cost of picking the increase. Indeed every fertilizer, whether used singly or in any combination whatsoever, gave a profitable increase.

	Lbs.
Average yield of seed cotton per acre, unfertilized	240
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	256
To acid phosphate plot	232
To kainit plot	240
To acid phosphate and kainit plot	400
Average increase with cotton seed meal	282
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	288
To cotton seed meal plot	264
To kainit plot	168
To cotton seed meal and kainit plot	328
Average increase with acid phosphate	262
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	192
To cotton seed meal plot	176
To acid phosphate plot	72
To cotton seed meal and acid phosphate plot	240
Avrerage increase with kainit	170

Fertilizer Experiments in Bullock, Barbour and Geneva Counties.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	Union Spgs A. M. Cope: Yield of seed cotton per acre	Union Spgs A. M. Cope: Increase over unfertilized plot	Louisville: Yield of seed cotton per acre	Louisville: Increase over unfertilized plot	Geneva: Yield of seed cotton per acre	Geneva: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*
1	200	Cotton seed meal ...	496	256	304	104	736	268
2	240	Acid phosphate	528	288	272	72	640	192
3	....	No fertilizer........	240	......	200	......	448	.....
4	200	Kainit	432	192	232	24	720	265
5	200 240	Cotton seed meal . Acid phosphate ..	760	520	456	240	872	410
6	200 200	Cotton seed meal . Kainit	672	432	472	248	720	252
7	240 200	Acid phosphate .. Kainit	600	360	312	80	624	150
8	....	No fertilizer........	240	......	240	......	480	.....
9	200 240 200	Cotton seed meal. Acid phosphate .. Kainit	1000	760	456	216	920	440
10	200 240 100	Cotton seed meal . Acid phosphate .. Kainit	808	568	480	240	872	392

BARBOUR COUNTY, 3 MILES NORTH OF LOUISVILLE.
BY J. D. VEAL, 1905.

Gray, sandy soil, with stiffer gray subsoil.

This field had been long in cultivation.

The season was wet; rust was severe and all yields were small. Nitrogen afforded a larger increase than did phosphate or potash. The most profitable mixtures contained cotton seed meal, mixed either with acid phosphate or with kainit.

The year before, on the same or similar land, a complete fertilizer was the most profitable. Both years cotton seed meal and acid phosphate were needed.

In 1904 kainit was profitably used, giving an average increase of 100 pounds per acre, as compared with an average increase of only 38 pounds in 1905.

	Lbs.
Average yield of seed cotton per acre, unfertilized	220
Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	104
To acid phosphate plot	168
To kainit plot	224
To acid phosphate and kainit plot	136
Average increase with cotton seed meal	158
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	72
To cotton seed meal plot	136
To kainit plot	56
To cotton seed meal and kainit plot	—32
Average increase with acid phosphate	58
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	24
To cotton seed meal plot	144
To acid phosphate plot	8
To cotton seed meal and acid phosphate plot	—24
Average increase with kainit	38

Geneva County, 4 1–2 Miles North of Geneva
M. P. Metcalf, 1905.

Gray sandy pine land with stiffer red subsoil eight inches from surface.

The land had been in cultivation six years. Both cotton seed meal and acid phosphate were very effective, and a mixture of the two was the most profitable fertilizer. This year kainit was in most combinations useless.

In experiments on cotton made by Mr. Metcalf on similar land in preceding years the results indicated a need for phosphate; and in two of his experiments kainit was also very effective. Nitrogen was also needed except when supplied by a preceding crop of peanuts.

	Lbs.
Average yield of seed cotton per acre, unfertilized	464
Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	288
To acid phosphate plot	218
To kainit plot	—13
To acid phosphate and kainit plot	290
Average increase with cotton seed meal	196
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	192
To cotton seed meal plot	122
To kainit plot	—115
To cotton seed meal and kainit plot	188
Average increase with acid phosphate	97
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	265
To cotton seed meal plot	—36
To acid phosphate plot	—42
To cotton seed meal and acid phosphate plot	30
Average increase with kainit	54

HENRY COUNTY, 3 1–2 MILES NORTH OF COLUMBIA.
THOS. Z. ATKESON, COLUMBIA, 1908.

Light gray soil with yellow loamy subsoil.

The field had been cleared about 40 years, the principal growth having been long leaf pine. There was very little rain from the time the seed were planted, and cotton wilt and root knot further reduced the yield under these unfavorable conditions. All fertilizers increased the yield, but none to any large extent.

Yet the increase on plot 5 was sufficient to pay a fair profit over the cost of the fertilizer.

	Lbs.
Average yield of seed cotton per acre, unfertilized	94
Increase of seed cotton when cotton seed was added:	
To unfertilized plot	785
To acid phosphate plot	96
To kainit plot	254
To acid phosphate and kainit plot	148
Average increase with cotton seed meal	144
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	35
To cotton seed meal plot	54
To kainit plot	74
To cotton seed meal and kainit	32
Average increase with acid phosphate	48
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	33
To cotton seed meal plot	209
To acid phosphate plot	72
To cotton seed meal and acid phosphate plot	124
Average increase with kainit	109

Fertilizer Experiments in Henry County.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	COLUMBIA: Yield of seed cotton per acre	COLUMBIA: Increase over unfertilized plot	HEADLAND 1907: Yield of seed cotton per acre	HEADLAND 1907: Increase over unfertilized plot	HEADLAND 1908: Yield of seed cotton per acre	HEADLAND 1908: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal ..	173	78	392	80	1015	130
2	240	Acid phosphate	130	35	208	104	1130	245
3	....	No fertilizer........	95	......	312	......	885	.....
4	200	Kainit	128	33	424	105	1020	150
5	200 240	Cotton seed meal . Acid phosphate ..	225	131	416	90	1245	390
6	200 200	Cotton seed meal. Kainit	380	287	656	324	1130	290
7	240 200	Acid phosphate .. Kainit	200	107	536	198	1170	345
8	....	No fertilizer........	93	......	344	......	810	.....
9	200 240 200	Cotton seed meal . Acid phosphate .. Kainit	3485	255	656	312	1425	615
10	200 240 100	Cotton seed meal . Acid phosphate .. Kainit	408	305	600	256	1410	600

HENRY COUNTY, 1 MILE EAST OF HEADLAND.
W. F. COVINGTON, 1907–8.

Gray sandy soil with yellow loam subsoil.

In 1907.—The experiment in 1907 was made on land that had been cleared about 40 years and was very poor, but otherwise representative.

The crop in 1906 was cotton fertilized with 500 to 600 pounds of a 9–3–3 guano. This probably explains in part why there was such poor response in 1907 to applications of phosphate. A further explanation is doubtless found in the observed fact that rust was worse on plot 2, fertilized with acid phosphate alone, than on other plots. Cotton seed meal and kainit both profitably increased the yield in whatever combination they were applied. The largest yield was made by a mixture of cotton seed meal and kainit, on plot 6. Mr. Covington writes: "The kainit made good in every test, especially so on plots 4, 6, and 7. On these plots the leaves held longer and the bolls were larger and much better matured, this last being especially noticeable on plot 6."

In 1908. The field had been cleared about ten years. On this land, not so deficient in vegetable matter as that used the preceding year, a complete fertilizer gave the maximum yield and the maximum profit. Of the three constituents of the complete fertilizer, acid phosphate was most influential, closely followed by both of the others. It is notable that the complete fertilizer on plot 10, containing only 100 pounds of kainit, in addition to meal and phosphate, afforded almost as large a yield and a greater net profit than did the complete fertilizer on plot 9, which contained double this amount of kainit. The net profit due to 540 pounds of fertilizer on plot 10 was $14.27 (600 lbs. at 3.2 cents, less $4.93) per acre.

Apparently this soil needs a complete fertilizer and this conclusion is not shaken by the slight response to acid phosphate under the exceptional conditions of 1907, as stated above; this view is strengthened by the favorable results from complete fertilizers in earlier experiments on what seem to be similar soils in that part of the state.

	Lbs. 1907.	Lbs. 1908.
Average yield of seed cotton per acre, unfertilized	328	848
Increase in seed cotton when cotton seed meal was added:		
To unfertilized plot	80	130
To acid phosphate plot	194	145
To kainit plot	219	140
To acid phosphate and kainit plot	114	270
Average increase with cotton seed meal	152	172

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	—104	245
To cotton seed meal plot	10	260
To kainit plot	93	195
To cotton seed meal and kainit plot	—12	325
Average increase with acid phosphate	—3	256

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	105	150
To cotton seed meal plot	244	160
To acid phosphate plot	302	100
To cotton seed meal and acid phosphate plot	222	225
Average increase with kainit	218	159

Experiments at Betts, Conecuh County.

Plot No.	FERTILIZER: Amount per acre	FERTILIZER: KIND	BETTS 1905: Yield of seed cotton per acre	BETTS 1905: Increase over unfertilized plot	BETTS 1906: Yield of seed cotton per acre	BETTS 1906: Increase over unfertilized plot	BETTS 1907: Yield of seed cotton per acre	BETTS 1907: Increase over unfertilized plot
	Lbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs*
1	200	Cotton seed meal...	784	216	1048	168	440	56
2	240	Acid phosphate	792	224	1064	184	424	40
3	....	No fertilizer.......	568	......	880	......	384	.....
4	200	Kainit	704	139	920	37	392	9
5	200 240	Cotton seed meal . Acid phosphate ..	864	302	1080	193	456	74
6	200 200	Cotton seed meal. Kainit	832	273	1056	166	456	76
7	240 200	Acid phosphate .. Kainit	824	269	1040	147	440	62
8	....	No fertilizer.......	552	......	896	......	376	.....
9	200 240 200	Cotton seed meal . Acid phosphate .. Kainit	896	344	1216	320	464	88
10	200 240 100	Cotton seed meal. Acid phosphate .. Kainit	880	328	1200	304	456	80

Conecuh County, 1–2 to 1 1–2 Miles North East of Betts.

R. H. Betts, 1905–6–7.

Gray sandy soil with red subsoil.

The land on which these tests were made had been cleared for 30 or 40 years. The original growth was reported hardwood and short–leaf pine; if so, probably this soil is defferent from the average soil of the long–leaf pine belt.

In 1908 there was so much rain and such small yields that all fertilizers were about equally ineffective and unprofitable. In 1906 when both fertilized and unfertilized plots yielded well, complete fertilizer (on plots 9 and 10) afforded the largest net profit. In 1905 a mixture of cotton seed meal and acid phosphate was nearly as effective and quite as profitable as a complete fertilizer.

	1905 Lbs.	1906 Lbs.	1907 Lbs.
Average yield of seed cotton per acre, unfertilized	560	888	380
Average yield of seed cotton when cotton seed meal was added:			
To unfertilized plot	216	168	56
To acid phosphate plot	78	9	34
To kainit plot	134	130	67
To acid phosphate and kainit plot	75	173	26
Average increase with cotton seed meal	126	120	46
Increase of seed cotton per acre when acid phosphate was added:			
To unfertilized plot	224	184	40
To cotton seed meal plot	86	25	18
To kainit plot	130	111	53
To cotton seed meal and kainit plot	71	154	12
Average increase with acid phosphate	127	119	31
Increase of seed cotton per acre when kainit was added:			
To unfertilized plot	139	36	9
To cotton seed meal plot	57	—2	20
To acid phosphate plot	45	—37	22
To cotton seed meal and acid phosphate plot	42	127	14
Average increase with kainit	71	31	16

INCONCLUSIVE TESTS.

The following inconclusive experiments were made:

Bullock County, O. M. Hill, Suspension, 1906.

Bullock County, F. B. Haynes, 7 miles South of Union Springs, 1908.

Chambers County, E. W. Smart, Fredonia, 1905.

Fayette County, J. B. Gibson, Newtonville, 1908.

Pickens County, D. W. Davis, Gordo, 1906.

The yields in these tests are given in the next table.

Inconclusive Experiments in Bullock, Chambers, Fayette, Montgomery and Pickens Counties.

Plot No.	FERTILIZER		SUSPENSION 1906		UNION SPRINGS Haynes, '08		FREDONIA 1905		NEWTONVILLE 1907		NEWTONVILLE 1908		NAFTEL 1905		GORDO 1906	
	Amount per acre	KIND	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot	Yield of seed cotton per acre	Increase over unfertilized plot
	Sbs.		*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1	200	Cotton seed meal ...	808	16	450	150	816	728	1090	650	336	72	608	72	880	256
2	240	Acid phosphate	872	48	580	20	888	200	1080	640	408	144	488	48	752	128
3	....	No fertilizer........	824	......	600	......	688	......	440	......	264	......	536	......	624	......
4	200	Kainit	856	37	740	180	912	152	1200	684	280	19	688	187	608	29
5	200 240	Cotton seed meal. Acid phosphate ..	1088	274	570	50	768	64	1320	728	272	14	336	130	688	38
6	200 200	Cotton seed meal . Kainit	984	175	630	150	192	288	1080	412	232	23	560	129	936	273
7	240 200	Acid phosphate .. Kainit	1000	195	540	100	1376	400	980	230	208	44	656	260	672	4
8	....	No fertilizer........	800	......	400	......	1048	......	820	......	248	......	360	......	688	......
9	200 240 200	Cotton seed meal . Acid phospaate .. Kainit	960	160	450	50	1256	208	1380	560	256	8	664	304	824	136
10	200 240 100	Cotton seed meal . Acid phosphate .. Kainit	1224	424	390	10	1096	48	1340	520	232	16	712	352	848	160

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

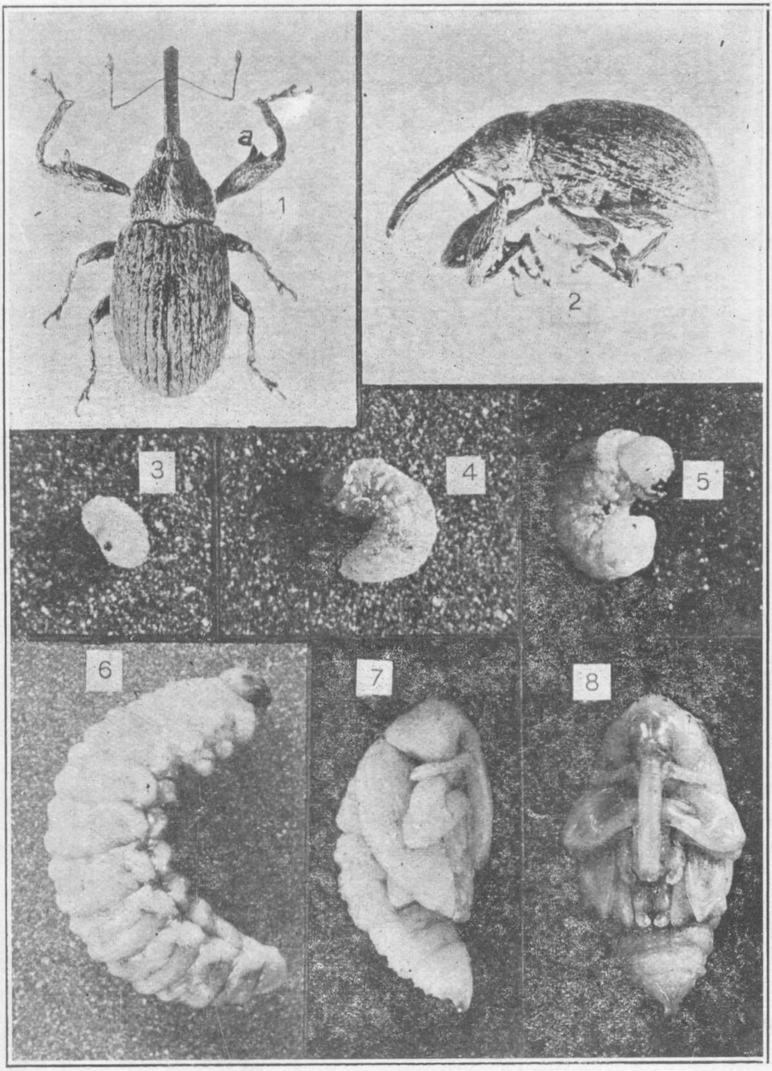
AUBURN.

FACING THE BOLL WEEVIL PROBLEM IN ALABAMA

BY
W. E. HINDS,
Entomologist

Opelika, Ala.:
The Post Publishing Company,
1909

PLATE I.



THE BOLL WEEVIL AND ITS STAGES.

Fig. 1, Adult boll weevil, viewed from above; *a*, two teeth on fore femur; fig. 2, adult weevil, side view; fig. 3, egg of weevil; fig. 4, grub about two days old; fig. 5, grub at entrance to second stage after shedding first skin, about three days old; fig. 6, grub fully grown, about ten days from egg; fig. 7, transformation or pupal stage, side view, snout, legs and wings forming; fig. 8, pupal stage, front view of fig. 7. Figs. 1, 2, 6, 7 and 8 enlarged about ten diameters; figs. 3, 4 and 5 enlarged about twenty diameters. (Original).

FACING THE BOLL WEEVIL PROBLEM IN ALABAMA

INTRODUCTION.

That within three years the Mexican cotton boll weevil will have entered Alabama is as certain as it is that cotton will continue to be produced in this and adjoining states before that time. The certainty that the cotton planters of Alabama will soon have to contend with an enemy more difficult to fight and more destructive to the crop than anything which they have ever been forced to face should be a matter of deep and immediate interest to every citizen of the state regardless of his occupation. If we shall meet this grave problem in a manner to result in a minimum of loss to all branches of commercial and professional as well as of agricultural life, it is essential that we improve to the utmost the few years which may intervene in direct and united preparation for the great changes in agricultural practice and in economic conditions generally which the presence of this pest has invariably caused wherever it has gone. We may well be willing to profit by the experience for which our sister States of Texas, Louisiana and Mississippi, particularly have paid so large a price. We should by all means begin immediately to put into active operation some of the fundamental improvements in agricultural practice which have been worked out during the past few years as a direct result of the fight against the weevil. If these practices are advisable and profitable anywhere with the boll weevil present they may be made even more so here and now before the weevil arrives. The great opportunity for gaining experience and determining the immediate applicability of any of these practices to our local conditions is evidently the period before the weevil comes and while we do not have to suffer the losses which it is very certain to inflict wherever it exists.

It may be pardonable in this case to mention a few personal facts which may enable the reader to judge of the writer's competency in this subject. From July 1, 1902, until September 30, 1907, he was engaged constantly and exclusively under the U. S. Bureau of Entomology in the investigation of the Mexican cotton boll weevil in Texas. The seasons of 1902, 1903 and 1904 were spent principally in South Texas where the weevil had been abundant for several years and where it was doing great damage. The seasons of 1905, 1906 and 1907 were spent in north Texas, in a region which was then but recently infested. In this work he was associated with Mr. W. D. Hunter who has been in direct charge of the boll weevil investigation from 1901 to the present time. The most important of the boll weevil publications are referred to in the Bibliography, see page 100.

Within the limits of this brief paper it is impossible to touch upon many of the important and interesting points in the discovery, introduction, life history and control of this insect.

It spread into the Southern part of Texas from Mexico about 1892 and from that time to this nothing has occurred to more than temporarily check its annual advance into new cotton growing country. Its annual spread is mainly by flight and cannot be prevented by human effort. The best that can be done is to guard against assisting in the spread of the pest and to do everything possible to avoid and to minimize the injury which its very presence involves. As soon as the weevil entered Texas it became apparent that the investigation of methods for its control constituted a National, rather than a State problem. Since 1901 Congress has been making special appropriations for the investigation of the boll weevil and from one to twenty trained men have been giving their time constantly to the study of this most serious problem. The writer was personally engaged in this work for more than five years. Naturally the damage which it has done has increased from year to year with the increase in the area infested. It is safe to say that the loss which it now occasions cannot be less than $25,000,000 each year, The National government has spent more than $1,000,000 in the investigations which have been made to discover effective methods of controlling the pest, and the various states affected have also expended large sums. The information and recommendations given in the following pages are gathered from the best that has been learned in this great struggle. A few of the important publications concerning the weevil are referred to in the Bibliography on page 100.

Since 1892 the weevil has spread Northward through Texas and the Southern half of Oklahoma and Eastward, crossing Louisiana, the Mississippi River and into Mississippi. From the infested territory each year it spreads ever onward as wave after wave spreads outward when a stone is cast into water. The old territory is not abandoned since only part of the host of weevils which is developed by fall will leave the field to seek new territory. Undoubtedly many fly back into previously infested fields where their presence is lost sight of but those which happen to fly into new localities quickly establish a new line of infestation which can be quite readily marked.

The distance through which they have thus advanced has averaged fully fifty miles each year. The first weevils crossed the Mississippi River in the fall of 1907 and during the fall of 1908 eighteen counties in the western part of that State became either wholly or partially infested. The area now infested constitutes more than one third of the cotton growing area of the United States and produces nearly one-half of the annual crop. The limits of the infestation, the relationship which this bears to the entire commercial cotton growing area, and the annual progress of the pest during recent years are plainly shown upon the accompanying map, Fig. 1, which was prepared by Mr. W. D. Hunter during the fall of 1908 from data collected by the numerous field agents of the Bureau of Entomology investigating the spread of the boll weevil.

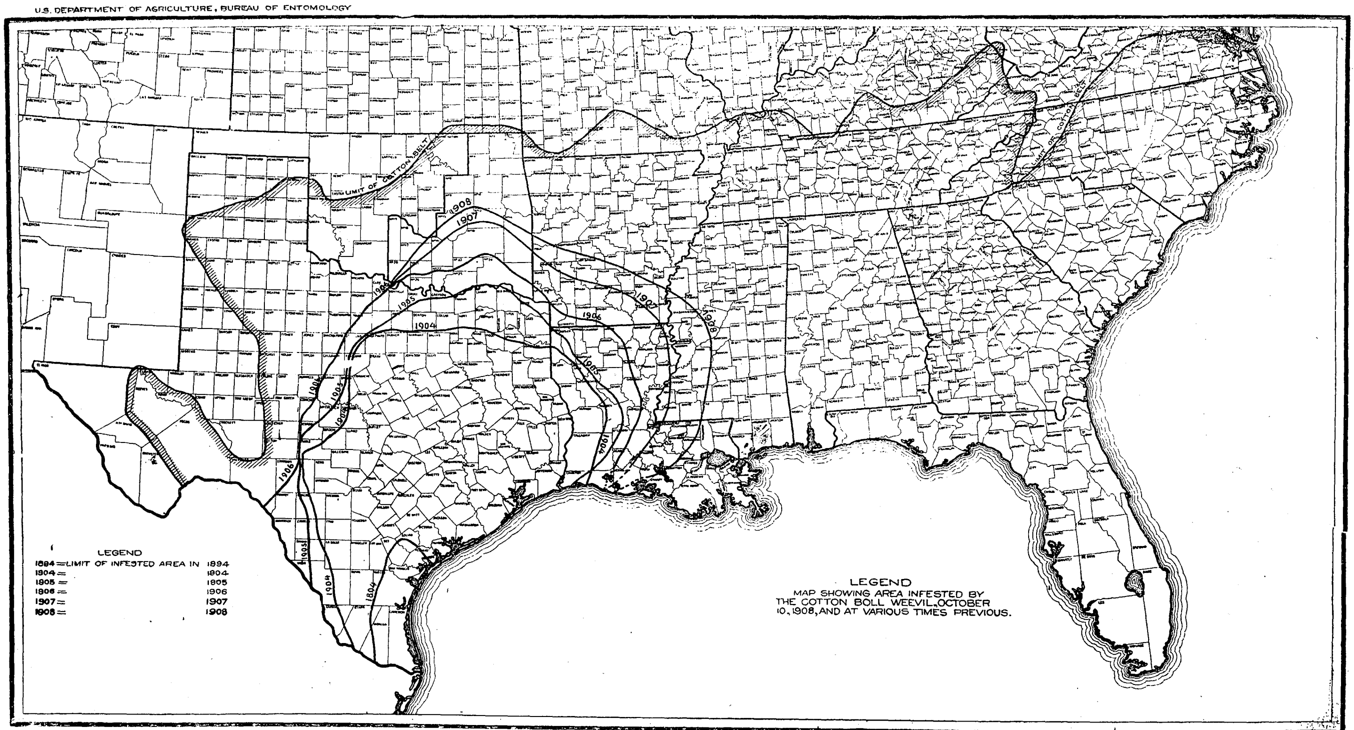


Fig. 1, The cotton growing area showing the area infested by the boll weevil during various years. (After Hunter, Farmers' Bul. 344.)

WHEN WILL THE WEEVIL REACH ALABAMA?

A brief study of this map with the facts stated relating thereto should be enough to convince anyone that the advance of the boll weevil will most certainly continue. The present northern limit of infestation is farther North geographically than is any portion of Mississippi, Alabama, or Georgia. The existence of the boll weevil depends primarily upon the occurrence of cotton which is its only known food plant. Besides its dependence upon this food supply the continued existence of the weevil depends also upon its ability to survive the winter climatic conditions in order to pass from the crop of one season to that of the next. The weevil has already shown that it can withstand successfully temperatures reaching nearly if not quite to Zero F. which is as low as is likely to occur anywhere in the cotton belt.

The eastward spread of the weevil therefore promises to be as certain and as rapid as was its northward spread through Texas and Oklahoma until ultimately it shall infest cotton wherever grown commercially in the Southeastern States. Its spread may be accomplished in two general ways.

In the first place the weevil will continue to spread by its own unaided flight which man is powerless to prevent. The entire area embraced within a line passing through the outermost points thus reached each year must be considered as constituting the "area of general infestation" although the weevil may not occur at many of the places included within but near the outermost edge of this area. The line referred to is "the line of general infestation" and this is what we reckon with in the annual spread of the boll weevil. It may be shown that this line has been steadily advanced through an average distance of about fifty miles each year. We may expect this rate to be maintained as the weevil continues eastward to the Atlantic Coast. From this basis we may easily and quite certainly determine that in two seasons more, that is by November 1910, we may expect the line of general infestation to reach the Mississippi–Alabama boundary. It is quite likely that some of the western tier of counties in this State may then become partially infested. It will require only about three years more for the weevil to spread over the entire State and to reach Western Georgia. Therefore we may consider it practically certain that throughout the western third of Alabama by the summer of 1911, through the central third by 1912, and through the eastern third by 1913, and in each case constantly after those dates, every cotton planter will have to reckon with the presence of the boll weevil and some degree of injury by it.

In the second place, we must consider that the boll weevil is *liable* to be brought into the State at any time ahead of the general infestation by the various methods of transportation, principally by railroads, with persons, household goods, cotton and its products, or with any other articles which may contain or shelter them. This danger naturally increases as the line of infestation approaches more closely. In numerous instances in Texas, Louisiana, Mississippi and elsewhere it has been clearly established that the weevil has been carried long distances in shipments of cotton seed from infested areas although fortunately it has not yet happened in the direction of uninfested territory. Infested cotton produced in the edge of the infested area has been hauled considerable distances beyond for ginning and planters bringing their cotton from other directions have carried away weevil-infested seed with them. Tenants and cotton pickers moving from infested to uninfested territory are very liable to carry weevils with them and thus establish new centers of infestation. These are among the considerations which have made necessary the establishment and strict enforcement of quarantine measures to guard against the accidental introduction of the weevil.

QUARANTINE REGULATIONS AGAINST THE BOLL WEEVIL.

Alabama passed such a law in 1903, and placed the enforcement of the act in the hands of the State Board of Horticulture, as at that time there was no special Entomologist connected with the State Experiment Station.

TEXT OF ALABAMA BOLL WEEVIL LAW.

AN ACT to prevent and prohibit the importation of seed from cotton affected with the Texas boll weevil.

SECTION 1. Be it enacted by the legislature of Alabama, That no person shall import or bring into the State of Alabama any seed from cotton affected with what is known as the Texas boll weevil, nor the seed from any cotton from any place where the cotton has been affected with said boll weevil.

SEC. 2. Any person who violates the provisions of section 1 of this Act shall be guilty of a misdemeanor, and on conviction shall be fined not less than ten dollars ($10.00) and not more than five hundred dollars ($500.00).

(H. 877, No. 559, approved Oct. 6, 1903.)

In addition to the above, the State Board of Horticulture organized by Act of the Legislature No. 121, approved March 5, 1903, has established regulations governing the shipment into and through the State of cotton products, packing materials, household goods, etc. The text of the regulations which are at present in force is as follows:

RULES AND REGULATIONS

GOVERNING THE IMPORTATION OF ARTICLES LIABLE TO CONTAIN THE MEXICAN COTTON BOLL WEEVIL.

RULE 11. In accordance with an act of the Legislature of the State of Alabama entitled: An act to Further Protect Horticulture, Fruit Growing and Truck Gardening, and to Exclude Crop Pests of all kinds in the State of Alabama, approved March 5, 1903; the following rules and regulations relative to the Mexican Cotton Boll Weevil were adopted:

(a) That in order to prevent the introduction of the Mexican Cotton Boll Weevil into the State of Alabama, a rigid quarantine is hereby declared against all infested localities in Texas or Louisiana, and of other sections that are or may hereafter become infested.

(b) That cotton lint (loose, baled flat or compressed) cotton seed, seed cotton, hulls, seed cotton and cotton seed sacks (which have been used) and corn in the shuck, originating in cotton boll weevil infested localities, shall be excluded absolutely from the State of Alabama.

(c) All shipments of household goods from infested areas shall be prohibited unless the same is accompanied by an affidavit, attached to the way-bill stating that the shipment contains no cotton lint, cotton seed, seed cotton, hulls, seed cotton and cotton seed sacks or corn in the shuck.

(d) All shipments of quarantined articles, mentioned in section (b) above, through the State of Alabama shall be made in tight, closed cars.

(e) No common carrier shall use for bedding, or feed for live stock, any of the quarantined articles when the shipments originate in regions infested with the cotton boll weevil.

(f) All railroads, steamboats, express companies and other common cariers, and all private vehicles, boats, etc., entering the State of Alabama from the states of Texas or Louisiana, or passing through the State of Alabama from any of the infested districts of the States of Texas or Louisiana, are especially enjoined to comply with the requirements of this order and of laws of the State of Alabama governing the same.

RULE 12. The State Horticulturist is hereby charged with the enforcement of the rules and regulations relative to the Mexican boll weevil.

The form of affidavit accompanying the waybill with shipments of household goods should specify the prohibited articles as not included, as follows:

State of...................., County of ....

Before me ....Notary Public in and for said State and County, personally appeared .... who being duly sworn states on oath that the shipment of .... waybill of which this affidavit accompanies, does not contain any cotton lint, cotton seed, hulls, seed cotton and cotton seed sacks or corn in shuck.

Sworn to and subscribed before me this......day of .... 190..

(Seal) .... Notary Public.

At the bottom of all law lies the general consideration that the safety and welfare of the public is more important than the convenience or interest of any private individual. It is certainly of public advantage that every possible precaution be taken to prevent needlessly hastening the spread of so dangerous an insect pest as this. The advance of the weevil will gradually transfer states, counties, and localities from the uninfested to the infested territory and thus reduce the area in which quarantine measures apply. Within five years, therefore, the boll weevil quarantine may become a thing of the past in this State. In the meantime it is of highest importance that we be able to definitely establish the limits of infestation and determine just where the application of the quarantine will do good instead of harm. Obviously no restriction of personal or commercial movement is justifiable or desirable if no protection or benefit may result. We therefore urge upon all concerns or individuals to whom the provisions of this quarantine may apply that they continue to give it their cheerful and complete support so long as may be necessary. More detailed information will be furnished all who may request it upon any specific points by the "Entomologist to the Experiment Station, Auburn, Ala."

DESCRIPTION OF THE BOLL WEEVIL.

It is of extreme importance that we learn of the presence of the weevil anywhere in the state as quickly as possible after its arrival. For information on this point we must necessarily depend principally upon the reports of cotton planters and others directly interested in this subject. As a rule we cannot depend for this information upon newspaper reports, even when these are vouched for by some planter who "came from the boll weevil country". With the boll weevil, as with most other insects, the ordinary casual observer fails to notice any but the most obvious characters on account of their small size. Therefore the characters noted are more than likely to be only those which are common to a group including hundreds of closely related species rather than those distinctive of a single species. By careful attention to the following brief description and to the illustrations given herewith we believe that the reader of average intelligence may be able to distinguish the boll weevil from the numerous other insects occurring on cotton, which are often mistaken for it (see appendix) and to recognize its attack on the plant with a reasonable degree of certainty. In any case of doubt specimens should be sent immediately in a strong, tight, tin or wooden box, with a letter of explanation to the Entomologist, Alabama Experiment Station, Auburn, Ala. He will gladly determine such specimens and report to the sender entirely free of cost.

The boll weevil is a beetle belonging to a large group, all of which are characterized by having part of the head in front of the eyes greatly extended to form a long slender snout. There are many hundreds of species of these insects, all of which are commonly called "weevils", but the Mexican cotton boll weevil is the only one of these many species which is at all serious as an enemy of cotton. While other species may be found upon cotton plants, their occurrence there is mainly accidental. Rarely indeed does any other species breed upon cotton. The boll weevil breeds upon cotton and upon nothing else. Like all other beetles the boll weevil has four distinct stages in the development of each individual. These are the egg (Pl. I, fig. 3), which is only about 1-30 of an inch long, white and delicate. This is always deposited in a cavity which the female eats in the square or boll and upon no other part of the plant. From the egg there hatches in a few days a white, legless grub or worm (Pl. I, figs. 3–6) which does not at all resemble the beetle which it may finally become. The grub of the boll weevil resembles very closely that of the "plum curculio" which is so familiar a pest in peaches, plums, cherries, etc., working in the fruit and usually around the stone. The boll weevil grub grows steadily from its initial length of about 1–25 of an inch until it becomes fully grown and measures from 1–5 to 2–5 of an inch in length. The body is strongly curved in the form of a crescent, in this respect being more curved than the "worm" in peaches, etc. (Pl. I, fig. 6.)

In order to attain the beetle form the grub must pass through an intermediate "transformation stage" which is known as the "pupa." (Pl. I, figs. 7 and 8.) In this stage no food is taken, and there is a complete change of the appearance and of structure. The grub sheds its skin and instead of the legless, wingless, snoutless worm, the pupa appears with all of these organs forming in sheaths closely applied to the body. In this stage the insect is very delicate, and perfectly helpless. It, as well as the egg and grub stages, is passed wholly within the interior of the square or boll. These three constitute the immature stages in the life of the weevil, but are as characteristic of the insect as is the adult form.

After a few days the pupa sheds its skin and becomes the fully formed adult weevil as shown in Pl. I, figs. 1 and 2, having the legs and snout free and usable, as are also the wings, which are folded back, under and protected and hidden by, the hard wing-covers, which meet in a straight line over the middle of the back of the beetle. For a few days the adult also remains protected within the square or boll while it becomes hardened and more able to care for itself. It then cuts a circular hole just the size of its body in the wall of its cell in the square, and through this opening makes its escape into the outer world, where from that time on it leads a free and active life.

The adult weevil, therefore, is the form most commonly seen around infested cotton, and this stage needs a more detailed description. The full grown weevils vary considerably in size and in color. In length they range between 1-8 and 3-8 of an inch, while the breadth of the body is approximately 1-3 of its length. The general color is uniform over the body and varies from a chocolate brown in the darkest specimens, which are usually below average size, to a grayish or yellowish brown in the lighter colored larger forms. The lighter colors are due to light colored scales or modified hairs which occur most abundantly in the larger specimens. If these are undeveloped or become rubbed off, then the dark brown ground color of the weevil appears. The slender snout is only slightly curved and is about 1-2 as long as the length from the head to the tip of the body. Neither the size, nor the structure or general appearance of the weevil changes at all after its emergence from the square or boll in its adult form. The adults feed and mate and the females then deposit eggs. This completes the "Life Cycle" and starts another generation all within a period of from three to four weeks.

THE EFFECT OF WEEVIL WORK ON COTTON.

The recognition of the presence of the boll weevil may depend upon the identification of the adults or the immature stages in squares and bolls or just as certainly upon the recognition of its feeding injuries or the effect of its work upon the fruiting of the cotton, as these are also characteristic. No other insect produces at all similar injuries to cotton.

The excrement deposited by the adult weevils on the squares upon which they work is of a bright orange color and so forms a conspicuous sign of boll weevil presence. The egg punctures, like those made for feeding, are eaten out but are only made large enough to receive the egg which is placed just inside of the floral coverings and usually near the base of the bud. The natural tendency of the green parts of plants to heal wounds in which decay does not occur causes a growth of plant cells to more than fill the canal leading to the egg cavity. The excess of this growth bulges outward so that it forms a distinct "wart". This "wart" is therefore characteristic of a boll weevil egg puncture. As the grub feeds and grows inside the bud it destroys the very heart of the square, until when about half grown its injury thereto becomes so great as to cause the destruction of that bud. The leaflets enclosing the bud spread apart, or "flare" as it is called, and the whole square turns yellow, wilts and is shed as are leaves when they can be of no further use to the plant. It is Nature's surgery in removing a diseased and useless member. Upon the ground the development of the grub continues and its transformation through the pupal stage to the adult beetle takes place. Practically one-half of the developmental period is spent in the square on the plant and the other half in the square after it has fallen to the ground. Badly infested cotton produces few, if any, blooms, while the infested squares shed by the plant as fast as they form are thickly scattered beneath it on the ground. Squares may be shed as a result of adverse cultural or climatic influences, but when shed from such causes they show no signs of weevil or other insect injury such as have been described.

RECOGNITION OF THE WEEVIL.

We may summarize briefly the most important characteristics upon which we may depend for the prompt recognition of the weevils' presence in Alabama:

1. The adult beetles (Pl. I, figs. 1 and 2) probably found on cotton only, are about 1–4 inch long, with slender, slightly curved snouts, of dark brown, ashy-gray, or yellowish brown color.

2. The crescentic grubs (Pl. I, fig. 6) about 3–8 inch long and the pupal stages (Pl. I, figs. 7 and 8) occur only in squares and in bolls. This is the only insect which breeds in this way in cotton.

3. The occurrence of open cavities 1–16 to 1–20 inch in diameter and reaching down to larger excavations among the pollen sacs, the presence of "warts" marking the egg punctures of the weevil, the occurrence of the orange–colored excrement on the buds, the abundant shedding of squares and the consequent scarcity of blooms without accompanying rain or cultural conditions to cause the shedding; these are among the most conspicuous signs of boll weevil presence and injury.

Whenever any specimens of weevil or cotton squares or bolls showing weevil stages or the signs of their work are discovered anywhere in Alabama in advance of the general infestation by the weevil, it is of the utmost importance that they be immediately submitted to the Entomologist, Auburn, for positive identification. We must depend upon the hearty co-operation of cotton planters in this work, as upon the promptness with which the first occurrence of the weevil in a locality is discovered and reported to the Entomologist

depends entirely the possibility or advisability of undertaking any measures for the extermination of the weevil which might prevent the infliction of damage to that locality for several years before it would necessarily occur through coming within the area of general infestation.

Undoubtedly during the next few years local newspapers, as well as the leading papers of the State, will frequently receive reports of the occurrence of the boll weevil in their vicinity. Editors, before publishing such items, should secure specimens and forward them to the Entomologist and await his report as to their genuineness. Published statements, if untrue, can only do harm among their readers, and for a time the harm will be as great as though they were true, as they will affect all agricultural and business interests. This is too serious a matter to permit of the creation of undue excitement through the circulation of misleading impressions. The situation should be faced calmly, intelligently and courageously to safeguard the best interests of all who may be affected by whatever effects the production and sale of cotton. If faced in this spirit there is absolutely no need for the existence in Alabama of the feeling of "panic" which has heretofore accompanied the weevil during the first few years of its occupation of new territory.

HOW THE BOLL WEEVIL MAY BE SUCCESSFULLY CONTROLLED.

The great difficulty in fighting the boll weevil has arisen from the fact that the peculiar habits of the adult and the protection of the immature stages within the squares and bolls render it practically useless to attempt to destroy them by any usual methods of insecticidal treatment. Hundreds of remedies have been tested and found ineffective for the above reasons, if for no others. As in human warfare, one of the most effective measures of subduing an enemy consists in destroying their food supplies, so it is equally true in the case of an insect which is dependent upon one species of food plant as is the boll weevil. That the weevil can be effectively controlled and the culture of cotton continued at fully as great profit as has usually been realized without the weevil, has been proven possible through the practical application in many thousands of cases in the weevil area of improved methods in cotton culture and in general agricultural practice. Some of these measures take advantage of and increase the effectiveness of certain factors of natural control. Most of them, however, are merely **steps in a system of cotton culture** which prepare the way for the application of the **one most effective direct method of destroying immense numbers of weevils by cutting off their food supply at the only season of the year when the destruction of cotton is possible, practicable and most effective in reducing the number of weevils. The final step is the complete destruction of all green cotton at least three or four weeks before the usual date for the occurence of the first killing frost in the fall.** This has often been called the most important single step in the cultural system of controlling the boll weevil. It may seem to many that it cannot be successfully applied under the conditions existing in Alabama. That has been claimed also in Texas, Louisiana and elsewhere, but it has been found always that **it is possible under almost all conditions if the necessary steps leading up to it are also employed.**

We must remember that the presence of the boll weevil inevitably produces a change in the conditions of cotton growth. Practically, there can never be "late cotton" in the infested area. The only portion of the crop to escape the weevils and mature is that which develops early in the season before the weevils have reached their maximum abundance. Therefore the very presence of the weevil tends to limit cotton production to the early crop and to clear the way for the proposed and necessary destruction of the stalks.

The effectiveness of this practice has been most positively established by the repeated experience of planters on large as well as upon small scales, and also through Nature's object lessons whenever through the effects of unusual climatic conditions or when by the defoliation of the plants by the cotton leaf caterpillar or cotton worm there has resulted the practically complete destruction of cotton at an unusually early date in the fall. In every such case the fall destruction has been followed by larger crops, less weevil injury and a great increase of net profit in the crop of the following year.

We have not room in this paper to give details regarding any of these great demonstrations, but can merely state that in many cases where the work has been conducted most carefully with adequate checks **the value of the increase in the crop on the area where stalks were destroyed has been from $15.00 to $20.00 per acre, as compared with the yield on the check areas on which the stalks were allowed to stand until the usual time of preparation for planting in the spring. In all other respects both areas received similar treatment and were grown under like conditions.**

STEPS IN THE CULTURE OF COTTON FOR CONTROLLING THE BOLL WEEVIL.

The immediate adoption of such improved agricultural practices, as rotation and diversification of crops, better culture and more careful selection of seed for cotton **as soon as the weevil is known to be within less than 100 miles of any locality.**

In order to practice early destruction of stalks it is essential that part, at least, of the other steps be also adopted as they are of prime importance in leading up to the early maturity of the crop. It is impossible for us here to attempt to describe these steps at all fully. Much more can be learned regarding them from a study of the publications referred to in the brief Bibliography on page 100.

If we begin this work for the control of the weevil in the fall, as is desirable for securing its greatest effectiveness, it may involve the sacrifice of a small amount of cotton from the late maturing bolls. It is not necessary to make this sacrifice until the first year that the weevil is likely to reach the locality. After that time the possible loss of a few pounds of "scrappings" should not be allowed to count as against the necessity for and larger benefits of early destruction.

Destruction of Stalks.—The best method of destroying the stalks is by uprooting and burning them. The roots, if cut, should be cut below the surface to prevent their putting out sprouts later. The plants should be thrown into windrows or piles while still green so that the leaves, squares and bolls may not be scattered but will remain on to assist in the early burning of the stalks and also because it is desired to destroy immediately the immature stages which may be present. Sometimes it will be found worth while to apply crude oil to faciliate the burning before the stalks have time to fully dry.

Advantages of Early Burning.—1. It stops absolutely the development of weevils late in the fall by destroying the immature stages then present in squares and bolls. 2. By the complete removal of their only food it forces the dispersion and starvation of the weevils already adult. Obviously the longer the period between the destruction of all green cotton and the occurrence of the first killing frosts, at which time the weevils may go into winter quarters with most assurance of survival, the more complete will be the destruction of the adults. 3. It removes a large amount of rubbish within which those weevils which escape destruction would find the most favorable conditions for their successful hibernation. 4. It prevents the development of adults emerging shortly before frost. These are the weevils which ordinarily stand the best chance of living through the winter. Where one weevil may live through the winter if stalks are destroyed by the 15th to the 20th of October, there will be at least ten survivors if the destruction of stalks is delayed until the middle of November. There is a constant increase in the percentage of survival between these dates.

Preparation of the Land for Cotton.—This should be more thorough than is usually given. On light soils fertilizers are needed for cotton, and those containing a relatively large percentage of phosphoric acid tend to promote the early maturity of the crop.

Planting.—Let this be done as soon as danger of frosts is passed. Early planted cotton invariably does better than even medium planted where the weevil occurs. It is desirable that the planting in a locality should be done as near the same date as possible, so that all of the cotton will be coming on together. The weevils thus have no chance to get a start upon any of the fields. Plant the rows at such distance apart as has been found to give best yields in any field.

Chopping.—Chop to a stand early, as this gives the plants that are left a better start. Space the plants as has been found best for yield in any field.

Cultivation.—This should be frequent and shallow. Its first object is to keep the soil in favorable condition for producing a steady and rapid growth of the crop. The destruction of weeds is accomplished incidentally. The surface crust that may form after rains should be broken up as soon as possible.

HARVESTING.—Let this be done as quickly as the bulk of the crop is open. Every effort should be made to have ready the necessary labor supply for this work as soon as it may be done. Remember always the need for keeping a winter cover crop on the soil and for clearing the way for the early destruction of the stalks. The earlier these may be destroyed the better. **Their destruction constitutes the last step in dealing with the cotton crop each year where the boll weevil is present and is also the first step in preparation for the next crop of cotton, even though the cotton may occupy some other field through the system of rotation.**

CONCLUSION.

We hope that we have made plain that the coming of the boll weevil is assured, and that we shall very soon have to reckon with it constantly in the culture of cotton. We hope also that what we have said may help the cotton planters of the State to face this serious question more intelligently and more courageously than they would otherwise have done. In spite of the admittedly serious nature of the weevil as an enemy of cotton, there is no need for a "feeling of panic" if the recommendations given herewith are put into practice immediately. Their general application will improve the conditions of farm life, increase the value of farm property and multiply profits to both owners and tenants. In most sections where the weevil has already gone there have been heavy losses during the first two or three years of infestation because planters have been slow in adopting just the changes in cotton culture which have been outlined herein. They have thought at first that they were perfectly familiar with the best methods of raising cotton, and that no "scientists" could tell them anything about it. As a result, they have been finally forced to give up cotton altogether, or to adopt part, at least, of the methods which have been described. With the adoption of the improved practices the control of the boll weevil has ceased to be an exceptionally serious problem, and they have found that in this way it is entirely possible to raise as much, or even more, cotton per acre as they were accustomed to raise before the coming of the weevil. The diversifying of crops has helped to make the farmers of the boll weevil area more independent of cotton as a single crop, and in many sections they are now more prosperous than ever before. In many respects the advent of this pest has resulted in greater final benefits than its injuries, and there has been brought about within five years a greater agricultural development than would have been likely to have come in two or more times as long but for the coming of the weevil.

If it shall lead to the immediate application of many of the improvements herein recommended, then the coming of the boll weevil shall bring a blessing and not a curse to this State. May every agency be united in a helpful co-operative campaign of progressive education that shall prepare us to best meet and to most effectively overcome the boll weevil in Alabama.

BIBLIOGRAPHY.

This is intended to be only a very partial list of the publications relating to the boll weevil, but to include those available which may be most useful to the planters of Alabama.

Publications of United States Department of Agriculture, Bureau of Entomology, Washington, D. C.

Bulletin No. 51. The Mexican Cotton Boll Weevil. Hunter & Hinds. 181 pp. Published 1905. (Write your Congressman for a free copy.)

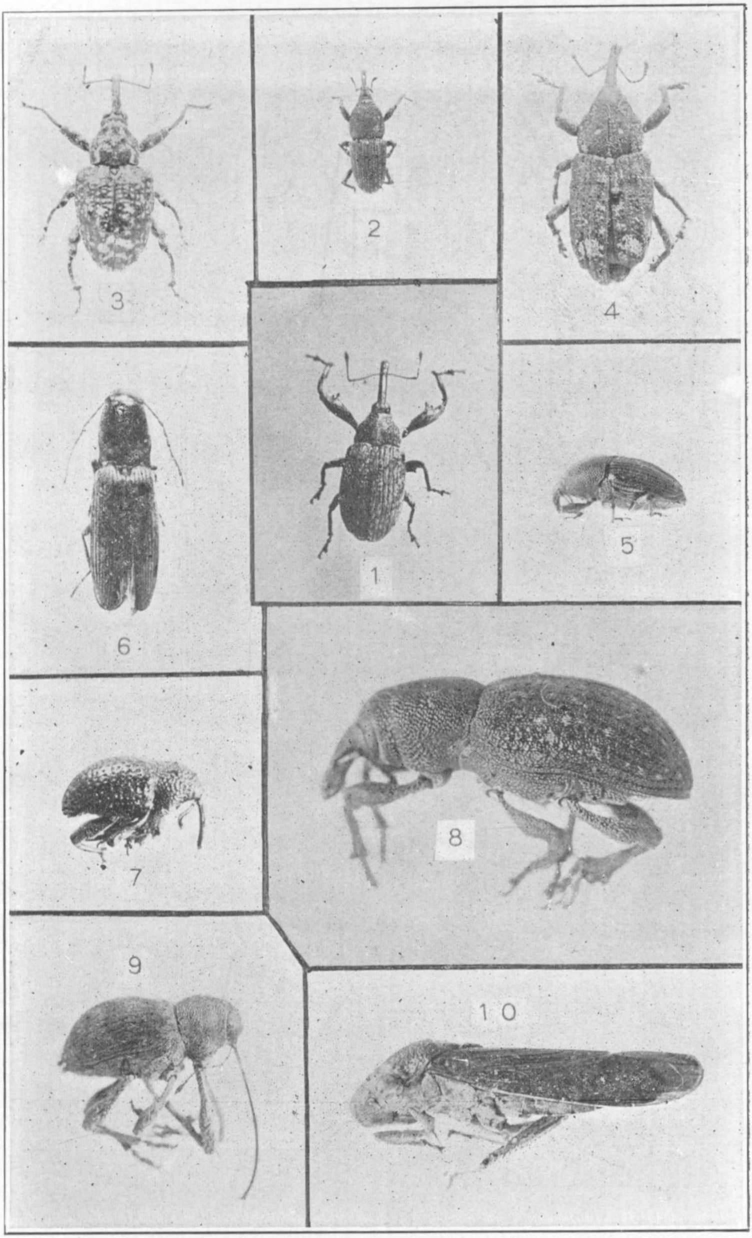
Bulletin No. 74. Some Factors in the Natural Control of the Mexican Cotton Boll Weevil. Hinds. 79 pp. Published 1907.

Farmers' Bulletins Nos. 47, 130, 163, 189, 209, 211, 216, 217, 223, and 344.

(All of the above relate to cotton insects, the boll weevil or to cotton culture, and may be obtained free upon request to the Department.)

Publications of Louisiana Crop Pest Commission, Baton Rouge. La. Circulars 8 and 23.

PLATE II.



INSECTS OFTEN MISTAKEN FOR THE BOLL WEEVIL.

Fig. 1, Boll weevil (*Anthonomus grandis Boh.*); fig. 2, rice weevil which breeds abundantly in corn (*Calandra oryzae* Linn.); fig. 3, plum curculio (*Conotrachelus nenuphar* Hbst.); fig. 4, white pine weevil (*Pissodes strobi* Peck.); fig. 5, transverse Baris (*Baris transversa* Say); fig. 6, a click beetle (*Monocrepidius vespertinus* Fab.); fig. 7, cow pea pod weevil (*Chalcodermus aeneus* Boh.); fig. 8, Pales weevil (*Hylobius pales* Hbst.); fig. 9, an acorn weevil (*Balaninus* sp.); fig. 10, sharpshooter (*Homalodisca triquetra* Fab.). All enlarged about five diameters. (Original.)

APPENDIX

The Mexican Cotton Boll Weevil and Some of the Insects Most Frequently Mistaken for it.

For the sake of facilitating comparisons a figure of the boll weevil is included on Plate II. Fig. 1. All figures have been taken at the same magnification of approximately four diameters.

In this list the "rice weevil," (*Calandra oryzae* Linn), Pl. II, fig. 2, has been included not so much because it has been, or may be, mistaken for the boll weevil, as because its size and general appearance may be more familiar to the general reader than any of the other species mentioned. A comparison of the adult insect with the illustration may aid in conveying a more correct conception of the other less familiar species. This weevil breeds very abundantly in corn, but does not injure cotton.

The "plum curculio", (*Conotrachelus nenuphar* Hbst.), Pl. II, fig. 3, which attacks peaches, plums, etc., very commonly, is about the size of the boll weevil but is much darker in color with markings of white or light colored scales on its back and legs. It has a shorter, more strongly curved snout and but a single tooth upon the thigh of the fore legs. It never attacks cotton.

The "white pine weevil", (*Pissodes strobi* Peck.), Pl. II, fig. 4, occurs in Alabama and must attack also some southern species of pine. The body is longer and more cylindrical, while the snout is relatively much shorter than in the boll weevil. Its wing-covers bear each a prominent white spot toward their tips.

The "pales weevil", (*Hylobius pales* Hbst.) Pl. II, fig. 8, is another species which attacks pine. It is a large species, being from 1-3 to 1-2 inch long. Its color is a dark brown with small spots of light colored scales scattered over the wing-covers. This species is very common in Alabama.

The "cow-pea pod weevil," (*Chalcodermus aeneus* Boh.), Pl. II, fig. 7, is often taken on cotton following a crop of cow peas in the same field or near vicinity. It is the only one of the species mentioned herewith which may do some slight damage to cotton. It sometimes feeds on the young cotton plants, boring into the main stems or leaf stems and causing the death of leaves and tips, but there is only one record of its having bred in a cotton square. The adults are shining black in color, somewhat shorter and more stoutly built than is the boll weevil, and the back of the body shows numerous small, circular pits arranged in several rows along the wing-covers.

The "transverse Baris", (*Baris tarnsversa* Say), Pl. II, fig. 5, is a small, black weevil much shorter, broader proportionately and flatter than the boll weevil. Its snout is very short and strongly curved. This species breeds in the roots of cocklebur, and the adults occur accidentally upon cotton as may another closely related and similar appearing species that breeds in the roots of ragweed.

There are several species of "acorn weevils" belonging to the genus Balaninus. One of these is shown in Pl. II, fig. 9. All have very long, slender snouts, sometimes even longer than the body. All breed in acorns, and are often attracted to lights, as the boll weevil never is.

Some of the "click beetles" have a habit of hiding during the day in cotton squares, and are therefore mistaken for the boll weevil, although they do not resemble it in the least. One of these (*Monocrepidius vespertinus,* Fab.), Pl. II, fig. 6, is most commonly mistaken. In its early stages it lives on the roots of grasses in the cotton field, and the adult hides around the plant, but it does not attack cotton at all. These are all long, slender, flat–bodied beetles which, if turned over on their backs, will spring into the air with a "click" and thus regain their footing.

The last species that we have space to mention here is a bug belonging to a group of insects known as "leaf hoppers". These insects have the habit of sucking sap from the stems of plants and may occur on cotton where they have sometimes been called "sharp–shooters". These are grotesque insects which do not resemble the boll weevil at all. One species, (*Homoladisca triquetra* Fab.), is shown in Pl. II, fig. 10.

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AUBURN

CRIMSON CLOVER

BY

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CRIMSON CLOVER

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SUMMARY.

Crimson clover is an annual soil-improving plant. It suits most soils in Alabama. The seed are sown in September among the growing plants and covered.

The plants in early bloom can be plowed under about April 1, as a fertilizer for cotton, corn, sweet potatoes, or other summer crop; or the clover can be cut for hay in the latter part of April and the stubble used as fertilizer.

The yields of summer crops following the plowing in of either the entire growth, or merely the stubble, of crimson clover have been much greater than where no crimson clover has been sown.

The condition most essential to success in growing crimson clover consists in inoculation. This is most certainly effected by sowing with the seed as much as practicable of the soil from a spot where crimson clover, red clover, white clover, or annual white clover, has recently grown successfully. The last mentioned occurs in nearly all parts of Alabama, but is not easy to find after May, when its white heads turn brown and the plant dies.

White clover and annual white clover can usually be found in old lawns and spots in pastures. Both are low plants with white heads on the end of the short flower stem, and both have leaves consisting of three roundish or heart-shaped leaflets each about the size of the finger nail of one's little finger.

Soil from lespedeza (Japan clover) does not inoculate crimson clover.

Soil has been found to be a more reliable method of inoculation than the use of artifical inoculating material, called pure cultures.

INTRODUCTION.

The most urgent need of southern agriculture is the enrichment of the soil. To improve southern soils the principal additions needed are (1) vegetable matter and (2) nitrogen. Crimson clover adds both vegetable matter and nitrogen to the soil on which it grows. In fact, this method of improving the soil by the growing of crimson clover seems to be the most generally practicable method that can be put into immediate effect by southern farmers. This is partly because crimson clover is suited to a wide range of soils, because usually the seed are cheap, and because the seed can be sown in September among the growing cotton plants without special preparation of the soii.

During each of the last fourteen years numerous experiments have been made at Auburn, both on gray sandy soil (Norfolk sandy loam) and on reddish loam (Cecil series). In addition to these accurately conducted experiments, tests have been made by farmers throughout the State under the direction of the writer. Many of these local tests, especially during the past few years, have been made in co-operation with the Bureau of Plant Industry of the U. S. Department of Agriculture. The conclusions here presented are based chiefly on experiments at Auburn and on local tests in Alabama, full data for which would be too voluminous for recording in this bulletin.

WHAT CRIMSON CLOVER IS.

Crimson clover is also known as scarlet clover, and its botanical name is *Trifolium incarnatum*. It is an annual plant, making its growth between September and May. The seed must be sown each year, for while this plant seeds freely here, yet these seed on dropping to the ground in May and June, germinate promptly, and the young plants are killed by the heat of summer. Crimson clover produces abundant crops of seed and farmers can save their own seed. To do this the seed must be flailed or threshed from the plants, and the seed still in the chaff sown without recleaning.

Crimson clover is a leguminous plant, or legume, and is ranked with the other cultivated legumes, cowpeas, velvet beans, vetches, red clover, etc., as a soil-improving plant.

HOW CRIMSON CLOVER IMPROVES THE SOIL.

Crimson clover improves the soil on which it grows by the following means:

(1) Since it grows during winter, its roots utilize any nitrates or other soluble plant food which would be washed or leached from the soil.

(2). On account of its winter growth it decreases surface washing of the soil.

(3). When either the stubble or the entire plant is plowed under, vegetable matter of a kind that readily rots is added to the soil.

(4). Crimson clover, like all the other soil-improving legumes, is able, when properly grown, to take nitrogen from the air to add it to the soil.

HOW LEGUMES ADD NITROGEN TO THE SOIL.

Crimson clover, like cowpeas, when grown under proper conditions, adds much nitrogen to each acre of soil. It takes this nitrogen from the air, where it is unavailable to corn, cotton, and most other farm crops. The only cultivated plants that can thus utilize the free nitrogen of the air for their own growth and for subsequent soil enrichment are the legumes, or leguminous plants, such as cowpeas, clovers, vetches, etc. Even these legumes cannot make use of the nitrogen of the air and cannot improve the soil except when they bear on their roots certain enlargements or bumps, called *tubercles or nodules*. (See Fig. 2.) Familiar examples of nodules are the roundish enlargements on the roots of cowpeas. Tubercles may be regarded as fertilizer factories for the manufacture of fertilizer nitrogen from the unlimited quantities of free, or gaseous, nitrogen in the air above. The air penetrates all cultivated and drained soils and thus comes into contact with the tubercles on the roots of leguminous plants, where it is used as the raw material for the manufacture of fertilizer nitrogen, an element which costs 15 to 18 cents a pound when bought as cotton seed meal, nitrate of soda, ammonated guano, etc.

INOCULATION.

The interior of these tubercles is swarming with microscopic life, called germs or bacteria. These bacteria, which belong to the vegetable kingdom, may be regarded as the workmen in these fertilizer factories. A tubercle does not develop on the roots of any legume unless the right kind of germ, suited to that particular kind of plant, is present on the seed sown or in the soil, ready to enter the tiny root. For example, the writer has examined scores of samples of crimson clover plants from all parts of Alabama that had no tubercles on the roots. These clover plants without tubercles, were dwarfed, pale or yellowish, and showed the crop thus grown without tubercles to be complete failures. The greater part of several hundred failures with crimson clover which the writer has investigated have been found to be due to the absence of tubercles. (See Fig. 1.)

Failures of this character need not occur. There is a simple, invariably remedy. It is called *inoculation*. Inoculation of this kind means the supplying of suitable germs to the seed to be sown or to the soil where crimson clover is to be grown, so that these germs thus supplied may penetrate the roots of the young plant and cause tubercles to develop. If the proper germ for causing tubercles on clover be present in the soil there will be no need of artificial inoculation.

However, large numbers of local tests under our direction made in almost every county in Alabama, lead to the conclusion that throughout most of Alabama the clover germ is not already present in the soil. But this germ is present in soils where any true clover has grown for several years and borne tubercles. Hence, the surest method of inoculating crimson clover consists in sowing on the field where this legume is to grow some soil taken from around the roots of any true clover. One may use the upper two or three inches of such soil. The true clovers may be known by the fact that they bear their seed in compact heads at the tip of the flower stem. This excludes Lespedeza, commonly called *Japan clover,* which in our tests *has proved unable to inoculate crimson clover.*

SECURING INOCULATING SOIL NEAR HOME.

Among the clovers, from spots of which the earth may be taken to inoculate crimson clover, are the following:

FIG. 1. *On the left, inoculated plant with severed root, showing tubercles; on the right, an average plant from an adjacent plot, not inoculated; there are no tubercles on the smaller plant.*

Crimson clover, red clover, white clover, and annual white or Carolina clover. Fortunately, careful search in April will usually be rewarded by finding the annual white clover in practically all parts of the State, in old lawns, old pastures, along roadsides, etc. Unfortunately, this clover dies in May, the white heads changing to brown and the plants soon disappearing until the next winter, or showing only a mass of short, slender, dead stems against the ground under the Lespedeza, or other summer growth.

White clover is not so widely distributed as the annual white clover, but the former may be found even up to midsummer in some parts of the State in old lawns and in old pastures where the soil is rich and moist.

DIRECTIONS FOR INOCULATING SOIL OR SEED.

The details of inoculation may vary according to the amount of soil available. If there is an abundance of soil it is only necessary to sow, immediately after the sowing of the seed and before covering the latter, at least one ton per acre of the inoculating soil. This method of inoculation may be made even more effective by combining it with the following method:

When there is only a limited amount of soil a gallon or more of it should be stirred into two or three times as much water; the seed should be thoroughly moistened with, or dipped into, this water and dried by mixing with another part of the very dry inoculating soil. Whatever soil remains should be sown broadcast before the seed are covered. This method is not well suited to seed as small as those of crimson clover. In this way a few pecks of suitable soil may partially inoculate the seed for an acre. A part of the seed would escape inoculation and plants from these would be small; the thinner stand of vigorous plants thus obtained would make the inoculated plants spread out more and grow not so tall as they would in a thick stand with all plants bearing tubercles. If much less than a ton of pulverized inoculating soil is used, one need expect only a *partial success* with crimson clover the *first year*. By sowing seed a second year in succession on such a partially inoculated soil, without further inoculation, the second crop should be thoroughly inoculated.

START AT ONCE ON A SMALL SCALE.

The importance of getting a start of a small area thoroughly inoculated is obvious when we remember that soil from such a spot will suffice the next fall to inoculate several hundred times as large an area. Those who find any difficulty in securing any considerable amount of soil from a spot of red, crimson, white, or annual white clover, should sow only a small area of crimson clover, say one quarter or one acre. No pains nor expense should be spared to get this thoroughly inoculated by using a liberal amount of inoculating soil. This area should be fenced against stock. It may even be lightly dressed with stable manure, after the plants are well up, though this is not necessary nor practicable on large areas. This "starter" patch should not be located in an old garden spot, for fear of possible presence there of nut grass, root-knot organisms, or germs of plant diseases, which would thus be scattered over the entire farm in the soil from this spot used in future to inoculate larger areas. Especially avoid for this "starter" patch any spot where black-root, or wilt, of cotton occurs, or where cowpeas die permaturely, or where there are root-knot swellings on the roots of cotton, turnips, etc. Too much care cannot be taken to ascertain that the spot selected for a "starter" patch is free from all plant diseases.

This does not entirely prohibit the growing of crimson clover where certain plant diseases occur, provided the soil from such spots be not carried elsewhere as inoculating material. Crimson clover may again be sown the second fall on the area used the year before as a starter, not repeating the inoculation.

In brief, start with an area so small that it can be thoroughly inoculated; and, especially if it proves to be only partially inoculated, again sow crimson clover there next season.

After one crimson clover crop, *well inoculated* as shown by abundance of tubercles, grown for one season on the "starter" patch, use soil from this to inoculate larger areas. Or, the next April locate in pastures, etc., spots of annual white clover in bloom, and place stakes at each corner of such spots, so that inoculating soil from these spots can be used the following September when the annual white clover is dead.

WHAT SOILS DO NOT NEED INOCULATION.

To sow crimson clover without inoculation means on most soils in Alabama complete failure. However, there are a few fields that do not require it. Such are fields where there have been, in the preceding year or two, successful growths of red, or crimson, or white, or other true clover, (not lespedeza).

BENEFITS OF INOCULATION TO CRIMSON CLOVER CROP.

There are two, viz., (1) increase in the yield of crimson clover, and (2), increased fertilizing effect of crimson clover, as shown in yields of subsequent crops of corn, sorghum, etc. All the experiments here mentioned were made on the Experiment Station Farm at Auburn. In all those mentioned in this section the inoculating material was soil from an older crimson clover field, applied broad-cast at the rate of at least one ton per acre at the time of sowing the seed.

In May, 1903, on reddish sandy upland loam soil (Cecil series), where a moderate dressing of stable manure had been used on the preceding crop of small grain, the yields of crimson clover hay were as follows:

Inoculated	6100 lbs. per acre
Not inoculated	000 lbs. per acre
Gain from inoculation	6100 lbs. per acre

The inoculated plants were green, tall, and their roots were abundantly supplied with tubercles. The plants not inoculated were yellowish, not branched, two to four inches tall and there were no tubercles on the roots. There was not enough for cutting with scythe or sickle. Fig 1 shows the contrast between typical inoculated and non-inoculated plants.

In the fall of 1908, on poor, whitish, sandy, upland soil (Norfilk sandy loam), although too late for best success, a plot of crimson clover was inoculated with soil from an older crimson clover field, and another plot left without inoculation. These plots were not harvested, but the marked difference in appearance were as follows: The inoculated plants were green, thrifty, about 14 to 16 inches tall, and their roots were covered with tubercles; the yield was estimated at about one ton of hay per acre. The plants not inoculated had no tubercles, were yellowish, and had but one or two stems per plant, and were not tall enough to cut, most plants dying before blooming, or blooming at a height of only 2 to 6 inches.

PURE CULTURES, OR ARTIFICIAL INOCULATING MATERIAL.

In August, 1897, and in August 1898, the writer published results of inoculation of crimson clover by the use of pure cultures, or bottled material prepared in the laboratory. As these bulletins (Nos. 87 and 96 of the Alabama Experiment Station) are now out of print, some of the results of these earlier tests will we referred to here.

In both of the following tests the pure cultures used was imported from Germany under the name "Nitragin."

Results of inoculation experiments on crimson clover, using "Nitragin."

Date of Sowing	Kind of Experiment	Kind of Soil	Hay, per Acre: Inoculated Yield	Hay, per Acre: Not Inoculated Yield	Increase from Inoculation	
			Lbs.	*Lbs.*	*Lbs.*	*Per ct.*
Fall, 1896	In pots	Sandy, 20 years in cotton	....	....	....	71
Fall, 1896	In pots	Sandy, 5 years since cleared .	....	....	....	74
Fall, 1896	In pots	Woodland, sandy...	....	....	....	326
Fall, 1896	In pots	Sandy, after cowpeas	....	....	....	379
Fall, 1897	In field	Sandy, worn........	4057	761	3296	433

Thus, it may be seen that when attempted inoculation with pure cultures is effective, the increase in crop is highly satisfactory. In the experiments tabulated above, inoculation in several instances increased the yield more than three-fold.

The above figures give the favorable side of inoculation with "Nitragin." Its use was, however, found impracticable because so often the germs in it were dead and inoculation did not result.

EXPERIENCE IN RECENT YEARS WITH PURE CULTURES OR ARTIFICAL INOCULATING MATERIAL.

In recent years the United States Department of Agriculture and a number of commercial firms have engaged in the manufacture of pure cultures, a special kind for the inoculation of each particular legume. At first these were sent out in the form of wisps of dried cotton, on which the proper germs were lodged. This Station had numerous tests of these cultures made on a great variety of soils. The result was a long list of failures, with few, if any, successes.

A later improvement was the sending of the cultures in liquid form in sealed tubes. The experience of this Station with these was, on the whole, unsatisfactory. For example, attempts to inoculate crimson clover were made in the fall of 1908 with pure cultures from crimson clover, both from the Department and from a commercial firm. Parts of both plots were occupied by small pale plants without tubercles, and the spots that were inoculated may have accidentally secured their inoculation, by wind or surface water, from an adjacent check plot inoculated with soil. Both culture plots were distinctly inferior to the plot inoculated with soil.

Constant improvements are being made in the methods of manufacturing and distributing the pure cultures made by the U. S. Department of Agriculture. The improvement and the successes sometimes reported give reason to hope that in due time this may become the best means of inoculating legumes. Its advantages are convenience; economy of labor; avoidance of the danger that is inherent in the use of soil, namely, spreading disease germs, root-knot organisms, weed seeds, etc. The only objection to pure cultures is their frequent failures, at this and at other Experiment Station, to cause the formation of tubercles or the obvious fixation of nitrogen. Our experience compels us to advise that at present pure cultures be not relied upon as a means of inoculation. Inoculation with soil has never, in our experience, failed; pure cultures have often done so. Still less advisable generally is the purchase, at additional cost, of seed said to be inoculated.

CRIMSON CLOVER AS A FERTILIZER.

When grown largely for fertiizer, crimson clover may be disposed of as follows:

(1). It may be cut for hay, plowing under the stubble as a fertilizer.

(2). The entire growth may be plowed under as fertilizer.

(3). During the last few weeks of growth crimson clover may be grazed, probably without sacrificing a very large part of its fertilizing value.

At Auburn crimson clover is in full bloom and ready to be cut between April 15 and 30. Observation has indicated that at Auburn the first few days in April constitute a suitable average date for plowing under crimson clover that is to be followed by a cotton crop. At this date it should be just begining to bloom and 12 to 15 inches high. By plowing the entire growth under at this time, and allowing the land to settle for about two weeks, before planting cotton near the middle of April, the yield of cotton has ranged as high as one and one-half bales per acre on gray sandy upland, naturally poor. The cotton crop following crimson clover receives its quota of commercial fertilizers, which in this case should be especially rich in phosphoric acid.

By waiting until the clover should be in full bloom, say April 15, doubtless the amount of vegetable matter and nitrogen added to the soil would be greater than by plowing it under about the first of April.

Not all the land intended for cotton could have its preparation delayed until this date, but crimson clover can be followed by late cotton, by corn, sweet potatoes, sorghum, etc. Where it becomes necessary to plow under crimson clover before April 1, its fertilizing effect is greatly reduced.

If crimson clover is grown chiefly for fertilizer, with pasturage also as a consideration, the nearer it comes to the blooming stage before being pastured the greater the fertilizing effect.

The following table gives the results of several experiments at Auburn, showing the increase in the next crop due to crimson clover or crimson clover stubble.

Yield of sorghum hay grown after crimson clover stubble in 1901.

......	*Yield Sorghum Hay* *Lbs.*	*Increase Per Acre* *%*
Yield crimson clover hay	2900	
Yield of sorghum hay after rye stubble	6460	
Yield of sorghum hay after crimson clover stubble	12710	
Increase due to clover stubble	6250	97

This shows that in 1901 on gray sandy land after crimson clover cut for hay, the yield of sorghum hay was practically twice as much as where the preceding crop was rye, used for hay.

On another field, also in 1901, on poor gray sandy soil, the results were as follows:

Yield of sorghum hay per acre grown after crimson clover and crimson clover stubble in 1901.

Preceding crop as fertilizer	Yield sorghum hay	Increase per acre	
	Lbs.	*Lbs.*	%
Rye stubble	5525		
Crimson clover stubble	9750	4425	76
Crimson clover, entire	10300	4775	86

This table shows that by plowing under crimson clover in April the yield of sorghum hay grown immediately after was nearly doubled. When the crimson clover was cut for hay the sorghum yield was increased by 76 percent. The yield of crimson clover hay on this stubble plot was 2741 pounds per acre, and the increase in sorghum hay due to the use of clover stubble as a fertilizer, was 4225 pounds per acre.

A third experiment on this line was made in 1903 on reddish loam soil which was naturally richer than the gray soil of the two experiments just mentioned. This reddish loam had also been helped by a light application of stable manure applied to the crop of small grain which preceded the crimson clover.

Under these favorable conditions the yield of crimson clover hay was 6100 pounds per acre. The adjacent plot had been treated exactly like the crimson clover plot as regards previous cropping and manuring.

Yield of sorghum hay per acre grown after crimson clover in 1903.

Preceding crop	Yield sorghum hay	Increase per acre.
	Lbs.	*Lbs.*
Winter and spring weeds	4400	
Crimson clover as fertilizer (stubble)	13000	8600

Here we have an extreme or maximum fertilizing effect of the crimson clover stubble of 8600 pounds of sorghum hay per acre. By adding to this the yield of clover hay, 6100 pounds, we have a total of 14700 pounds per acre of the two kinds of hay, as the measure of the advantage of sowing the land in crimson clover as compared with permitting it to grow up in winter weeds.

Both the crimson clover hay and the sorghum hay when weighed were dry enough for safe storing in the barn. Even if we assume a shrinkage of 25 per cent in the barn we should have a total yield of more than 7 tons of hay per acre produced in one season and a gain of about 5 1-2 tons as the result of devoting the land to clover instead of to weeds.

CRIMSON CLOVER STUBBLE VERSUS ENTIRE GROWTH OF CRIMSON CLOVER.

In 1908 cotton was planted very late after oat stubble, after crimson clover stubble and after attempting to plow under the entire growth of mature and thoroughly dry crimson clover.

Only a part of the mature plants were covered by the plow, so that the full effects as fertilizer were not obtained. The late planting, the period of extremely unfavorable weather in August, when this late cotton suffered especially, and the necessity of preparing these plots before frost for another crop, obscured the full fertilizing effect of the crimson clover. In the part of the season for which records were kept the yields of seed cotton per acre were as follows::

After oat stubble ....342 lbs.
After clover stubble ....456 lbs.
After clover, entire growth ....528 lbs.

The color and size of plants on these three plots gave promise of much larger yields and much greater differences, if the experiment could have been carried to a normal conclusion.

Measurements showed that the bolls were largest on the plot where the entire growth of crimson clover was plowed under and smallest on the plants growing after oat stubble.

In one of the experiments described above the yield of sorghum hay after plowing under the entire growth of crimson clover was only 550 pounds greater than after plowing under crimson clover stubble, on land where the yield of crimson clover hay was 2741 pounds per acre.

In another experiment the superiority of the entire growth of crimson clover as a fertilizer over the stubble alone was measured by an increase of only 800 pounds per acre in the yield of sorghum hay. Here the yield of clover hay on the stubble plot was 1441 pounds per acre. Thus both experiments show that it was more profitable to cut the hay than to plow the entire growth under as a fertilizer for *sorghum*.

Doubtless the principal advantage of plowing under the entire growth, rather than the stubble, consists in the greater permanancy of the improvement in the land. The analysis of the entire plant of crimson clover, including the roots, and of the stubble alone, (Alabama Station Bulletin No. 96.), showed that only about 16 percent of the total nitrogen was contained in the stubble and roots of crimson clover. With stubble of the usual length, probably 20 percent or more of the nitrogen would be found in the stubble and roots. The conclusions suggested by considering together both field tests and analysis are the following:

(1). A greater immediate profit results from using only the stubble as a fertilizer.

(2). A much larger amount of nitrogen and of vegetable matter is added to the soil by plowing under the entire growth of crimson clover, and hence doubtless this course results in a greater and more permanent improvement of the soil.

(3). By plowing under the entire growth a farmer may prepare the land three or four weeks earlier than by waiting to cut the hay, thus making it practicable to grow cotton on a field where the entire growth is plowed under.

CAUTION IN USING CRIMSON CLOVER HAY.

Cases have been reported where horses eating hay from very ripe crimson clover have had trouble from the formation of balls of matted hairs in the stomach. These hairs stiffen as the seed approaches maturity. It is believed that this trouble can be avoided by cutting the hay before it is past full bloom and by feeding partly on some other hay, if that from this clover is overripe.

DIRECTIONS FOR SEEDING CRIMSON CLOVER.

The amount of seed required is 15 pounds, or one peck, per acre. We have more frequently sown 20 pounds. The time of sowing at Auburn has varied from early in September to late in October. From a study of the results of our many experiments the conclusion is reached that safe dates at Auburn are at least as early as September 10, and as late as October 10. Sowing the latter half of September is preferred. If crimson clover seed are sown too early, the hot weather of September sometimes kills the sprouting seed, or the young plants before they become well rooted. If the sowing is postponed much beyond the 10th of October at Auburn, the stand is sometimes injured by the cold of a severe winter. The following dates are suggested as suitable periods for sowing in different parts of Alabama:

September 1 to September 30 in north Alabama,
September 10 to October 10 in central Alabama, and
September 20 to October 20 in south Alabama.

SOILS.

Crimson clover thrives on a wide range of soils from sandy to black-waxy, or prairie. In the sandy regions it does better on the loam soils or those containing a medium amount of clay. In regions of stiff soils it requires good drainage. On deep gray sands it is apt to fail, though where the stiffer subsoil is not too deep, it may succeed here. It is not wise to risk large areas of crimson clover on acid soils unless lime is used.

PREPARATIONS FOR SOWING.

At Auburn crimson clover has grown equally as well when sown among the growing cotton plants as when the land was thoroughly plowed and harrowed.

Sowing of crimson clover seed in the cotton field should be done immediately after the first or second picking to avoid knocking any of the seed cotton out of the bolls. This crop has repeatedly succeeded well when the seed were harrowed in among the stubble on a field that had received clean culture while growing a crop of drilled sorghum.

The sorghum stubble or the cotton stalks, are, however, inconvenient if it is desired to mow the clover for hay. When this clover is grown for hay the land should be plowed if possible several weeks before the time of planting, and repeatedly harrowed until the seedbed becomes fine and settled. If the seed must be planted soon after the land is plowed, a roller or drag, as well as a harrow, may be needed to compact the soil. The best time to sow the seed is while the soil is moist from a recent rain.

The inoculating soil is best sown broadcast, immediately after sowing the seed, using, if practicable, a ton of soil from a spot of red, crimson, white, or annual white clover. Always cover the inoculating soil promptly. In a few tests we have succeeded in making a successful inoculation by scattering the inoculating soil over the growing plants during a period of wet weather in the early part of winter.

It is essential that the crimson clover seed be well covered with one-half to one and one-half inches of soil. In all of our tests attempts to secure a stand by sowing without covering the seed have failed. Failure has occurred even when a heavy rain fell soon after the sowing. When the seed are sown on a well prepared seedbed, covering is best done with a spike-tooth, two-section harrow. When the seed are sown among the growing cotton plants they may be covered by using any shallow-working one-horse cultivating implement, such as a five-tooth cultivator, a spring-tooth one horse cultivator, a wide heel scrape, etc.

It is not easy to get a stand of crimson clover either on prepared or unprepared soil where there is a large amount of vegetation; hence, it is not usually easy to sow crimson clover seed in a corn field laid by early, nor on old pasture land, nor on weed land.

A field where drilled or broadcast cowpeas have recently been cut for hay is probably, next to a clean cotton field, the best place for sowing crimson clover. Here it is better to prepare the surface by the use of a disk harrow than by the use of a turn plow. After disking, the seed should be sown, the inoculating soil and fertilizer sown, and all covered with a spike-tooth harrow.

FERTILIZER.

Crimson clover, if thoroughly inoculated, adds considerable nitrogen to the soil. But it does not add phosphoric acid nor potash. If the soil be so poor as to require these two forms of plant food for the successful growth of crimson clover, they should be applied at the same time that the seed are sown. A suitable amount of acid phosphate is 200 to 300 pounds per acre. If the clover is to be removed from the land as hay, it may pay, especially on the sandier soils, to employ at the same time either 40 pounds of muriate of potash, or 160 pounds of kainit per acre. In sowing the crimson clover among the standing cotton plants on soils in fair condition we have often used no fertilizer and yet obtained a satisfactory growth. In making a start with crimson clover it is advisable to fertilize it with acid phosphate.

When it is especially important on small areas to secure a good growth and thorough inoculation of the soil, it may even be advisable to apply stable manure, since stable manure will probably make a small amount of inoculating soil more effective than if the small amount of inoculating soil were applied to a soil deficient in vegetable matter. Stable manure should not be relied upon as a substitute for inoculation nor as a means of inoculation.

LIMING.

Most clovers prefer a soil rich in lime. If the soil should be so deficient in lime as to be acid it is advisable to use slacked lime for crimson clover. At Auburn on very poor gray sandy soil, not acid, but neutral, slacked lime at the rate of 1200 pounds per acre greatly increased the yield of crimson clover hay. On the same character of soil, but in a higher state of fertility, the effect of lime on crimson clover was not conspicious. There are large areas of acid soil in Alabama, especially in the southern part of the state and in the sandy "mountain" lands of north Alabama. On such acid soils it will probably pay to use, as a preparation for crimson clover, six to eight barrels of builder's lime per acre, first slacking the lime to a powder.

The lime is best harrowed into the soil before the seed are sown and should not be brought in immediate contact with the seed and fertilizer. To test a soil for acidity, press the soil in a natural damp condition against both sides of a narrow strip of blue litmus paper, which may be obtained from a druggist. If the blue litmus paper turns to a pinkish or reddish color the soil is acid, and a crop of crimson clover growing on it will probably be helped by lime.

VARIETIES OF CRIMSON CLOVER.

There is but one kind of crimson clover in general use in the United States. In a few localities another variety, called the white blooming crimson clover, or more properly white trifolium, is grown to a small extent. The white trifolium bears a long white head similiar in size and shape to the scarlet head of crimson clover. The white trifolium is several weeks later in reaching a suitable stage for cutting. At Auburn this white kind has usually grown a little taller and afforded a considerably larger yield of hay. We have grown in Auburn three varieties having scarlet heads and called early crimson, ordinary crimson, and late crimson; in 1909 these yielded practically two tons of hay each per acre, as follows:

Ordinary crimson	3888	pounds hay per acre.
Late crimson (S.P.I.No.21208)	4106	pounds hay per acre.
Early crimson (S.P.I.No.21282)	4288	pounds hay per acre.

In 1909 the yield of white trifolium was obviously greater than that of any other varieties, but the hay was ruined by continued rain. The date of mowing white trifolium averaged 22 days later than the date of cutting ordinary

FIG. 2. *On the right, a field of ordinary crimson clover in bloom; on the left, a field of late crimson clover, not yet in bloom.*

crimson clover. This disadvantage for a cover crop to precede cotton more than counteracts the larger yield of the white trifolium.

Early crimson clover was several days earlier than any other variety, which is a decided advantage in a winter cover crop, since it permits earlier preparation for the cotton or other summer crop.

YIELDS.

After the first year,—that is, after crimson clover has become thoroughly inoculated by using suitable soil the first year of its growth,—it is safe to count on at least one and one-fourth tons of hay per acre. Under favorable conditions the yield of hay should be nearly two tons per acre. In only two experiments at Auburn has the yield approach-

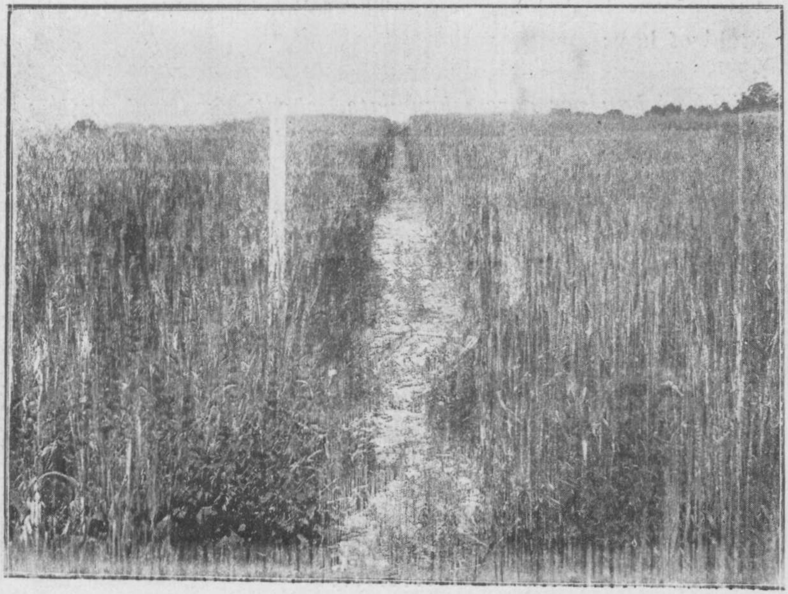

FIG. 3. *On the right, a mixture of crimson clover and Blue Stem wheat; on the left, a mixture of crimson clover and Red Rust Proof Oats; all ready for mowing.*

ed three tons of hay per acre, and in both cases this was on reddish clay loam where in preceding years some stable manure had been used.

PLANTS TO GROW WITH CRIMSON CLOVER.

For several years crimson clover has been sown broadcast in connection with either oats, wheat, rye, or beardless barley. The amount of clover seed used was 24 pounds per acre, when sown alone and also this amount in all combinations in 1909, but only 15 pounds per acre in all combinations in 1903. Oats were sown at the rate of 1 1–2 bushels per acre in 1903 and 2 bushels per acre in 1909. Blue stem wheat was sown at the rate of one bushel per acre in 1903 and 1 1–2 bushels per acre in 1909. Beardless barley was used at the rate of 1 1–2 bushels per acre in 1903 and 2 bushels per acre in 1909. Rye was sown at the rate of one bushel per acre. The following tables give the yield of hay:

Yield of hay per acre when oats, wheat, rye, or beardless barley was sown with crimson clover or with white trifolium.

	1906 *Lbs.*	1909 *Lbs.*	Average *Lbs.*
Crimson clover alone	2960	2713	2836
Crimson clover and Red rust proof oats	3280	5175	4228
Crimson clover and Blue stem wheat	3624	3918	3771
Crimson clover and Southern rye	2000		
Crimson clover and Beardless barley	3520	3872	3695
White trifolium		1200	poor stand
White trifolium and Blue stem wheat		2320	poor stand
White trifolium and Red rust proof oats		2600	poor stand

It is noteworthy that the yield has been increased whenever oats, wheat, or beardless barley has been sown with crimson clover. Red Rust Proof oats have given the largest average yield, but this plant is a little too late to permit very early cutting of crimson clover. An acclimatized strain of the Blue Stem wheat is ready for hay at exactly the same time as ordinary crimson clover, and is probably the best combination for soils strong enough to grow wheat. Beardless barley ripens too early, and is too subject to winter killing to be recommended for growing with crimson clover. Rye can be sown with crimson clover for pasturage, but this makes an unsatisfactory combination for hay, the rye maturing too soon and being too coarse.

In other tests where the weights of hay could not be taken by reason of continued rain just after harvest, the following facts have been ascertained:

Burt oats are in condition for hay at the same time as crimson clover, and in regions where it is considered safe to sow this variety in the fall, Burt oats and crimson clover make a good combination for hay.

Cheat was too late in reaching the hay stage to be sown with crimson clover, and because of its weedy nature it should be avoided.

For sowing with white trifolium, Red Rust Proof oats are most satisfatory.

In growing crimson clover for hay or pasturage it is probably advisable to sow it with one of the grains as mentioned above. The consequent advantages are the following:

(1). An increased yield of hay, though this hay is somewhat lower in feeding value than pure crimson clover hay.

(2) The easier curing of the mixed hay.

Of course if crimson clover is grown chiefly as a fertilizer, no grain should be mixed with it. If it is intended chiefly for pasturage, it is well to sow it with either rye, turf oats, red rust proof oats, or wheat, using the ordinary amount of seed grain per acre. This increases the amount and lengthens the period of pasturage.

WHERE TO GET SEED.

Crimson clover seed can be purchased from any Southern seedsmen and from most seedsmen in other parts of the United States. Among those who have supplied the Alabama Experiment Station with seed are the following:

Amzi Godden Seed Co., Birmingham, Ala.

Harvey Seed Co., Montgomery, Ala.

T. W. Wood & Co., Richmond, Va.

H. G. Hastings & Co., Atlanta, Ga.

Alexander Seed Co., Augusta, Ga.

Willett Seed Co., Augusta, Ga.

Usually the price of seed is $3 to $4 per bushel of 60 pounds. The partial failure of the last crop has about doubled the price. While this may discourage the planting of large areas in the fall of 1909, it should not keep any one from planting a small patch, say of one-fourth to one acre, largely for the purpose of securing inoculating soil with which to inoculate large areas next year.

The more thorough the inoculation on such "starter" patches and the thicker the stand there, the more effective will that soil be for purposes of inoculation a year later. Hence, not less than 20 pounds per acre should be sown on such small areas.

In view of the high price of seed, it may be advisable in the fall of 1909, for those who are prepared to sow large areas, *with thorough inoculation,* to reduce the amount of seed to 12 pounds per acre, an amount which is smaller than was used in any of our tests, but which has sometime been reported as giving a satisfactory stand.

WHERE TO GET INOCULATING SOIL.

Whenever possible get this in your own neighborhood. Most readers can find it by searching for white clover, or for the dead remains of annual white clover in old lawns and on the richer spots in old pastures.

Each of the parties mentioned below consents to furnish to each of a limited number of applicants, and for $1.00 per 200 pound sack, a single sack of soil from a patch of inoculated crimson or red clover. The Experiment Station has not inspected any of these fields and can give no guarantee as to the absence from them of disease germs, etc., nor any other guarantee.

Under no circumstances will the Alabama Experiment Station distribute any soil from its farm, for this is known to contain the organisms that produce various plant diseases and root-knot.

Name	*Postoffice*	*County*	*Railway*
J. O. Burleson	Decatur, R. F. D.	Morgan,	L. & N.
A. G. Diseker	Russellville	Franklin,	Southern
J. J. Edge	Loachapoka	Macon,	W. of Ala.
Yancey Swearington	Shorter	Macon,	W. of Ala.
D. W. Davis	Gordo	Pickens,	M. & O.
W. Tyrrell	Citronelle	Mobile,	M. & O.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

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1. Raising Lambs in Alabama. Maintenance Rations for Ewes.

2. Feeding Cotton Seed Meal to Pregnant Ewes.

BY

DAN T. GRAY AND J. W. RIDGWAY

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PART I.

RAISING LAMBS IN ALABAMA.

By Dan T. Gray and J. W. Ridgway.

When one rides through the State of Alabama and sees the thousands of acres lying idle, growing up in brush and fine grasses, one wonders why there are not more sheep produced in the State than there are. It is usually stated that only 40 per cent of the area of Alabama is being cultivated or used to return wealth to the State. In some counties no more than 15 per cent of the total area is under cultivation. The other 85 per cent is lying idle. Money is tied up in the whole amount, but the farmer, on the average, is making use of but about 40 per cent of his whole capital invested. If sheep and other kinds of live stock were more generally introduced the usable area could be greatly increased, as these animals would make use of the present waste places and hill sides and help develop the pasture side of our farming operations. Even now thousands of acres under cultivation should be put down to permanent pastures and stock placed upon them. Hill-sides which wash should be put down to grass. This could be done without at all decreasing the cultivated area. The sheep need not occupy one foot of our already cultivateable area; he would but be a means of putting more of our land capital to work. The Alabama farmer can surely farm in such a way as to use more than 40 per cent of his land capital. What would we think of the business ability of a banker who used but one-half of his available capital, or the merchant who sold goods from but one side of his store?

Then, in addition to the fact that the sheep is probably the best animal known to put our waste areas to use, Alabama is just suited to sheep production. In any line of live stock production pastures must be made the base, and

Alabama can have permanent pastures for at least ten months in the year by the use of bermuda and burr clover. The remaining two months can be bridged over with temporary winter pastures. The Northern farmer must be contented with a grazing period of not more than six months. Then again our climate is so mild the year through that the lambs can be born in the mid-winter and suffer none from the cold. This permits the Alabama farmer to get the lambs upon the early spring market at the time when high prices are realized. In the North when the lambs come in December or January very expensive care must be given them to keep them from freezing, as they must be kept in a "hot house." In the South the early lamb is free to run at will throughout those months, and can even have green pastures to graze upon.

Still further, when the lamb is ready for the market good prices can be realized upon him. Some there are who claim there are no markets for lambs. But there is a great demand for the early lamb. The farmer should realize that a part of his business consists in finding a market for what he produces. The business man lays in his stock of goods and then looks for a market for it. The farmer must do the same thing. Many Southern cities offer as good a market for early lambs as does the St. Louis market. A following picture shows some spring lambs, that had nothing but their mother's milk and pastures, which sold in Birmingham for 10 cents a pound live weight on April 15th, 1908. Birmingham would use thousands of such lambs. These were good lambs, but no better than any other farmer could produce. They were raised by J. S. Kernachan, of Florence, Alabama. A good market can always be found for good fat stuff. The local market may not furnish a good sale for this class of stuff, but the cities are more than glad to receive it. The express charges do not prohibit the lambs being sent a good ways from home.

The Southern farmer depends too much upon one crop for a living. He is like the man with all his eggs in one basket—if a mishap befalls the basket all of the eggs are broken and lost. So if the season should happen to be unfavorable for the growing of cotton the man who depends altogether upon cotton for a living finds that, at the end of the season, he has but a limited bank account to carry himself and family through the winter months. If this farmer has some pigs to sell, or a mule colt, or some wool or a few lambs, the short cotton crop will not be of so much importance. The farmer who is interested in more than one farm product suffers very much less in time of unfavorable seasons than the man who grows but the one crop, cotton. Even though it be too wet for the cotton to do its best, it may be, and probably will be, a very favorable season for the pastures, and the man who has a good flock of sheep out on the pastures raising some good fat lambs will not worry so much about the unfavorable season for cotton, as he feels that, although the cotton may be a partial failure, the sheep will bring him excellent returns.

There is yet another advantage in the sheep business. Spring is the time when the average farmer has not a cent coming in. This is the very time when the heavy expenditures must be made for machinery, fertilizers, mules, harness, etc., and to obtain these things the farmer usually asks some merchant to credit him until fall. The sales from the flock of sheep come in just when the money can be used for the above purchases. Both the wool and the early lambs are ready to sell and the money derived from these sales can be used to fit up the farm for spring work. From 100 ewes there could be sold, by the middle of April, from sixty to eighty dollars worth of wool and as many dollars from the early lamb sales, and probably much more from the lambs, provided they were dropped at a very early date.

Objects of Experiment.

Realizing the importance of the sheep industry to the State this Station began, four years ago, some experimental work with the following objects in view:

1. To study early lamb production in Alabama.
2. To study feeds and methods for carrying the pregnant ewe through the winter months.
3. To test cotton seed meal as a feed for pregnant ewes.

By an early lamb the authors mean one that is born in December or early January and ready for the market by the middle of April. Some farmers of the state are so fortunately situated that the second object will have little interest to them, as they already have abundant winter range supplied. The man who has a good winter range, or cane brake, needs no additional feed for the ewes. All such an ewe requires is care and attention and shelter at lambing time. But when sheep are generally introduced into the state, they will be introduced by the small farmer who is not supplied with an unlimited winter range. The small farmer will therefore be interested in knowing what are the best feeds for the winter months and the expense incurred in carrying the animals over the cold months. It might be said, in passing, that the sheep is the ideal animal for the man with the small capital. The business can be entered into with but a small outlay of money and large returns secured upon the outlay within a few months after the investment is made. The poor man cannot wait long for his investment to begin to return dividends. The sheep and the hog are the poor man's animals. Of course large amounts of money can be invested in them if desirable.

The work began in the summer of 1906 with the old flock of ewes which had been kept upon the Station farm for several years previous. This flock consisted of but 16 ewes, of mixed breeding, headed by a pure-bred Southdown ram. The pictures will show the general quality of the animals. Later on, in 1907, there was a flock of 30 scrub ewes added to these, headed by a pure-bred Dorset ram, but the Station is not yet ready to report upon the work done with this scrub flock, except with respect to some winter work in cotton seed meal feeding.

How the Old Flock Was Handled.

During the summer months, while the pastures were green, no attention was given the sheep at all except to see that they had plenty of water and a mixture of tobacco dust and salt before them at all times. The object in feeding the tobacco was to keep down stomach worms, as the worms are the bane of the sheep farmer, and it is claimed that tobacco dust will hold the pest in check. This was given them in proportion of one pint of dust to about four pints of salt. The sheep soon acquired a taste for the tobacco. It is well known that sheep should be changed from pasture to pasture as often as possible, unless the range be exceedingly large. The object in changing the pasture is to hold in check the stomach worms. The Station's pastures, or lots, are small, so the sheep were changed from one to the other as often as the grass became short. There was no regularity followed in making the change.

The period of gestation in the ewe is about five months, so if the lamb is to be dropped in December or the first of January she must be bred in July or early part of August. To be sure that she breeds in these months she should be turned upon a fresh pasture just before the time for breeding and then given a little cotton seed meal daily. As far as possible this plan has been followed with this flock. Of course there will always be a few late lambs, but if the ewes are in good breeding condition, neither too fat nor too poor, throughout July and August, the great majority of them will breed to drop lambs from Christmas to January the 15th.

The Station ram was allowed to run with the ewes at all times. If there had been as many as 50 ewes it would have been wise to have kept him away from the flock during the day time, and turned him in with them at night only. But with the few that we had he could be expected to be a safe breeder when running with the ewes both night and day. Some sheep farmers do not permit the ram to run with the flock at all through the breeding season, but unless the owner has time to examine the ewes closely every day it is better for the male to be with them at least one-half of the time or the lamb crop will come on irregularly.

Winter Feeding of Ewes.

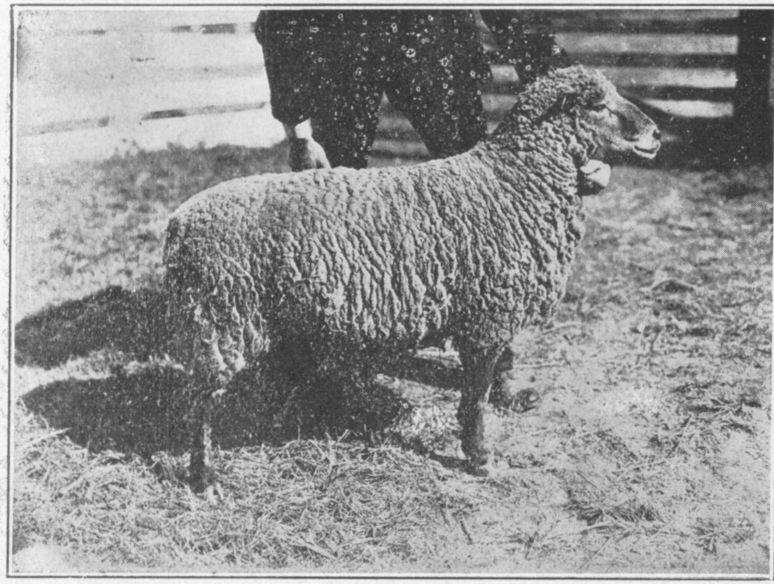
In the fall when the pastures became exhausted the ewes had to be managed as the small farmer would have handled them. There was no open range upon the Station farm so they had to be fed throughout the winter months. The man who has a farm with a winter pasture or range could have avoided this extra expense.

Some farmers in the state feed nothing but cotton seed meal and hulls to the pregnant ewes during the winter months. Others feed nothing but cotton seed. Still others are afraid to feed either cotton seed meal or cotton seed, thinking that cotton by-products are dangerous feeds for sheep. It is often claimed that cotton seed or cotton seed meal will cause blindness, dizziness, etc., and sometimes death when given to ewes. During the winter of 1906-'07 the old flock was divided into two lots of eight ewes each, and one lot was fed upon soy bean hay alone and the other lot upon cotton seed meal and hulls. The soy bean hay was of excellent quality but had no mature beans upon it, as it was cut before the beans were ripened. The cotton seed meal was fresh and bright.

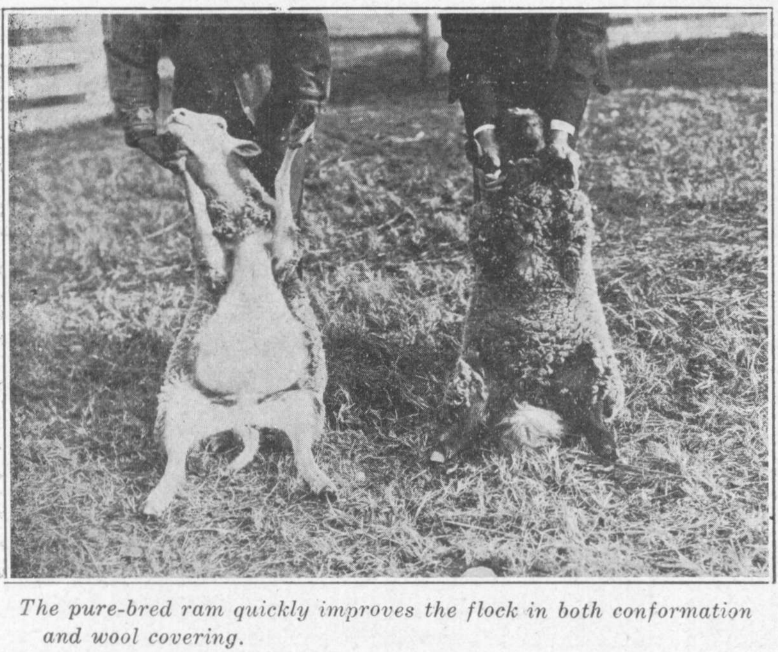
Local conditions determine, to a large extent, the prices of feeds. Any prices that the authors might assume would not meet all conditions, so actual Auburn prices were taken as a basis upon which to rest the financial estimates. The local prices were:

Cotton seed meal	$25.00 per ton.
Cotton seed hulls	$ 6.00 per ton.
Soy bean hay	$12.50 per ton.
Pasture rent per sheep per month	.10
Cotton seed	$12.00 per ton.

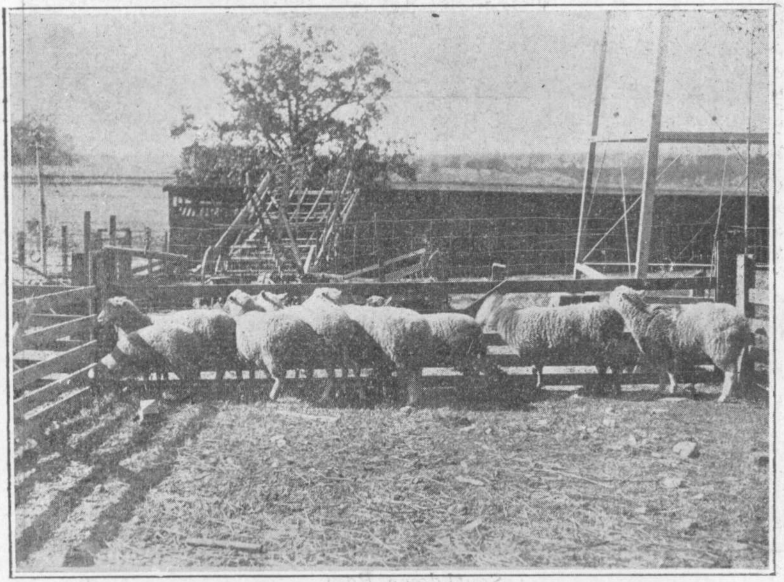
During the winter time the animals were enclosed in a small pen, with a shelter across one end, so they could get



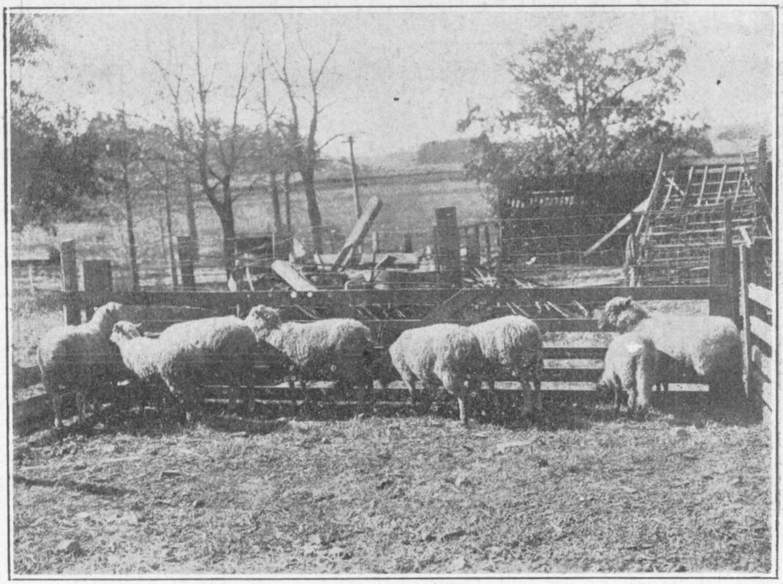
Southdown Ram.



The pure-bred ram quickly improves the flock in both conformation and wool covering.



Lot I—Wintered on Soy Bean hay.
Hay per ewe daily, 1.9 *pounds.*
Expense to feed each ewe a month, 35 *cents.*



Lot II—Wintered on Cotton Seed Meal and Hulls.

Feed per ewe daily { .5 *pound cotton seed meal.* / 1.3 *pound cotton seed hulls.* }

Expense to feed each ewe a month, 30 *cents.*

no feed but that which was weighed out to them. Salt and water were kept before them constantly. No tobacco was used throughout the winter months, but perhaps it would have been wise to have used it. They were fed twice daily. The ewes were pregnant, and of course did not all lamb upon the same date. When one dropped a lamb she was taken out of her lot and put into a third lot, where the object was to learn how much the feed must be increased to maintain a ewe while milking.

The following table tabulates the results of the winter work—1906-'07:

Table 1. Cotton seed meal and hulls versus Soy Bean hay for wintering pregnant ewes.

Lot.	Ration.	Av No. ewes for 106 days	Feed eaten daily per ewe	Total gain each ewe for 106 days	Cost of feed per ewe per month
			Lbs.	*Lbs.*	*Cts.*
1	Cotton seed meal Cotton seed hulls	5.8	0.5 1.3	1.8	30
2	Soy bean hay	6.4	1.9	1.6	35

The ewes were not, of course, given all they could eat. The object was to feed them only enough to maintain them, that is, to keep them from either losing or gaining in weight throughout the winter months. The above ewes gained between one and two pounds each during the entire winter. It would, no doubt, have been better if they had been given enough feed to have made them gain from six to eight pounds each, as each one had to develop a foetus which weighed from five to nine pounds at birth.

The farmer could have cheapened the ration of lot 1, the cotton seed meal lot, by not feeding as much cotton seed meal as was fed in the test. It would have been cheaper to have cut down the meal and increased the hulls, but a large amount of meal was used in the test so that it would be possible to collect some data upon the effect of rather large daily feeds of cotton seed meal upon the health of the ewes. In this test the cotton seed meal ration was fixed at one-half a pound daily per ewe and the hull part of the feed was varied so as to hold her at a uniform weight.

The test shows .5 of a pound of cotton seed meal and 1.3 pounds of hulls to be sufficient to maintain these pregnant ewes in the winter time. The ewes averaged about 95 pounds in weight. The animals were given this ration for 106 days and some of them even longer. One and nine-tenths pounds of soy bean hay per ewe per day proved to be sufficient to maintain the other lot. Both lots came through to the lambing period in excellent health and spirits, but the cotton seed meal lot seemed to be more spirited and alert than the soy bean lot. No objection, though, could be brought against either feed as far as their general effects upon the animals were concerned.

When the prices are quoted as heretofore given the cotton seed meal ration proved to be the cheaper of the two. In lot one it cost 30 cents a month to feed each animal, while with lot two the expense was 35 cents a month per ewe. A little change in the price of feeds would alter the financial statement, however. But, taking the above results and quotations as a basis, the soy bean hay proved to be worth $10.68 a ton for carrying the ewes through the winter when compared to the cotton seed meal and hull ration. In some parts of the state that price would be a good one for the hay, but in other portions of the state conditions are such that a farmer could well afford to sell the hay upon the market, and with the proceeds buy cotton seed meal and hulls to use in feeding the sheep. In many points in the state soy bean hay sells for $15.00 to $20.00 a ton. The farmer cannot afford to feed it to sheep, or, in fact, any other kind of live stock, except probably the work animals, when he can secure $20.00 a ton for it after a short haul. Other feeds are cheaper.

Feeding the Milking Ewe.

As stated above, when a ewe brought a lamb she was taken out of her lot and placed in a third lot, where she was given more feed than when dry. After the lamb came she was a milking animal and had to be treated as such. The cow in milk requires much more feed than does the dry cow, and so the milking ewe must be fed more liberally than the dry one. The most economical thing to have done with the ewe when she dropped the lamb would have been to put her and the lamb out upon green pasture. This date would be around January the first. Green pastures can easily be provided at this time of year, as oats, vetch, rye, wheat, burr clover and barley pastures. The pasture method is the way the farmer should handle his flock for the greatest profit, but the Station wished to learn how much the feed should be increased after the ewe came into milk, and also study the effect of prolonged feeding of cotton seed meal upon the health of the animal, so it was not possible to employ the cheapest methods in this particular test. So the mothers were confined in a third lot and fed upon an increased amount of cotton seed meal and hulls. A small passage was made in the fence leading out into the pasture, which was composed of oats and vetch, and the lambs only were given the freedom of this run.

But it might be that the farmer would not be supplied with a green field when the lambs begin to come, and he would be interested in knowing just how much the feed should be increased when the ewe changes from a dry to a milking animal. The majority of owners allow their ewes, cows, sows and mares to run down rapidly in flesh when they come into milk.

It has been a rule of the writers to increase the feed of a mare or a cow twenty-five per cent. when the young animal was born, thinking that this increase in feed would be sufficient to maintain the mother in as good condition as she was before giving birth to the young animal, but the following data show that an increase of twenty-five per cent. was not sufficient:

Table 2. Amount feed required to maintain a ewe before and after lambing.

Lot	Ration	Am't feed eaten daily	Total gain each ewe for whole period	Cost to carry each ewe for one month
Before lambing:		*Lbs.*	*Lbs.*	*Cts.*
1	Cotton seed meal	0.5	1.8	35
	Cotton seed hulls	1.3		
After lambing:				
2	Cotton seed meal	.88	1.5	54
	Cotton seed hulls	2.35		

At the beginning of the test the feed of those ewes in milk was made just double the amount given the dry ewes so that the animals would be sure to not lose in weight, but it was soon learned, as the ewes begun to increase in weight, that an hundred per cent. increase was more than necessary, so the amount was gradually decreased until it was brought down to the above average figures. They were carried along upon this basis for a period of seventy-three days. The ewes were practically maintained, as far as total weight was concerned, as they gained but one and one-half pounds for the whole time. In the test it required 75 per cent. more cotton seed meal and 81 per cent. more hulls to maintain a ewe when suckling a lamb than when she was dry and pregnant. Of course there are several factors that would be controlling ones in determining the amount of feed required for an animal after lambing, as the amount of milk given, but under conditions as they existed in this test the necessary increase in feed, when the animal came into milk, was not less than 75 per cent. above that which she received when dry.

In some experimental work with grade angus cows, Professor Mumford, of the Illinois University, in bulletin III, says, "In this test it took approximately twice as much feed to maintain a cow suckling a calf as it did during her pregnancy."

Handling and Feeding the Lambs.

As a rule, the farmer feeds the early lamb nothing in addition to its mother's milk and what little pasture it can secure during the winter months. It will pay to feed the lambs though, and to feed them well. Any animal makes its cheapest gains when young. If it has a good pasture of oats and vetch to run upon it will eat but little grain in addition. But it will eat some corn and should have it, because this early lamb, to derive the greatest profit upon him, and at the same time lessen the risk of summer disease, should be pushed to an early market. The first lambs were dropped January the 8th. This was late, which fact gave greater cause for pushing them to an early market. From the sixteen ewes fourteen lambs were raised to a marketable age. Two of the ewes were too young to breed at this time. As soon as the lamb was born he was placed in a third lot with his mother. In the fence of this lot was a small hole which permitted the lambs to creep through and make use of the pasture of oats and vetch. The pasture, which had been fall planted, was ready for grazing by the time they could use it. As stated above, it would have been better and cheaper if the mothers had been allowed the run of this pasture also, but they were kept off for reasons heretofore mentioned. A small pen was also cut off in the corner of the lot where the mothers were kept and a creep made into this pen large enough for the lambs to go through. In this pen coarsely ground corn was kept all the time in a small trough. The pasture and grain should be given the lambs as soon as they are born and they will begin to eat by the time they are ten days old. The lambs did not eat much corn, but what they did eat helped to put the finish on them at an earlier date, so that they sold well upon the market. The 14 lambs ate but 6.6 bushels of corn during the whole winter and early spring. So the lambs had all of the corn, milk and green pastures that they wanted. With this combination of feed they, of course, did well.

They were sold at an average age of 101 days and had attained an average live weight of 51 pounds (Atlanta weights). They made excellent gains to be born of mothers that average only 95 pounds in weight.

It might have been more profitable to have carried them to a heavier weight, but that point could not be determined. If they had been born earlier they could have been fed longer and still been placed upon the early market. The object was to sell them as early in the season as possible and yet have a reasonable size. This is the reason why earliness of birth is such an important question. When warm weather comes on the price of mutton declines, as people do not like mutton during the warm months, so it is to the advantage of the owner to let the lambs go at the earliest possible date. And, too, when they are sold in the early spring the danger of losses from summer diseases is also considerably lessened. The earliest bunch was sent to Atlanta, April 23rd, 1907. The Station has succeeded, during the last two years, in getting some lambs ready for the market by the middle of April. Two of the bunch sold for nine cents a pound live weight, while three sold for eight and one-half cents a pound. The remaining ones were sent on later and sold for but eight cents a pound. The late ones were, in fact, better lambs than the first ones, but the weather was becoming warm and there was not as great a demand for them as there was for the early ones. The best prices prevail just before Easter time. The Station has not been able to secure as good prices for lambs as have some farmers of the state. A picture in another part of the bulletin shows some lambs which were sold, in April, 1908, in Birmingham, for ten cents a pound live weight.

It must be remembered, too, that these lambs were not fancy bred ones. They were just common lambs. In fact, two of them were out of scrub mothers by a pure bred Southdown ram. The others were out of grade mothers.

Salt Fed.

Salt was placed in small boxes and kept before the animals all the time. They are very fond of it, as the following table shows. Each ewe ate at the rate of 15 to 19 pounds of salt yearly, or a flock of 100 ewes would have consumed in one year's time from 1,500 to 2,000 pounds of salt.

Table 3. Salt eaten per month by each ewe.

Lot	Ration	Pounds salt eaten per ewe each month
1 (1906)	Soy bean hay...............	1.35
2 (1906)	Cotton seed meal, Cotton seed hulls	1.53
1 (1907)	Green sorghum plus mixed hay (summer work).....	1.23
2 (1907)	Cotton seed meal.........., Cotton seed hulls (summer work)	1.29

Water Drank.

It is often thought that sheep will not drink much water, and that they will thrive as well without it as with it. Data were collected on the amount of water consumed by some ewes from August 21st to September 9th, 1908, while they were confined in small sheltered lots. The weather was about normal for this time of year.

Table 4. Water drank per ewe per day.

Lot	Ration	Pounds water used by each ewe per day
1	Green sorghum.....................	2.5 (.3 gallons)
2	Cotton seed meal and hulls.........	6.1 (.95 gallons)

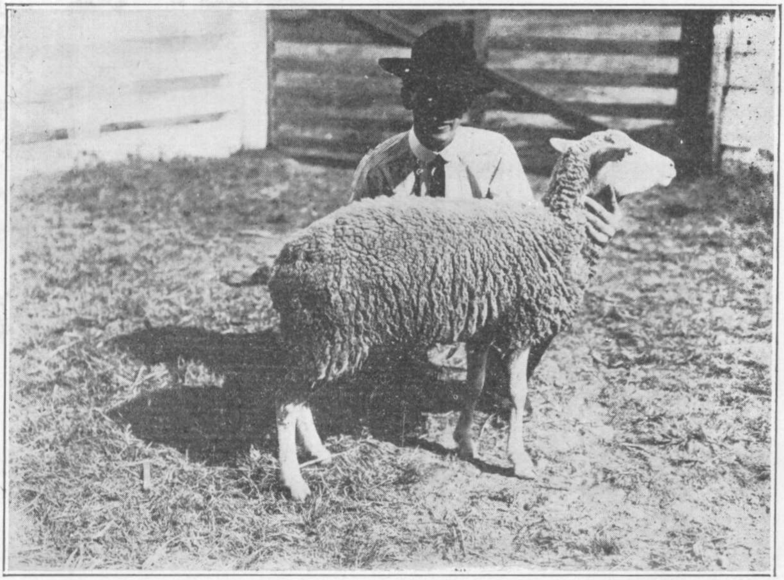
Financial Statement For Old Flock.
1906-'07.

The financial statement includes all the income and expenses upon the old flock of 16 ewes and one ram from October the first, 1906, to October the first, 1907,—a year's time. While the flock was not carried through the year with a view of rendering a financial statement at the end, still the statement points out what profit can be made upon a small flock if profits be the only point in view. The authors had other questions to solve with the flock, so it was not carried through the year as cheaply as the farmer could have carried it through. If profits had been the only point in view the animals would have been handled more economically by feeding the ewes very little grain after the lambs were born. To secure the greatest returns the mothers should have been turned out into the oat and vetch pasture with the lambs and fed little, if any, concentrated feeds. But owing to the fact that the Station at that time owned no other flock, this same flock had to be used in the spring experiment of 1907, when a study was made of the amount of feed required to maintain a ewe after lambing.

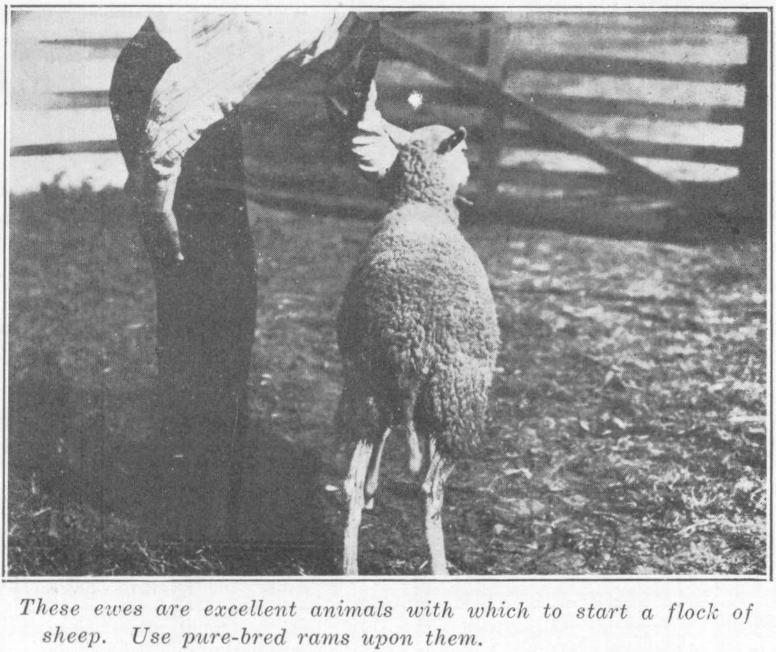
This, of course, ran the expense up very materially—about 30 per cent. more than it should have been. But in the following financial statement all of the expenses have been counted against the flock.

Table 5. Financial statement of old flock—1906-1907.

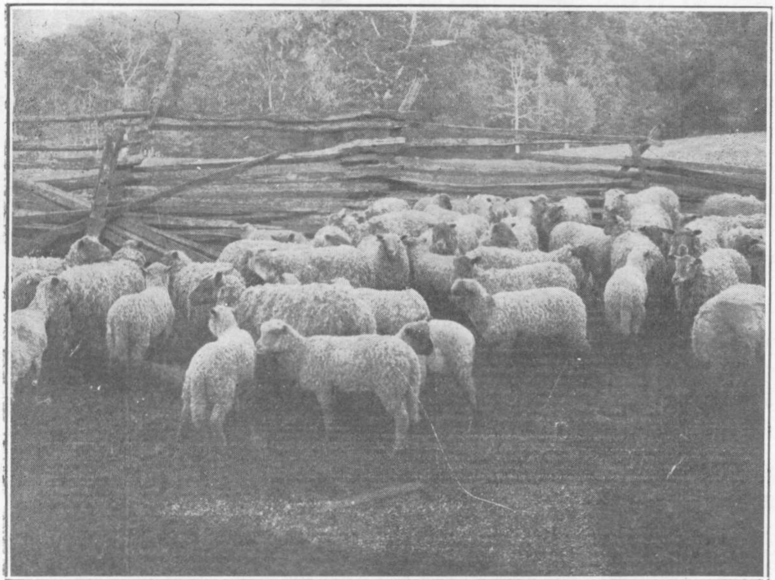
Expenses:		
	Rent on pasture, 10 cts. per sheep per month	$12.24
Lot 1.	1503 lbs. soy bean hay at $12.50 per ton	9.39
Lot 2.	342 lbs. cotton seed meal at $25.00 per ton	4.27
	879 lbs. cotton seeed hulls at $6.00 per ton	2.64
Lot 3. (after lambing)	530 lbs. cotton seed meal at $25.00 per ton	6.62
	1332 lbs. cotton seed hulls at $6.00 per ton	3.99
	198 lbs. cotton seed at $12.00 per ton	1.19
	1 ton green hay at $2.00 per ton	2.00
Lambs	371 lbs. corn at 70 cents per bushel	4.63
	35 lbs. bran at $30.00 per ton	.52
	Death one ewe	3.00
	Express charges to send lambs to Atlanta	7.00
	Express charges to send wool to Atlanta	.60
	Total	$58.09
Receipts:		
	To 14 lambs	$53.56
	To 55 1-2 lbs. wool, 26 1-2 cts. per lb.	14.64
	Total	$68.20



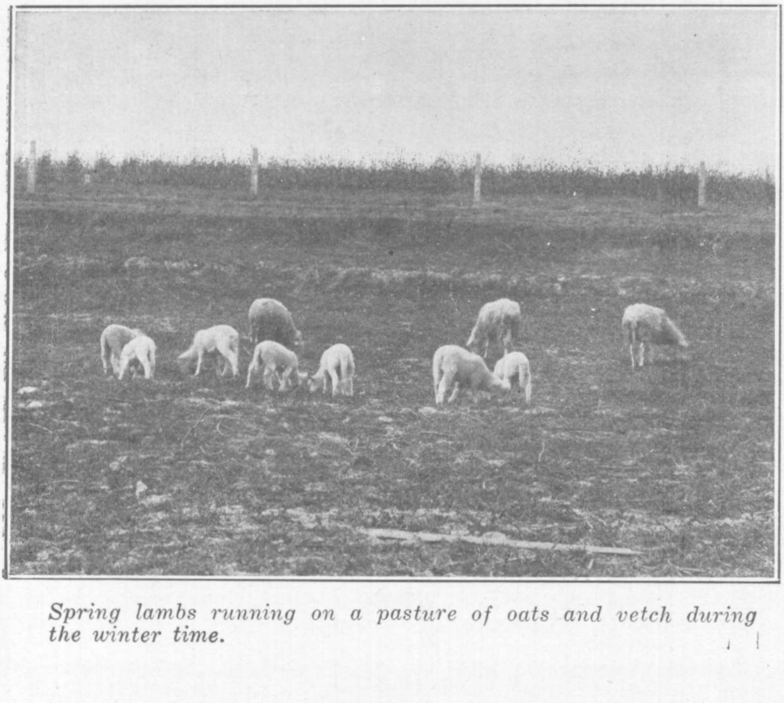
Side view of average Alabama scrub ewe. Price $1.50—$3.00.



These ewes are excellent animals with which to start a flock of sheep. Use pure-bred rams upon them.



16 *lambs of this bunch sold for* 10 *cents a pound, live weight, at Birmingham, April* 15, 1908. *Belonged to J. S. Kernachan.*



Spring lambs running on a pasture of oats and vetch during the winter time.

The above tabulation shows every item of expense against the flock during the entire year except the labor required to look after it. It has been assumed that the value of the manure will offset the labor expenses. After all of these expenses were considered the flock gave a return of $10.11. What do these figures mean? Do they mean that the Station received but $10.11 on the whole flock? No, that is not all they mean. They mean that the Station realized $12.50 per ton for all the soy bean hay eaten throughout the winter, that the pasture rented for ten cents per sheep per month, that 70 cents per bushel were realized upon the corn used and $12.00 a ton on the cotton seed—and finally, in addition to marketing the farm crops at the above prices, $10.11 were realized. The financial returns were satisfactory, but not as satisfactory as they could have been made if the feed bill had been cut down and pasture made use of after the lambs came. For instance the farmer would have almost entirely dispensed with the feed item of $13.70 for lot 3. Live stock should be looked upon as a means of marketing the farm crops at good prices while, at the same time, the manure is returned to the soil.

Experience of Two Alabama Sheep Farmers.

Many farmers will be interested in the following statements from good farmers who have tried the sheep business and are making a success of it—

Alabama Experimental Station.

Dear Sirs:—

About fifteen years ago I bought six head of ewes and one buck as a start in the sheep business. Up to that time I had never liked sheep, but experience has taught me to be more and more pleased with them as time goes by. They have been great money makers for me . I kept all the ewe lambs for several years and today have one hundred and forty head of breeding ewes. For the last five years have sold both male and female lambs, keeping just enough ewe lambs to keep up the number where I want it.

I do not know of any investment that will make money faster than sheep—with proper care and attention. We think an investment is doing wonderfully well if the original capital doubles itself in ten years. But see what the sheep did; if they had increased to twelve only within the ten years they would have doubled the investment. But they did much more than simply double. Within the ten years the ewe part of the flock—that part retained upon the farm—doubled about five times, to say nothing of the number of ewe and male lambs that have been sold from the farm within the ten years. I have realized, in the fifteen years, about one thousand dollars for lambs, while the wool has paid for the keep of the flock every year.

I have never been bothered by dogs. I have always kept the sheep upon my own lands, never allowing them to run upon the commons.

The animals have been perfectly healthy all the time. I have never lost a sheep except from old age. They run upon pasture about nine months of the year without any other feed in addition. The pasture keeps them in fine condition. During the lambing time the ewes need some extra feed, so I then give them some cotton seed—about three bushels to each one hundred ewes—and any good hay that I happen to have on hand.

The lands upon which the sheep have been running will carry twice as many head of stock now as it would ten years ago. The sheep is called the "golden hoofed" animal and I think they are entitled to the name; they have not only brought in the money, but have improved the land. The manure spreader is said to be a paying investment, but sheep are a decided improvement on any manure spreader, as they manufacture and spread the manure, too. I have never had trouble arise from running other kinds of stock with the sheep. I keep horses, cattle and sheep in the same pasture all through the grazing season, except when the lambs are young, when I keep them away from all other stock. The other stock do not object to eating the grass upon which the sheep have grazed.

Yours truly,

J. S. KERNACHAN, Florence, Ala.

Alabama Experiment Station.

Dear Sirs:—

In January, 1904, when we bought our farm, the man of whom we bought it had a small flock of forty-eight head of sheep and was very anxious to leave them with us on shares, but we had always heard that sheep would ruin a pasture, and so were unwilling for them to stay. But finally we agreed to keep the sheep for him for eighteen months on shares; we were to receive one-half of the wool and lambs and bear the expense of pasture and the labor to look after them.

The first year we raised fifty-four lambs and divided up about July first. As he intended to sell his part of the lambs he took the bucks and left us twenty--seven ewe lambs as our part of the first crop of lambs. Now, it is strange, but it is a fact, that the next spring every one of these twenty-seven ewes had lambs and some of them had twins. When we divided up again the next year, about July first, we had about seventy-five sheep, and besides had received some money for our part of the wool. In the meantime we had watched pretty closely and found that instead of injuring our pastures, the sheep had benefited them by eating weeds and other things which our cattle would not eat.

So far, we were well pleased with our experiment and decided that, by breeding up our sheep, we could make some money, so we ordered two Southdown rams from Kentucky We decided on the Southdown because, after reading and making inquiry, we thought they would suit us best as we prefer a dual purpose animal—one that would produce both wool and mutton. We have had no cause for regret in making this selection, as they have been very hardy here and proved to be the ideal sheep for our needs. Every year we have put in new bucks, selected and kept our best ewe lambs, and sold the buck lambs and the old ewes.

Our investment in sheep has never paid us less than one hundred per cent. and many years has paid us even more than that. The higher we grade them up the better they pay us, notwithstanding the fact that the higher they are graded up the greater price we place upon the breeding flock. As evidence of this fact, we have sheared from one hundred and seven sheep six hundred and thirty-three pounds of wool in the grease, but free of burrs and dirt. Although our lambs were unusually late this season, they have been dressed and shipped, having made an average dressed weight of about forty pounds. Their quality has been such as to tax our capacity for supplying them, and we have received the best price we have ever obtained.

The sheep we started with were scrubs—just the ordinary sheep of the county. Our farm is no better than many other farms of the state, yet our sheep have proven to be a better investment to us than money at compound interest. Still it is a fact that some farmers contend that there is no money in live stock on the farm, and that, here in Alabama, we cannot afford to have anything but scrub cattle, sheep and hogs. If the farmer who thinks this will try in but a small way to improve and build up his stock—giving the business the same conservative thought and care that brings success to other undertakings—he will soon have a good balance to the credit of the live stock account, besides having the satisfaction of owning useful and pretty animals.

We try to keep only about one hundred ewes, and carry them in the pasture along with about one hundred and fifty cattle. The sheep benefit the pasture by keeping down weeds. There is no objection to having the sheep and cattle in the same pasture. We make our living from the farm, consequently everything upon the farm must pay its own way and make something for us besides. We have found, and the Southern farmers who try it will find, that sheep are a paying proposition. They have the following advantages:

They require but a small capital to begin the business.

They will do well on hilly and broken lands.

Their manure is one of the richest animal manures that can be obtained.

The money comes in from them in the spring and early summer when money is scarce.

They subsist on things that other animals will not eat.

They afford us two sources of profit—wool and lambs.

Yours very truly,

J. B. McDaniel, Camden, Ala.

PART II.

FEEDING COTTON SEED MEAL TO SHEEP.

It is generally thought that cotton seed meal has a toxic effect on sheep similar to the effect it often has on hogs. Many farmers will not use it as a sheep feed because of the reported ill results. It is charged with producing illness, blindness, dizziness, etc., after being used for a few weeks. For the last four years this Station has been trying to determine whether cotton seed meal is an injurious feed for sheep or not, and, so far, no ill results have come from its use, with possibly one exception in 1906.

The old flock of ewes has been used in this work together with a flock of scrub ewes which were brought to the farm in the summer of 1907. The animals using the meal have been fed by the side of other animals which were being given rations without cotton seed meal so as to study the effect of the cotton seed meal upon the general health of the animals, even though no deaths should occur as a result of its use. The following table gives the details of the live weight, total cotton seed meal eaten and number of days that each ewe ate the cotton seed meal:

Table 6. Feeding cotton seed meal to sheep.

Ear No.	Live Weight	Total cotton seed meal eaten	Meal eaten daily	No. days on cotton seed meal	REMARKS
1906.	Lbs.	Lbs.	Lbs.		
5	120	68.5	.5	137	Excellent health throughout.
2	125	98.6	.5 for 53 das. .88 for 82 das.	135	Excellent health throughout.
15	90	94.2	.5 for 60 das. .88 for 73 das.	133	Excellent health throughout.
9	106	33.2	.5	66	Became sick; taken out of test, died within four months of stomach worms.

3	120	94.2	.5 for 60 das. .88 for 73 das.	133	Excellent health throughout.
28	47	67.5	.5	135	Excellent health throughout.
123	95	88.3	.5 for 78 das. .88 for 56 das.	134	Excellent health throughout.
61	75	78.8	.5 for 103 das. .88 for 31 das.	134	Excellent health throughout.
1907.					
5	120	105.0	.5	210	Excellent health throughout.
7	102	92.5	.5	185	Died Jan. 31-'08. No blindness, dizziness, etc. Cause of death probably worms, as worms were in stomach.
3	120	105.0	.5	210	Excellent health throughout.
4	132	73.5	.5	147	Died Jan. 11-'08. She seemed blind, staggered, would not eat well when fed in trough. Died fat. Would eat if feed placed before her.
96	32	17.5	.5	35	Died Sept. 19-'08. Death caused by getting head fastened in fence.
33	59	105.0	.5	210	Excellent health throughout.
29	65	105.0	.5	210	Excellent health throughout.
190	65	16.8	.25 for 44 das. .28 for 10 das. .33 for 9 das.	63	Excellent health throughout.
191	75	34.0	.25 for 44 das. .5 for 46 das.	90	Excellent health throughout.
192	65	16.8	.25 for 44 das. .28 for 10 das. .33 for 9 das.	63	Excellent health throughout.
193	83	16.8	.25 for 44 das. .28 for 10 das. .33 for 9 das.	63	Excellent health throughout.
194	85	31.8	.25 for 44 das. .28 for 10 das. .5 for 36 das.	90	Excellent health throughout.
195	65	16.8	.25 for 44 das. .28 for 10 das. .33 for 9 das.	63	Excellent health throughout.

196	70	16.8	.25 for 44 das. .28 for 10 das. .33 for 9 das.	63	Excellent health throughout
197	54	16.8	.25 for 44 das. .28 for 10 das. .33 for 9 das.	63	Excellent health throughout.
170	74	18.2	.32 for 57 das.	57	Aborted after weigh day.
171	46	18.2	.32 for 57 das.	57	Had been on sorghum; beca very weak before putting cotton seed meal.
174	47	18.2	.32 for 57 das.	57	Had been on sorghum; beca very weak before putting cotton seed meal.
198	35	5.9	.28 for 21 das.	21	Had been on sorghum; beca very weak before putting cotton seed meal.
177	68	18.2	.32 for 57 das.	57	Had been on hay. Gai rapidly when put on cot seed meal.
181	61	18.2	.32 for 57 das.	57	Had been on hay. Gai rapidlv when put on cot seed meal.
140	52	18.2	.32 for 57 das.	57	Had been on hay. Gai rapidly when put on cot seed meal.
185	58	18.2	.32 for 57 das.	57	Had been on cotton s before placed on cotton s meal.
188	50	18.2	.32 for 57 das.	57	Had been on cotton s before placed on cotton s meal.
189	65	18.2	.32 for 57 das.	57	Had been on cotton s before placed on cotton s meal.
199	49	18.2	.32 for 57 das.	57	Had been on cotton s before placed on cotton s meal.
1908.					
185	95	65.1	.23 for 94 das. .8 for 33 das. .57 for 30 das.	157	Excellent health throughou
48	100	65.1	.23 for 94 das. .8 for 33 das. .57 for 30 das.	157	Excellent health throughou

182	110	80.5	.23 for 67 das. .80 for 60 das. .57 for 30 das.	157	Excellent health throughout.
177	96	79.9	.23 for 68 das. .80 for 59 das. .57 for 30 das.	157	Excellent health throughout.
194	84	16.6	.23 for 72 das.	72	Aborted. Taken out of test.
5	109	58.1	.23 for 165 das. .48 for 42 das.	207	Excellent health throughout.
186	100	84.3	.23 for 84 das. .80 for 43 das. .57 for 30 das. .48 for 28 das.	185	Excellent health throughout.
193	90	27.8	.23 for 121 das.	121	Died. No report on death.
58	81	77.1	.23 for 73 das. .8 for 54 das. .57 for 30 das.	157	Excellent health throughout.
190	68	19.8	.23	86	Aborted. Taken out of test.
178	95	77.1	.23 for 73 das. .8 for 54 das. .57 for 30 das.	157	Excellent health throughout.
61	99	74.2	.23 for 78 das. .80 for 49 das. .57 for 30 das.	157	Excellent health throughout.
30	102	65.5	.23 for 106 das. .57 for 30 das. .48 for 50 das.	186	Excellent health throughout.
33	93	31.1	.23	135	Aborted. Taken out of test.
17	60	16.8	.23	73	Taken out of test as sh was young and was gettin weak.
70	110	91.7	.23 for 71 das. .8 for 56 das. .57 for 30 das. .48 for 28 das.	185	Excellent health throughout.
71	100	101.1	.23 for 73 das. .80 for 54 das. .57 for 30 das. .48 for 50 das.	207	Excellent health throughout.
174	75	97.4	.5 for 71 das. .8 for 56 das. .57 for 30 das.	157	Excellent health throughout.

192	91	38.5	.50 for 77 das.	77	Excellent health throughout.
2	114	114.8	.50 for 93 das. .80 for 34 das. .57 for 30 das. .48 for 50 das.	207	Excellent health throughout.
195	75	98.6	.5 for 67 das. .8 for 60 das. .57 for 30 das.	157	Excellent health throughout.
47	85	47.0	.5 for 94 das.	94	Absorted. Taken out of test.
14	135	106.0	.5 for 109 das. .8 for 13 das. .57 for 30 das. .48 for 50 das.	202	Excellent health throughout.
196	70	118.1	.5 for 82 das. .8 for 45 das. .57 for 30 das. .48 for 50 das.	207	Excellent health throughout.
29	105	97.3	.5 for 116 das. .8 for 11 das. .57 for 30 das. .48 for 28 das.	185	Excellent health throughout.
59	85	102.1	.5 for 100 das. .8 for 27 das. .57 for 30 das. .48 for 28 das.	185	Excellent health throughout.
181	81	109.9	.5 for 74 das. .8 for 53 das. .57 for 30 das. .48 for 28 das.	185	Excellent health throughout.
36	101	102.6	.5 for 155 das. .57 for 2 das. .48 for 50 das.	207	Excellent health throughout.
199	80	105.5	.5 for 124 das. .8 for 3 das. .57 for 30 das. .48 for 50 das.	207	Excellent health throughout.
26	69	102.6	.5 for 162 das. .48 for 45 das.	207	Excellent health throughout.
191	99	104.8	.5 for 91 das. .8 for 36 das. .57 for 30 das. .48 for 28 das.	185	Excellent health throughout.

Sixty-five ewes have been fed upon cotton seed meal for different lengths of time, and in varied amounts and no ill results have occurred with the possible exception of one ewe (Ewe No. 4). After she had been on a cotton seed meal ration for 147 days (in 1907) she staggered and became blind, and finally died. Aside from the blindness and staggering she seemed to be in good health and was very fat when death occurred. There were, during the four years, six cases of abortion among the ewes eating cotton seed meal. Among the check lots (those eating no cotton seed meal) there were as many abortions. The ewes in 1908 were fed upon the same load of cotton seed meal that killed several hogs in the swine experimental work, but not a single ewe suffered any ill results from its use. It is true that the ewes did not receive as much cotton seed meal as did the hogs, per hundred pounds live weight, but still the sheep were kept upon the meal double the length of time the hogs were.

The roughage used in all of the above cases was cotton seed hulls.

While the results are but negative ones, still they seem to warrant the conclusion that there is very little risk to run, if any, in feeding cotton seed meal to ewes, when fed in amounts just sufficient to carry the animal through the winter in good breeding condition.

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AUBURN

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Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

TESTS OF VARIETIES OF COTTON IN 1909

BY

J. F. DUGGAR, Director,

AND

E. F. CAUTHEN, Farm Supt. and Recorder.

Opelika, Ala.:
The Post Publishing Company,
1910

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TESTS OF VARIETIES OF COTTON IN 1909.

BY

J. F. DUGGAR AND E. F. CAUTHEN.

In 1909 thirty varieties of cotton were tested on plots on the Experiment Station Farm at Auburn. The cotton was left one plant in a hill in checks 3 1-2 by 3 1-2 feet. The fertilizer per acre consisted of 240 pounds acid phosphate, 120 pounds nitrate of soda and forty pounds of muriate of potash, making a total of 400 pounds.

The rather large yields (up to about 1 1-2 bales per acre) for this grade of naturally thin, gray, sandy land were attributable chiefly to plowing under with a disc plow early in April, 1909, a crop of crimson clover, which was then ten to eighteen inches high and beginning to bloom. Seed of crimson clover had been sown on this inoculated land September 9, 1908, and merely cultivated in between the rows of corn.

After making allowance for vacant hills, the varieties ranking highest in combined value of lint (at 14 cents) and seed (at $25.00 per ton) were the following: Cook, No. 206; Cook, No. 221; Dixie; Hardin; and Poulnot.

Cook, No. 206, and Cook, No. 221, are both strains of Cook Improved that have been bred up at the Alabama Experiment Station. In yields of lint per acre, (793 pounds and 736 pounds), and in total value of seed and lint per acre, ($125.58 and $117.36), and in per cent. of lint (40.6 and 39.1 per cent.), they show superiority to the parent variety and to the other varieties tested.

These two improved strains of Cook suffered severely from anthracnose, generally called boll rot; so did all strains of Cook, whether improved or not; also Brown, No. 1, Blue Ribbon and Hardin. All varieties were attacked by this disease, but to a smaller extent than those mentioned.

Varieties of cotton in 1909, ranked according to total value per acre of seed and lint.

VARIETY	Actual Yield per Acre. (Stand variable) Lint	Value per acre of lint at 14c. and of seed at $25 per ton	Percentage of lint.	Corrected to Uniform Stand. Lint per acre	Value per acre of lint at 14c. per pound and of seed at $25 per ton
	Lbs.		Per ct.	Lbs.	
Cook, No. 206	746.7	$117 73	40.6	793.5	$125 58
Cook, No. 221	687.9	109 29	39.1	736.1	117 36
Dixie	602.5	98 59	31.9	681.3	113 75
Hardin	693.2	110 22	38.8	693.5	110 96
Poulnot	602.6	96 69	37.1	666.6	107 35
Peterkin	654.9	104 68	37.8	658.1	105 63
Cleveland	634.5	102 77	35.4	643.1	104 65
Layton	661.2	104 83	39.4	659.1	103 85
Cook	607.9	97 43	37.3	629.0	101 26
Texas Bur	602.5	98 41	34.8	610.4	100 22
Brown, No. 1	597.2	95 87	37.4	606.1	97 72
Broadwell's Double Jointed	575.9	92 77	36.1	599.6	97 21
Georgia Best	586.5	94 37	36.6	591.5	95 60
Cook, No. 232	559.9	88 05	41.2	596.2	94 06
Toole	581.2	92 03	39.7	587.3	93 36
Truitt	575.9	94 61	33.1	565.2	93 35
Russell	522.6	86 89	31.4	556.5	93 13
Cook, No. 239	527.9	83 50	39.9	585.1	92 95
Blue Ribbon	521.5	85 37	31.6	541.5	90 54
Dillon	479.9	77 32	36.3	557.9	90 28
Gold Coin	533.2	85 50	37.2	545.4	87 78
Rowden	525.5	85 15	34.4	526.9	86 28
Strickland	485.2	79 22	32.6	514 0	85 20
Drake (Defiance)	474.6	77 97	36.2	506.1	83 59
Simpkins	511.9	82 79	35.7	512.7	83 33
King	474.5	76 77	35.6	502.4	81 69
Triumph	495.9	80 88	34.3	499.7	81 92
Allen Long Staple	469.2	78 62	30.4	485.8	82 00
Keenan	399.8	67 05	30.3	414.1	69 87
Trice	400.0	66 58	31.2	390.0	64 71

On account of the amount of anthracnose on the Station farm in 1909, and because the seed is believed to be one of the means of conveying this widely spread disease, the Station must decline to send out seed of these strains of Cook until further selection has been made for resistance to this disease.

Dixie, which ranked third in total value of products and fourth in yield of lint per acre, is a strain of wilt-resistant cotton developed by the U. S. Department of Agriculture.

In our variety tests in 1909, Dixie ranked third in value of products. The plant is compact and well supplied with fruit limbs, on which the bolls are borne close together. Its conspicuous merits are (1), its ability to thrive on land where most other varieties are killed by cotton wilt or black root, and (2), its productiveness, the results of scientific selection. The chief faults are lateness, small bolls and a low percentage of lint.

Hardin, which ranked fourth in corrected yield, is a small-bolled, semi-cluster variety. In none of the previous tests at Auburn has it shown conspicuous productiveness nor given nearly so high a percentage of lint, (38.8) as in 1909.

Poulnot is a semi-cluster variety, with medium to large bolls. It has usually ranked rather high in our variety tests. Its worst fault is its rather late maturity.

The other varieties that stood above the middle of the list in 1909 ranked, in value of total products per acre, in the following order: Peterkin (6th), Cleveland, Layton, Cook Improved, Texas Bur, Brown No. 1, Broadwell Double-jointed, Georgia Best, Cook No. 232 and Toole.

Fifteen other varieties ranked below all of those mentioned above. The ranking varieties in the last four variety tests at Auburn are as follows:

1905.	1906.	1908.	1909.
Toole	Cook	Dillon	Cook, No. 206
Cook Improved	Cleveland	Gold Coin	Cook, No. 221
Cleveland	Layton	Dixie	Dixie
Bancroft Herlong	Toole	Cook Improved	Hardin
Christopher	Poulnot	Hart	Poulnot

From this it appears that Cook was in the list of "five best" in each of three years; Toole, Cleveland and Poulnot, each occurred twice in the list of most productive varieties.

Each of the most productive varieties has some shortcoming. Cook is more susceptible than most varieties to boll rot; Toole has small bolls; Cleveland readily drops the seed cotton from the burs; Dixie and Poulnot are late. Each grower can decide which of these faults he considers least objectionable, or whether, to avoid all of them, he will choose some good variety which, at this Station, has proved less productive,—for example, Triumph.

The earliest varieties grown in 1909 were Trice, Broadwell Double-jointed, Simpkins and King; the last two appeared to be practically identical.

A number of varieties additional to those mentioned in the table were grown for observation on areas too small to determine the yields per acre.

NUMBER OF DISEASED BOLLS.

Anthracnose of the bolls, generally called boll rot, was so prevalent on the Station farm in 1909 that an unusual opportunity was offered to test the relative susceptibility of different varieties to this disease. The figures in the following table are based on counts made in winter of the total number of burs and of the number of bolls that had been so injured as to cause the loss of one or more locks. Diseased bolls as here reported consisted chiefly of those injured by anthracnose, but the figures include also smaller losses due to another disease. They also doubtless include a small number of bolls damaged by boll worms.

Percentage of diseased bolls; varieties arranged in order of freedom from diseased bolls.

Varieties.	*Per cent.*
Rowden	5
Cleveland	5
Dixie	5
Simpkins	5
Strickland	6
Trice	6
Drake Defiance	7
Truitt	7
King	7

ADDRESSES OF GROWERS.

The Experiment Station has no seed for distribution. The seed used in the variety test was secured from the following parties:

Cook Improved—J. R. Cook, Ellaville, Ga.

Cook, Nos. 206, 221, 232, and 239—Alabama Experiment Station, Auburn, Ala.

Brown No. 1—M. L. Brown, Decatur, Ga.

Hardin—W. P. Letson, Glen Allen, Ala.

Dillon—U. S. Department of Agriculture, Washington, D. C.

Dixie—U. S. Department of Agriculture, Washington, D. C.

Keenan—U. S. Department of Agriculture, Washington, D. C.

Poulnot—J. E. Bradberry, Athens, Ga.

Drake's Defiance—J. C. McAuliffe, Harlem, Ga.

Broadwell Double-jointed—J. B. Broadwell, Alpharetta, Ga.

Blue Ribbon—South Carolina Experiment Station, Clemson College, S. C.

Allen Long Staple—Amzi Godden Co., Birmingham, Ala.

Layton Improved—R. D. Layton, St. Mathews, S. C.

Gold Coin—Excelsior Seed Farm, Bennettsville, S. C.

Peterkin—J. A. Peterkin, Fort Motte, S. C.

Cleveland—Alabama Experiment Station, Auburn, Ala.

Rowden—Ben Crawford, Blake, Okla.

Texas Bur—R. D. Tatum, Palmetto, Ga.

Strickland—J. R. Strickland, Pleasant Grove, Ala.

Triumph—Wade Brothers, Alexander City, Ala., and Chas. L.Gay, Montgomery, Ala.

Georgia Best—G. W. Stone, Oxford, Ga.

Russell,—A. M. Troyer, Calhoun, Ala.

King—J. W. Mitchell, Youngsville, N. C.

Simpkins—W. A. Simpkins, Raleigh, N. C.

Trice—W. N. McFadden, Warren, Tenn.

Toole—W. F. Covington, Headland, Ala.

Truitt—G. W. Truitt, LaGrange, Ga.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

RAISING BEEF CATTLE IN ALABAMA

BY

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AND

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Opelika, Ala.

Post Publishing Company

1910

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*In co-operative beef work with Bureau of Animal Industry.

Some Alabama grass steers. In Experimental work in summer 1909.

RAISING BEEF CATTLE IN ALABAMA

By Dan T. Gray and W. F. Ward.

INTRODUCTION.

The work of eradicating the "Texas-fever" tick is progressing satisfactorily in the South; every year new areas are freed from the tick, and with the progress of the work there comes an added interest in all kinds of cattle production. When the ticks in a county are exterminated, renewed interest begins to be immediately manifested in the beef cattle business, as the Southern farmers now realize that the "Texas-fever" tick has been practically the only drawback to the cattle business in the past. When the tick is finally exterminated no section of the United States will be as well suited to beef production as the South, because of its mild climate, long grazing season, and cheap lands.

At the present time the South produces but a small proportion of the meat that her people consume. In Alabama there are but 544,000 head of cattle other than milk animals; or, in other words, there are about 1.2 head of cattle in the State to each family. If no outside meats were shipped into the State, the people would consume all of this beef in less than a year's time. There is a wide field open to the Southern farmer who wishes to produce beef.

There are many reasons why the Southern States should raise more beef cattle than are being raised at the present time. First, the South, under the present system of farming, has thousands of acres—and good ones, too—which are not being used at all. Statistics tell us that only about 40 per cent of the tillable or arable land of the South is being used. Sixty per cent of the land is lying idle and returns to the owner not a cent in wealth. All of the lands cannot be used as cotton lands, because, first, there are not enough people to work the lands in any such way, and second, many of these pauper acres are not suitable for cultivation. In fact, many acres that are now under cotton cultivation should be turned into permanent pastures and grazed with live stock. No state can become wealthy when only 40 per cent of the land capital is being used. The grocer, or the banker, or the hardware merchant, could not possibly make a profit on his business if he used only 40 per cent of his capital. And the farmer cannot hope to be successful in his operations until he begins to make use of at least a reasonable proportion of his capital. No farming business can be made successful when only $4,000 out of a possible $10,000 is being used.

Then again beef cattle should be more generally introduced because of the good they do in building up and maintaining soils. Under the present system of cotton farming the soils are becoming poorer and poorer. With the introduction of cattle the soil will begin to be built up. Director Thorne, of the Ohio Station, has been making tests with barnyard manure for several years, applying the manure upon a plat of ground upon which was running a three years' rotation of corn, wheat and clover. Eight tons of manure an acre were applied. The average yearly increase an acre, following the one application, was as follows:

Corn, 14.7 bushels at 70 cents a bushel	$10.29
Corn stover, 744 pounds at $6.00 a ton	2.23
Wheat, 8.36 bushels at $1 a bushel	8.36
Wheat straw, 897 pounds at $4 a ton	1.79
Clover hay, 686 pounds at $12 a ton	4.12
Total value 8 tons of manure	$26.79
Total value 1 ton of manure	3.35

He further states (Bul. 183, Ohio Experiment Station) that the value of farm manure can be materially increased by balancing the manure with the addition of a carrier of phosphorous. The farm manures are too high in nitrogen as compared with the other elements. By balancing stable manure, the value of 8 tons was increased $12.20 after deducting the cost of the material used for the balancing of the manure. This is $1.53 a ton, or when added to the $3.35 above, brings the total possible value of each ton of manure up to $4.88. During a feeding period of 100 days each steer will produce at least 1.5 tons of manure. This profit should be added to the feeding or direct profits. The Arkansas Station (Bul. 68) made a test to determine the value, to each succeeding crop, of growing peas in the corn, gathering the corn and then grazing both the peas and the stalks by the steers. The steers were being fed some cottonseed in addition to the grazing. As the result of this crop of peas and the grazing, the succeeding cotton crop was increased 626.5 pounds of seed cotton over the area where corn alone had been grown. A third lot was planted to corn, and the increase in corn, due to the pea crop and the grazing, was 14 bushels per acre.

A third reason why beef should be more generally produced in the South, is that there is a demand for it, and the demand should be met in order that the money may be kept at home. "During the year of 1907 there were about 15,151 home raised animals slaughtered in the city of Birmingham (this includes cattle, veal, hogs, sheep and kids), while there were 36,097 live Western animals brought into the city and slaughtered. In addition to all this, thousands of pounds of cured meats were also retailed over the city." (Farmers' Bulletin No. ...) This money should be kept at home and added to the Southern wealth. Packing houses are now being built throughout the South, and good markets are assured for the beef animals which the farmer produces.

The fourth reason offered in favor of beef production is, that as our farmers learn the value of diversification in farming operations, there will be an increased amount of roughage, as corn, fodder, cowpea and clover hays, soy beans, etc., which, many times can be marketed more profitably through the beef animals than in any other way. The beef cattle serve as important machines for converting the surplus fodders into valuable barnyard manure, which gives to the growing crops not only the benefits of its fertilizing elements, but increases the mechanical condition of the soil by the addition of that important compound—humus. No animal can take the place of the beef steer in making use of the winter corn and cotton fields.

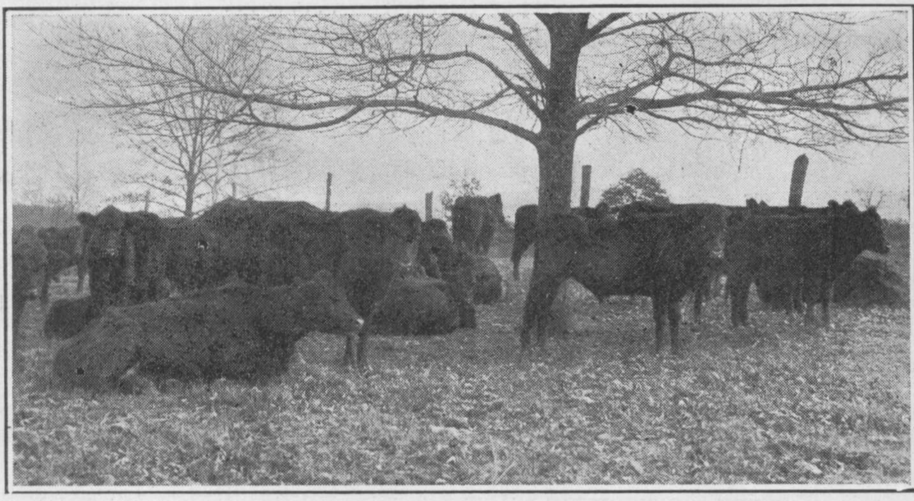
Beef cattle are peculiarly suited to fit into the farming operations of the South. The farms are large, and many acres are not being used because of the lack of sufficient labor. At present there is no better way to put the whole farm to work than by introducing beef cattle into the system of farming. They require but a small amount of labor in addition to that used upon the average cotton farm. The hog, while he deserves a prominent place upon almost every farm, cannot be made to use all of the large uncultivated areas on the farms, for he is not strictly a grazing animal. Many farmers who have the large uncultivated areas are not now sufficiently skilled in the handling of live stock to introduce sheep or dairy cattle, as the sheep and dairy business require more skill than the beef business. Then, too, the dairy business requires an increase in the amount of labor used upon the farm; and the labor item is one that many farmers are trying to reduce.

DETAILS OF THE TEST.

Object of the Work.

The primary object of this work was to learn what it would cost to raise a grade steer to the feed-lot period, under average Southern conditions. After this was determined, it was expected that suggestions could be made and plans offered by which beef animals could, in the future, be produced more cheaply than were the ones in this test.

In order to obtain definite information regarding beef



General view of cattle used in experiment.

production in the South, which would enable them to logically outline work for the future, the Alabama Experiment Station, and the Bureau of Animal Industry of the United States Department of Agriculture, jointly undertook a co-operative experiment with a large stock farmer in the Tennessee valley.

Cattle Used.

The animals used in the work were a herd of grade Aberdeen-Angus cows, headed by two pure-bred Aberdeen-Angus bulls. Mr. J. S. Kernachan, of Florence, Alabama, the farmer with whom the work was conducted, began in 1900 the work of grading up some Holstein and scrub cows by the use of pure-bred Aberdeen-Angus bulls. The Holstein cows had been used for dairy purposes. The scrub cows were bought from some of the neighboring farmers. The scrub and Holstein mothers were not included in the experimental work. Their grade offspring were used. The experimental herd, at the beginning of the test in 1906, consisted of the following animals:

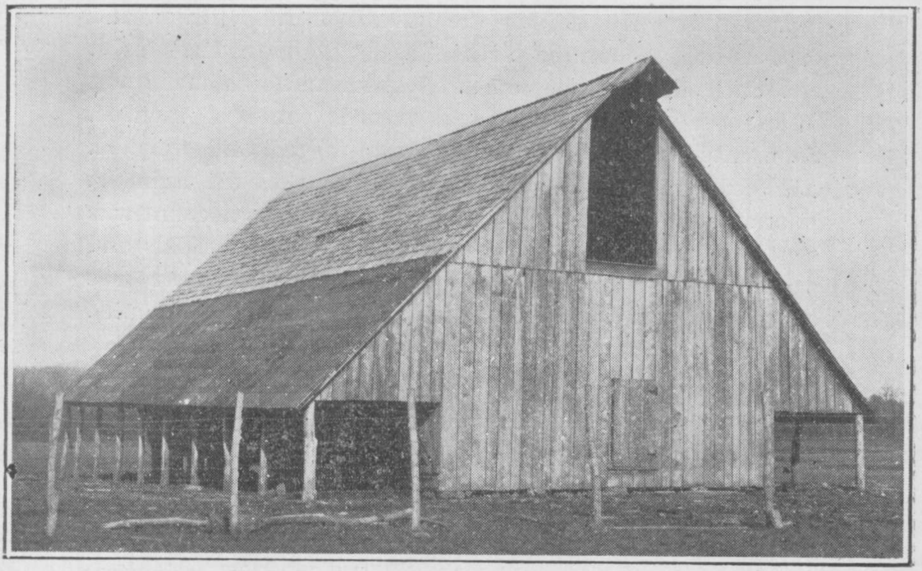
Cows (that had dropped calves)	15
Two year old heifers (18 to 30 months) ...	13
Yearling heifers (12 to 18 months)	12
Heifer calves (recently born)	14

Three of the above cows were five years old; the others were less than five years of age. All of them were grade Angus. Some of the young ones were three-fourths pure, but the majority were but one-half pure. While Mr. Kernachan had some pure-bred Aberdeen-Angus cows upon his farm, they were not included in the test. No pure-bred animals except the bulls were used.

Management of the Herd.

During the summer months the herd grazed upon a good pasture; no feed was given in addition to the pasture. This pasture was made up principally of white clover, bermuda and lespedeza. This afforded the animals abundant pasture for about seven months of the year. During the winter months all of the cattle, young and old, had the run of the range. This range, which was inclosed, consisted of the old corn and cotton fields, with some cane along the river and creek banks. In addition to the winter range, hay and cottonseed were fed (See statement later for the winter feeds). The cattle were not made to go through the winter on range alone, so when spring came they were in reasonably good flesh. It might have been profitable to have kept all the animals gaining throughout the winter months; as to this the authors cannot say since this test does not cover that point. The young stuff did make gains during each winter, but the cows and older animals usually lost in weight during the latter part of the winter.

The shelter was of such a nature that none of the animals suffered from the cold. During the mild winter weather the canebrake afforded ample protection from the cold. During severe storms or continued wet spells the cattle barn was used.



The barn used to store hay and shelter cattle. Note the open sheds on each side. 50 x 70 feet.

During the first year of the test the bulls were not allowed to run with the cows. The males were kept in a pasture separate from the cows and the cows brought there to be bred. It was learned, however, that many of the cows went through the year without bringing calves, as the other farm work prevented the owner from keeping in close touch with the cows. During the second year's work the bulls were allowed to run with the cows; thereupon the per cent of calves born during the first quarter of the year increased very materially over what it was when the bulls were kept in a pasture to themselves.

No effort was made to completely eradicate the ticks. When the cattle became badly infested with ticks they were greased on the parts of the body where the ticks were most numerous.

How Data was Collected.

The farm was visited at least every three months by a representative from either the Bureau or the Station, and data secured about the births, deaths, weights, feeds used, etc. Each animal was numbered by means of a metal tag in the ear so that individual records could be secured. Soon after a calf was born it was tagged and weighed. All feeds were weighed or measured out to the animals. Vast amounts of manure were produced, but no account was kept of it, as most of it was dropped out in the fields and pastures. During the winter months some manure was collected around the barns and lots; this was all hauled onto the cultivated fields.

Price of Feeds.

Local conditions determine, to a large extent, the price of feeds. Any prices that the authors might assume would not meet all conditions, but the following prices have been taken as a basis upon which to rest the financial estimates:

Mixed hay	$ 6.00 a ton
Cottonseed	14.00 a ton
Green sorghum	1.50 a ton
Pasture	2.50 an acre for season

The hay, which consisted of a mixture of sorghum, crab grass, Johnson grass and cowpeas, was not of good quality, so a rather low farm price was placed upon it. Six dollars a ton was all it was worth. The green sorghum was used one fall (1906) for several days to supplement a short pasture which was rendered short on account of an extreme drouth, and an early frost. The sorghum was cut and immediately thrown to the cattle. No price was placed upon the winter range. One hundred sheep, and about thirty horses and mules used the winter range in common with the cattle.

Weights and Gains.

Table I. *Average Weights and Gains of Cattle for Two Years*

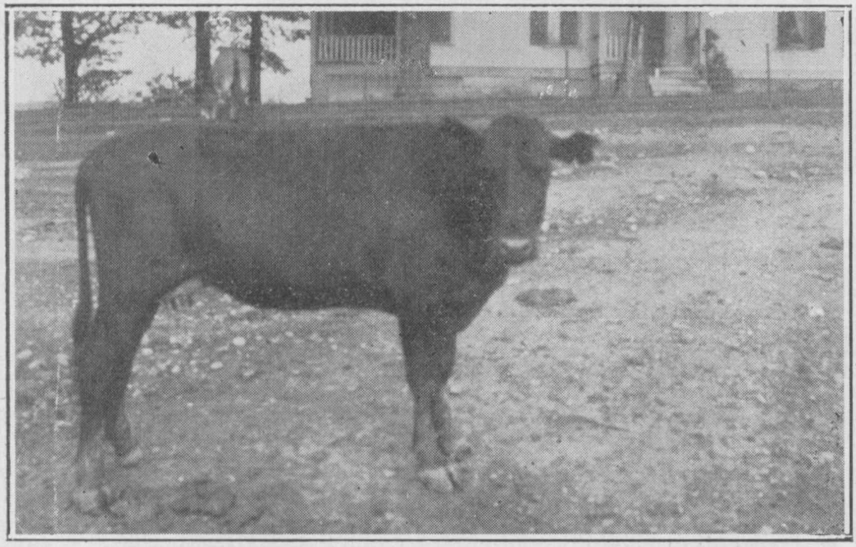
CLASS	No. of animals	Average final weight	Summer gains		Winter gains		Summer and winter gains	
			Average total gain per head for summer	Average daily gain	Average total gain per head for winter	Average daily gains	Total gain	Daily gain
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1-12 months	44	402	224	1.24	52	.29	276	.77
12-24 "	42	645	219	1.22	—16	—.089	203	.564
24-30 "	30	773	196	1.09	—25	—.14	170	.472
24-33 "	18	832	170	.95	—35	—.19	136	.40
Cows*.			116	.65	—104	—.58	12	.034

*Number of cows varied from time to time.

From the above table (Table 1) we see that at twelve months of age the calves averaged 402 pounds in weight, while the 24 months old steer averaged 645 pounds, the 30 months old steers averaged 773 pounds, and the animals which were 33 months old weighed 832 pounds. These were light weights, which were due, in part at least, to the fact that the animals had ticks on them during the summer months.

During the summer the gains were heaviest with the calves, each one making a gain of 224 pounds from April 15th to October 15th, or a daily gain of 1.24 pounds. Each yearling made a gain of 219 pounds, or a daily gain of 1.22 pounds during the six months of summer. During the third period (24-30 months) a daily gain of 1.08 pounds was made, while in the fourth period (24-33 months) a daily gain of only .95 pounds per head was made. The cows gained .65 of a pound per head per day, or a total gain of 116 pounds each during the summer.

During the winter months (October 15th-April 15th) each calf made a total gain of 52 pounds or a daily gain of .29 of a pound. The yearlings lost 16 pounds each in weight for the winter, the animals ranging from 24 to 30 months old lost 25 pounds each, and those which came in the fourth class (24-33 months) lost 35 pounds each for the same period. The cows lost 104 pounds each; this was largely due to the fact that many of them dropped calves during the winter time.



An average cow of the herd. Does not show compactness and sufficient depth of body for an ideal beef cow.

An average of the whole year shows that the calves made a daily gain of .77 pounds or a total gain of 276 pounds per head. The yearlings made a daily gain of .564 pounds per head, or a total of 203 pounds for the 12 months. A gain of 170 pounds per head, or a daily gain of .47 of a pound, was made by the cattle while they were increasing from 24 months to 30 months in age, while 136 pounds or .4 of a pound per head per day, was made by the animals while they were increasing in age from 24 to 33 months. The cows gained only 12 pounds for the year, showing that they were practically mature when they first dropped calves.

In short, the above table shows that, under the conditions of this experiment the daily gains were smaller as the animals increased in age. This was true in both the summer and winter work.

The gains were not as large as they should have been, due partly to the extremely dry weather from June to July 20, 1906, when the grass in the pastures became perfectly dry, and partly to the fact that one of the pastures used in 1907, was so wet in the early spring, that the grass did not grow satisfactorily during the whole summer. The fact has already been mentioned that the animals were also infested with the Texas tick.

Cost of Gains.

The cost of gains during the summer was based upon a rental of $2.50 per acre for all land used for pasture; calves under one year of age were charged one-half price. When the cost of keeping the dam was not charged against the calves, they made 100 pounds at a cost of 63 cents, but when the expense of the dam, as well as the pasture of the calf were charged against the calf, the cost of 100 pounds of gain was raised to $1.88. The cost of keeping the dam is the expense of keeping 1.39 cows, as only one calf was produced to every 1.39 cows. (See table 4). The yearlings made 100 pounds of gain during the summer at a cost of $1.28, the two and a half year old steers (24-30 months) at a cost of $1.43, and the gains of the steers in the fourth class (24-33 months) were made at a cost of $1.65 per 100 pounds.

TABLE 2. *Average Cost of Summer and Winter Gains.*

CLASS	Summer: Pounds gain	Summer: Cost of pasture	Summer: Cost of 100 pounds gain	Winter: Pounds gain	Winter: Cost of feed	Winter: Cost of 100 pounds gain	Whole Year: Pounds gain	Whole Year: Cost of pasture and feed	Whole Year: Cost of 100 pounds gain
Calves* 1–12 months	224	$1 40	$0.625	52	......	......	276	$1 40	$ 0 51
Calves** 1–12 months	224	4 20	1 88	52	$4 90	$9 42	276	9 10	3 30
Yearlings 12–24 months	219	2 80	1 28	—16	4 90	......	203	7 70	3 79
2-yr. olds 24–30 months	195	2 80	1 43	—25	4 90	......	170	7 70	4 53
2-yr. olds 24–33 months	170	2 80	1 65	—35	4 90	......	136	7 70	5 66
Cows all ages	116	2 80	2 41	—104	4 90	......	12	7 70	64 18

*Keep of dam not charged. **Keep of dam charged.

Feeds charged as follows: Cottonseed at $14.00 per ton; green sorghum at $1.50 per ton; mixed hay at $6.00 per ton; pasture charged at $2.50 per acre for season.

In the winter all cattle had access to the corn, cotton and pea-stubble fields of the plantation, and were fed some hay and a small amount of cottonseed to keep them in a reasonable condition of flesh. The average cost of wintering those animals that were more than twelve months of age was $4.90 per head (See table 3).

When the cost of wintering the dam was charged against the calf, the cost of 100 pounds of gain was $9.42. As all the other animals lost some in weight during this period, the cost of gain could not be determined.

The last column of Table 2 shows that when the cost of keeping the dam was not charged against the calf, 100 pounds of gain for the whole year cost 51 cents, but when the dam's yearly expense, as well as the pasture of the calf, were charged against the calf, the total cost to make 100 pounds of gain was $3.30. The cost of keeping an animal from the time he was 12 months until he was 24 months old was $7.70; the amount of gain was 203 pounds, thus making 100 pounds of gain cost $3.79.

The two year old animals (24-30 months) gained 170 pounds at a cost of $7.70, or at a rate of $4.53 per 100 pounds for the year. The cost of gain on the long two year old cattle (24-33 months) was $5.66 per 100 pounds.

The last column of the table points out the fact that, as the animal advanced from the calf period to maturity, the cost of 100 pounds of gain increased, and all other conditions being equal, the younger the animal the cheaper were the gains.

WINTERING CATTLE.

Table 3, shows the total amount of feed consumed, the total cost to winter the whole herd, and the average cost to winter each animal for three consecutive winters.

TABLE 3. *Cost of Wintering Cattle**

YEAR	No. of cattle	Pounds of cotton seed consumed	Cost of cotton seed	Pounds of green sorghum consumed	Cost of sorghum	Pounds of hay consumed	Cost of hay	Total cost	Average cost per head
1905-'6..	45	27000	$189 00	......	......	35600	$106 80	$295 80	$6 57
1906-'7..	65	12000	84 00	22000	$16 50	39600	118 80	219 30	3 37
1907-'8..	59	3132	21 92	......	......	86443	259 32	281 24	4 77
Average	....	14044	98 31	7333	5 50	53881	161 64	265 45	4 90

*Only animals above one year old were counted. The feed that the calves ate was charged against those animals which were more than one year old.

During the winter of 1905-'6 the herd consumed 27,000 pounds of cottonseed and 35,600 pounds of hay. That is, each animal that was more than 12 months old, consumed 600 pounds of cottonseed and 791 pounds of hay for the whole winter. The winter of 1905-'6 was a hard one on the cattle, as it was very wet and rainy. The winter range was not as good as usual, hence the large amount of feed consumed.

With cottonseed charged at $14.00 a ton, and hay at $6.00 a ton, each animal that was over twelve months old, consumed $6.57 worth of feed. The cattle, as a herd, came through the winter in good condition.

The winter of 1906-'7 was very mild and the cattle did not eat as much feed per head as they ate the previous winter.

There were two very heavy frosts on the nights of October 13th and 14th, however, which killed all the lespedeza, so the cattle had to be fed some green sorghum from the middle of October until the fields became available as winter range.

Each animal consumed, during the whole winter, 338 pounds of green sorghum, 185 pounds of cottonseed, and 610 pounds of hay. The cost of wintering each animal above twelve months old was $3.37.

From October 15th to December 1st, of the winter 1907-'8, the cattle were fed hay and a small amount of cottonseed, as there was no green sorghum to be used. During this time they consumed 11 pounds of hay and 1.2 pounds of cottonseed per head per day. From December 1st to January 1st they were in the fields and canebrake and did not come up for feed. From January 1st to March 20th, 1908, the cattle came up to the barn each evening and were fed hay, but no grain.

For the whole winter each animal consumed 53 pounds of cottonseed and 1,465 pounds of hay. The cost of wintering the cattle was $4.77 per head.

The average for the three winters shows that it cost $4.90 to winter each animal over twelve months of age.

Area of Pasture Required per Animal.

A number of cattle, not in the experiment, were grazed in the pasture with the experimental cattle. Assuming that two calves would eat as much grass as an animal over twelve months old (and this assumption is followed out in rental charges), there would be the equivalent of 92 animals on 103 acres of land during the summer of 1906, or an average of 1.12 acres of pasture to each animal.

During the year of 1907 there were 90 animals on the 103 acres, giving an average of 1.14 acres to each animal.

An average for the two years shows that 1.13 acres of land furnished pasture for one animal. This area, when charged at $2.50 per acre, gives a cost of $2.80 per season for the pasture of each animal over twelve months old.

This pasture was far better than the average Alabama pasture, as is shown by the fact that 1.13 acres supplied sufficient pasture for one animal. On an average, from 3 1-2 to 5 1-2 acres are required for each animal. When this piece of land was first put down to pasture it would not to keep as many animals as it does now; in fact, it was no better than the average pasture but by grazing, it has been raised to its present state of fertility.

Breeding Record.

Table 4. *The Per Cent of Calves Born.*

YEAR	No. of cows	No. of calves dropped	Per cent. of calves dropped	Record by quarters; number of calves dropped: Jan. 15 to April 15	April 15 to July 15	July 15 to Oct. 15	Oct. 15 to Jan. 15
1906..........	24	17	70.8	5	4	5	3
1907..........	25	18	72	9	1	5	3
1908..........	25	14	56	14	..*	..	..

*The experiment closed on April 15th, so no record was obtained later than this date.

An animal that had dropped a calf was classified as a cow; the heifers were put in this class as soon as they calved. The number of calves born was very small, when compared to the number of cows that should have brought calves, especially during the year 1906. This low number was partly due, no doubt, to the fact that the bulls were kept away from the cows and the owner, owing to the pressure of other business, not being able to breed the cows when they should have been bred. The owner soon realized the fact that too many of the cows went through the year without bringing calves, so in the spring of 1907 he turned the bulls with the cows and permitted them to run together the year round.

A complete record of the number of calves dropped was not secured for the year 1908—the year after the bulls were turned with the cows—as the test closed in April; but during the first quarter of the year 1908, fourteen calves were born, while during the same quarter of the years 1906 and 1907 only 5 and 9 calves, respectively, were born. No record was kept of the number of calves dropped after April, 1908, but when the last notes and weights were made it was seen that practically all of the cows were pregnant. Of course, it is a disputed point whether it is better to allow the bull to be with the cows or to keep him away from them all of the time. The farmer who has large pastures and has other business to look after, in addition to the cattle, cannot possibly obtain a high per cent of calves unless the bull is permitted to be with the cows. The busy farmer will not see the cows at the right time.

The breeder of registered animals should not allow the bull to run with the cows, for it is desirable that a record of the date of service be kept.

It is important that as many of the cows as possible produce calves each year; the idle cow is not only idle capital but she is a constant consumer of farm products. The idle cow has a very important part to play in the total expense of raising a calf, as the expense of keeping her must be charged against the calves which other cows produce (See financial statement, table 5-A). When there were 25 cows the owner had $750 invested in cattle (estimating each cow to be worth $30); of this amount only $540 was returning a profit when 72 per cent of the cows brought calves. In this case there were $210 invested in idle capital; this amount represents the equivalent of seven cows, and those seven cows consumed $51.80 worth of feed in a year.

FINANCIAL STATEMENTS.

Feed Expense to Raise a Beef Animal to Various Ages.

As a rule the farmer charges nothing against the cost of raising a calf but the feeds consumed. Looking at it from this standpoint the cost of raising a calf in this experiment, to various ages was as follows:

A. To 12 months:

To winter feed of 1.39 cows the first winter	$ 6.81
To summer pasture of 1.39 cows	3.89
To summer pasture of 1 calf	1.40
Total cost	$12.10
Cost per hundred weight	3.01

B. To 24 months:

To cost of 12 months old calf	$12.10
To winter feed of animal (12-24 months)*	4.90
To summer pasture (12-24 months)	2.80
Total cost	$19.80
Cost per hundred weight	3.07

C. To 30 months:

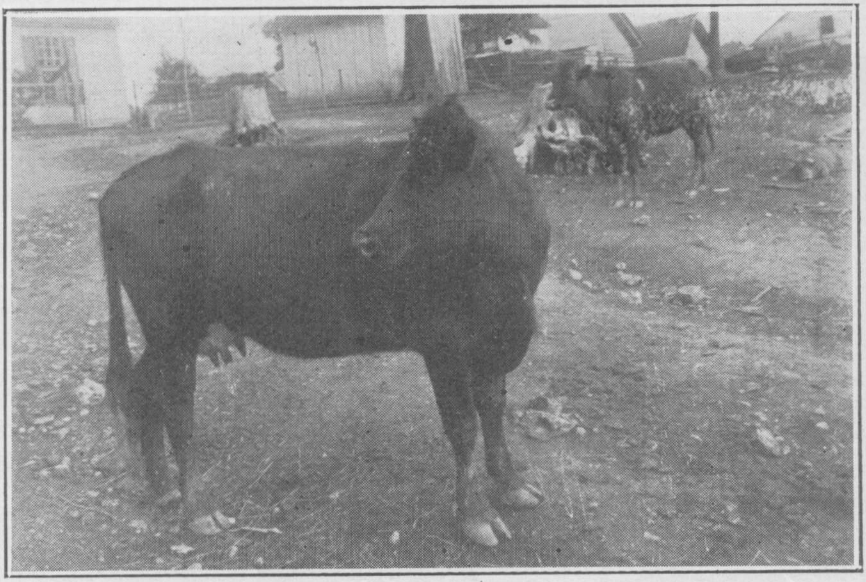
To cost of 24 months old steer	$19.80
To winter feed of animal (24-30 months)*	4.90
Total cost	$24.70
Cost per hundred weight	3.20

D. To 33 months:

To cost of 30 months old steer	$24.70
To summer pasture for one-half summer	1.40
Total cost	$26.10
Cost per hundred weight	3.14

*Here again it is assumed that all animals over twelve months of age ate the same amount of feed, which assumption is, of course, not absolutely accurate. In rental practice, though, this assumption is carried out.

It should be remembered that the different classes of animals were not kept separate and fed in different lots; they all ran together, so the above statement is only a close approximation of the cost of raising the animals to the various ages. In the above statement it has been assumed that all animals which were over twelve months of age ate the same amount of feed and pasture; it was further assumed that the animal under twelve months of age used only one-half as much pasture as the animal which was over one year old. The last assumption is in keeping



A good cow of the herd. She dropped a calf every year.

with actual farm charges for pasture. It should be remembered that the cost to winter an animal was secured by dividing the total number of animals over one year old into the total cost of feed consumed during the winter months.

When placing the value upon the feeds, as shown on page 2, it cost $12.10 to raise a twelve months old calf, $19.80 if he was kept until he was twenty-four months of age, $24.70 to raise him to two and one-half years old, and

$26.10 to keep him until he was thirty-three months old. Or, it cost about three cents a pound to grow the animal to various ages, when nothing but the feed and pasture was charged against him.

This feed bill could be materially reduced by extending the pasture grazing season. The pasture season could be extended three months, almost anywhere in the South, by the use of "spotted" burr clover (Medicago maculata). Burr clover is a winter growing crop and occupies the ground in common with bermuda, which makes its growth during the summer months.

Feed Expense, Interest, Insurance, etc., to Produce a Beef Calf.

In estimating the cost of producing a beef animal, it is usual to charge nothing against the animal but the winter feed and the pasture used. But there are other items that should be charged against this animal, as interest on the money invested in the cattle, mortality, depreciation in value of the cows, etc. He should be credited with the manure produced. The following estimates charge the calf not only with the feeds used, but the other items mentioned above, and gives him credit for the approximate amount of manure produced:

A. To 12 months old:	
To winter feed of 1.39 cows	$ 6.81
To summer pasture of 1.39 cows	3.89
To summer pasture of calf	1.40
To 7 per cent interest on 1.39 cows at $30 per head	2.92
To 7 per cent interest on 1-25 of a bull worth $150	.42
To annual depreciation in value of 1.39 cows at $1.50	2.09
To pro rata depreciation of herd bull	.80
To taxes, insurance, fencing and repairs	.86
To 4 per cent mortality	1.20
	$20.39

*By 3,600 pounds of calf manure at $1.25 a ton ..	$ 2.25
By 10,800 pounds of mother's manure at $1.25 a ton	6.75
Total expense of calf	$11.39
Cost per hundred weight	2.85
B. To 24 months old:	
To cost at 12 months of age (manure not included)	$20.39
To winter feed	4.90
To summer pasture	2.80
To 7 per cent interest on yearling	1.45
To taxes, insurance, repairs, etc.	.86
To 4 per cent mortality	.83
	$31.23
By 23,400 pounds of manure for 24 mos. at $1.25 a ton,	14.63
Total expense of steer	$16.60
Cost per hundred weight	2.57
C. To 30 months old:	
To cost at 24 months of age(manure not included)	$31.23
To winter feed	4.90
To 7 per cent interest on 2 year old animal for 6 mos.	1.10
To taxes, insurance, repairs, etc., for 6 months	.43
To 4 per cent mortality of 2 yr. old animals for 6 mos.	.63
	$38.29
By 28,800 pounds of manure for 30 mos. at $1.25 a ton,	18.00
Total expense of steer	$20.29
Cost per hundred weight	2.62
D. To 33 months old:	
To cost at 24 months old (manure not included)	$31.23
To winter feed	4.90
To 3 months pasture	1.40
To 7 per cent interest on 2 yr. old animal for 9 mos.	1.65
To taxes, insurance, repairs, etc., for 9 months	.64
To 4 per cent mortality for 9 months	.94
	$40.76
By 31,500 pounds of manure for 33 mos. at $1.25 a ton,	19.69
Total cost per steer	$21.07
Cost per hundred weight	2.53

*In estimating the amount of manure produced it was assumed that the animal under one year of age produced 20 pounds per day for 180 days; that the yearling produced 25 pounds per day for a year; and that the two year old steer and the cow each produced 30 pounds per day. The price of manure, $1.25 a ton, is an assumed one, as there was no way to determine its exact value. But, judging from the many tests that have been made at Stations, the above value is a very conservative one. For instance, as quoted in the introduction, the Ohio experiments show raw manure to be worth $3.35 a ton when placed under the crops mentioned; when the manure was treated with a phosphorous carrier, its value was raised to $4.88 a ton. There was a difference, though, between the Ohio manure and the manure secured in the above tests; the Ohio manure was collected in the winter time when grains and hays were fed. It was a richer manure than that made during the summer months in this test, but probably no richer than the Alabama manures made during the winter months.

It is seen that when a calf is charged with everything that could be charged against him, and then credited with the manure produced, the cost of making 100 pounds of gain was somewhat smaller than the figures obtained when nothing but the feed and pasture were taken into consideration.

The labor employed to feed and look after the animals was not included in the above estimates, as it was a very small item. One winter the labor to feed and care for the cattle was $10.00 for the whole herd. Another winter the total labor item was only $7.50. The method used in the feeding and handling involved the use of but little labor; there was no feeding to be done but once a day, when the cottonseed and the hay were measured out to the cattle in a very few minutes.

When all of the expenses were charged against the animals and no credit was made for the manure, the expense of producing a steer varied from $4.84 to $5.07 per hundred pounds. The cost per hundred weight of raising a steer, when the manure produced received no credit, was as follows:

To 12 months of age	$5.07 per hundred weight
To 24 months of age	4.84 per hundred weight
To 30 months of age	4.95 per hundred weight
To 33 months of age	4.90 per hundred weight

These figures mean that if the above animals were sold for the above prices (The above prices can be realized for good cattle, as is shown by the fact that 60 steers, of about the same quality as those in this test, were fed by the Alabama Experiment Station and the Bureau of Animal Industry and sold February 28th, 1910, on the Louisville market for $5.75 per hundred weight) the feeds used were marketed at a good farm price; all deaths were deducted; seven per cent interest was received on the money invested in the animals; $2.50 an acre were secured for the summer pasture; and finally the manure was secured free.

Of course, in order that all these profits be realized, good cattle must be raised; it cannot be done with scrubs; the scrub will not sell to advantage when he is offered to the butcher or packer, as his meat is of a poor quality and he dresses out a low per cent of salable meat.

The cattle upon this farm were not produced as cheaply as it is possible to raise them in the South. At least two farm practices can be introduced upon the average farm which will make it possible for steers to be raised much cheaper than were these animals. In this test no winter pastures were used, except the winter range. Through the use of a combination of burr clover and bermuda the pasture season can be extended at least two months in the year. The farmer who lives as far south as Greenville, Alabama, can have a grazing pasture the year through by the use of bermuda, burr clover and velvet beans. In the second place, the cattle were infested with the Texas tick, which reduced their average size no small amount. It is impossible to state just how much the tick retards the growth of a steer, but there were several severe cases of tick fever reported. Some of these cases died, and some of them lived, but when they did live they never attained anything near their normal size. Through the efforts of both the Southern States and the Federal Government the tick is now being exterminated; when the tick is eliminated, the farmer can expect to raise larger cattle than formerly, and, too, the death rate will be materially decreased.

BULLETIN No. 151 JUNE, 1910

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

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1. Wintering Steers in Alabama.
2. Fattening Cattle on Pasture in Alabama.

BY

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and

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*In co-operative beef work with Bureau of Animal Industry.

SUMMARY.

Part 1.

1. The cattle used in all of these tests were practically mature ones.

2. Winter rations used:

	1907-'08.	1908-'09.
Lot 1....	Range alone.	Range alone.
Lot 2....	Range plus half ration cottonseed meal and hulls.	Range plus half ration cottonseed meal and hulls.
Lot 3....	Range plus half ration peavine hay.	Range plus half ration cottonseed.
Lot 4....		Range plus half ration cheap hay.

3. In 1907-'08 each range steer (Lot 1) lost 97 pounds in weight. In 1908-'09 each range steer (Lot 1) lost 106 pounds in weight.

4. In 1907-'08 each steer in Lot 2 received 2.35 pounds of cottonseed meal and 8.5 pounds of hulls each day in addition to the range. During the winter of 1908-'09 each steer in Lot 2 received 2.41 pounds of cottonseed meal and 8.71 pounds of hulls daily. The first year each steer lost 6 pounds in weight; the second year each steer gained 3 pounds in weight.

5. In 1907-'08 each steer in Lot 3 was fed a daily ration of 8.5 pounds of good peavine hay in addition to the range; the loss in weight per steer for the winter was 9 pounds.

6. In 1908-'09 cottonseed was tried as a supplement to the range, 4.71 pounds being fed to each steer daily. The loss in weight per steer for the winter was 40 pounds.

7. In 1908-'09 cheap hay was used in Lot 4 to supplement the range, 11.8 pounds being fed to each steer daily. The winter loss per steer was 40 pounds.

8. The total cost to winter each steer in 1907-'08 was $4.70 and $3.57 in Lots 2 and 3 respectively. The total cost to winter each steer in 1908-'09 was $5.63, $3.23 and $2.06 in Lots 2, 3 and 4 respectively.

9. In 1907-'08 the fall buying price was $2.50 per hun-

dred weight. When the expense of wintering the steers was added to the fall price the spring prices were found to be $2.89, $3.17 and $3.03 per hundred weight in Lots 1, 2 and 3 respectively.

10. In 1908-'09 the fall buying price was $2.56 per hundred weight. When the expense of wintering the steers was added to the fall price, the spring prices were found to be $3.01, $3.34, $3.20 and $3.09 per hundred weight in Lots 1, 2, 3 and 4 respectively.

Part II.

1. The steers which were used in the above winter work were re-divided into lots and continued into the summer feeding work.

2. In 1908 the steers were fed for a period of 112 days on pasture. In 1909 they were fed for 154 days.

3. The summer rations were:

	1908.	1909.
Lot A.	Pasture alone.	Pasture alone.
Lot B.	Pasture plus cottonseed cake.	Pasture plus cottonseed cake.
Lot C.	Pasture plus "Caddo" cake.	
Lot D.	Pasture plus cottonseed cake.	
Lot E.	....	Pasture plus cottonseed.

4. In 1908 the amount of feed used daily per steer, in addition to the pasture, was 3.31 pounds, 3.31 pounds and 2.76 pounds in Lots B, C and D respectively. In 1909 the daily amount of feed used per steer to supplement the pasture was 3.40 pounds and 4.49 pounds in Lots B and E respectively.

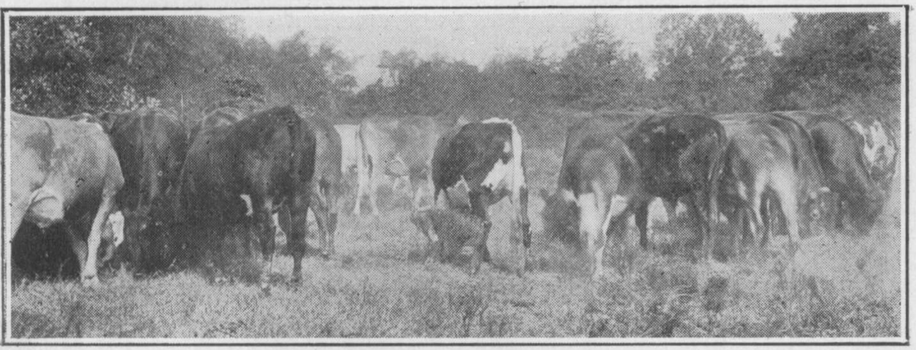
5. In 1908 the average daily gains were 1.51, 2.32, 1.84 and 1.62 pounds in Lots A, B, C and D respectively. In 1909 the average daily gains were 1.74, 1.88 and 2.06 pounds in Lots A, B and E respectively.

6. In 1908 the total cost to make one hundred pounds gain was $1.18, $2.56, $3.03 and $3.24 in Lots A, B, C and D respectively. In 1909 the total cost to make one hundred pounds of gain was $1.03, $3.21 and $2.39 in Lots A, B and E respectively.

7. In 1908 the net profits per steer were $2.86, $10.42, $6.62 and $0.43 in Lots A, B, C and D respectively. In 1909 the net profits per steer were $7.06, $6.99 and $8.39 in Lots A, B and E respectively.

8. In 1908 the steers dressed out (farm weights) 49.5 per cent, 53.8 per cent, 53.6 per cent and 52.7 per cent in Lots A, B, C and D respectively. In 1909 they dressed out (farm weights) 51.8 per cent, 54.2 per cent and 53.9 per cent in Lots A, B and E respectively.

9. These experiments are being continued at the present writing.



Some Alabama grass steers. In Experimental work in summer 1909.

1. Wintering Steers in Alabama.

2. Fattening Cattle on Pasture in Alabama.

By Dan T. Gray and W. F. Ward.

INTRODUCTION.

In Bulletin No. 150* are published the results of the information which was collected by the Alabama Experiment Station and the Bureau of Animal Industry at Washington in a three years' test to determine the cost of raising a beef calf. One point is brought out clearly in that work, namely, that if money is to be made upon beef operations, the steer must be properly finished for the market before he is offered for sale. If the steer is sold unfinished, the man who raised him is almost sure to lose money on the operation.

The question arises, then, How shall the steer, after he has been raised, or has reached the feed-lot period, be finished for the market to get the greatest possible profit out of him? The steer can be finished in one of two ways: he can be fattened during the winter months, or he can be

*Those interested in the subject of beef production can get the bulletin by writing to the Alabama Experiment Station at Auburn, or the Bureau of Animal Industry at Washington.

fattened during the summer months while the pastures are available. Since the co-operative beef work between the Alabama Experiment Station and the Bureau of Animal Industry began, some results have been published relative to winter fattening.** The present bulletin presents the results of two years' work in fattening cattle upon pasture during the summer months and selling the cattle at the end of the summer. It should be understood that this bulletin is only a report of the progress of the work, as the experiments are being continued.

DETAILS OF THE EXPERIMENTS.

Plan of the Work.

The cattle were bought in the fall, on account of the fact that they could be bought much cheaper in the fall than in the spring. In fact, they could hardly be bought at all in the spring. But they were not to be fattened until the following summer, so it became necessary to make a study of the cheapest and best methods of getting these mature steers through the winter months. So the work was divided into:

1. A study of methods of wintering mature steers,
2. Fattening these steers on pasture the following summer.

The cattle used in the winter's work were continued into the following summer's work.

Cattle Used.

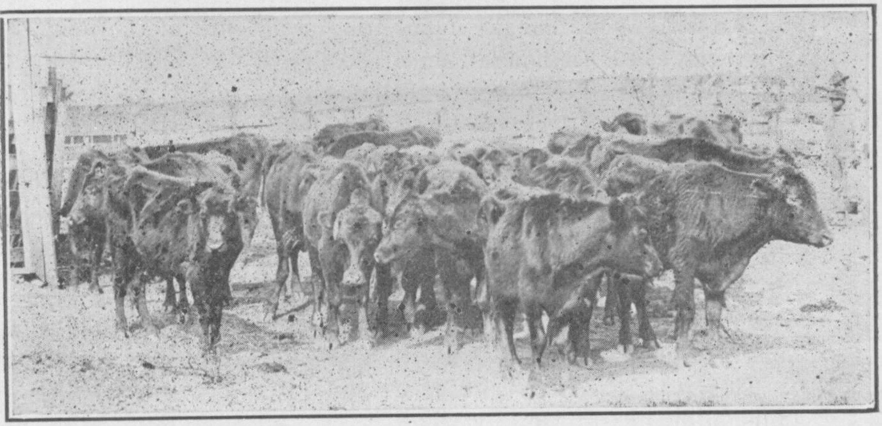
The various pictures will show the kind of cattle which were used in these tests. Grade Aberdeen-Angus, Shorthorn, Hereford, and Red Polled were used. Many of them had a predominance of Jersey and scrub breeding. They were all bought of farmers in Sumter, Wilcox, Marengo, and neighboring counties, so they represented the average cattle of the western part of Alabama. They varied from two to four years in age. As will be seen later, the average weight at the beginning of the fall work was about 750 pounds each.

**See Bureau of Animal Industry Bulletin No. 103.

How the Work was Carried on.

Owing to the fact that pasture was not available upon the Experiment Station at Auburn, Alabama, the work was carried on upon the farms of Cobb and McMillian of Sumterville, Alabama, who kindly agreed to co-operate with the Alabama Experiment Station and Bureau of Animal Industry. The winter range and summer pastures were divided into lots suitable for the work. One of the authors of this bulletin, Mr. W. F. Ward, was stationed upon the farm and had personal supervision of all the experimental work.

At the end of each experiment the cattle were all shipped to the New Orleans market, where complete sale and slaughter records were secured.



Lot 1.—*End of winter* 1908. *Feed, range alone. Total winter gain of each steer,*—97 *pounds. Total cost to winter each steer,* (?).

The Winter Range.

The winter range consisted of the winter corn and cotton fields. The leaves had not been stripped from the corn stalks. Crab grass had grown up sufficiently between the rows of corn after the last cultivation, to be of some value to the cattle during the early weeks of the winter. No cane brakes were used. The cattle, except those in the range lots, were not given unlimited range; each lot was confined to a certain area. Of course, the man who has cane brakes has an advantage in handling and feeding cattle in the winter time. Those animals which were confined in limited areas had about ten acres each upon which to graze. The outside cattle, or range lot, had an unlimited grazing area.

The winter range was available for use immediately after the cotton had all been picked.

Summer Pasture.

The summer pasture used in these experiments consisted of a mixture of sweet clover (Melilotus), Japan clover (Lespedeza), Johnson grass, crab grass, and some bermuda. The sweet clover became available for grazing about April 1, while the Japan clover was not ready until about June 15. In some sections of the country sweet clover is considered a pest, as stock will not eat it, but in the South, or at least in Alabama, all kinds of stock eat it with great relish: here they take to the sweet clover as readily as to alfalfa.

The pasture was divided into lots; the size of each lot depending upon the number of cattle grazed upon it, and as to whether the steers were to be fed a concentrated supplement or not. The object was to have an abundance of pasture for each bunch of cattle.

Method of Feeding and Handling the Cattle.

In both the winter and summer work the steers were fed but once a day. In the winter time movable feed troughs were placed out in the fields in which to feed the hulls, cottonseed meal and cottonseed, and movable hay racks were made in which to feed the hay. The racks and troughs were all made movable so that the manure would be distributed over the corn and cotton fields.

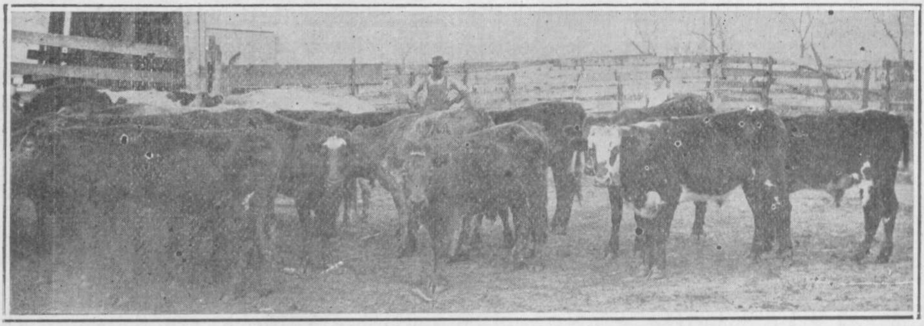
Movable feed troughs were also used during the summer feeding on pasture. No feeds were thrown upon the ground.

No shelter, except trees, was provided for the cattle in either the winter or summer time. They had no access to sheds. They did not suffer to any appreciable extent from the cold in the winter time or from the heat in the summer time. The summer pastures were well provided with good shade trees. When a summer shade is provided, cattle will not suffer as much from heat in Alabama as they will in Illinois or Iowa.

While there were ticks in the pastures, the cattle were not permitted to become badly infested with them; a dipping vat was used to keep down heavy infestation. In the two years' work, during which time over 300 head of cattle were fattened, there were only four cases of Texas fever, and none of these cases was lost. In future work it is expected that the tick will be entirely eliminated.

The weight of each steer was secured at the beginning and end of each test. The total weight of each lot was secured every twenty-eight days.

When the steers were sold they had to be driven nine miles to a shipping point.



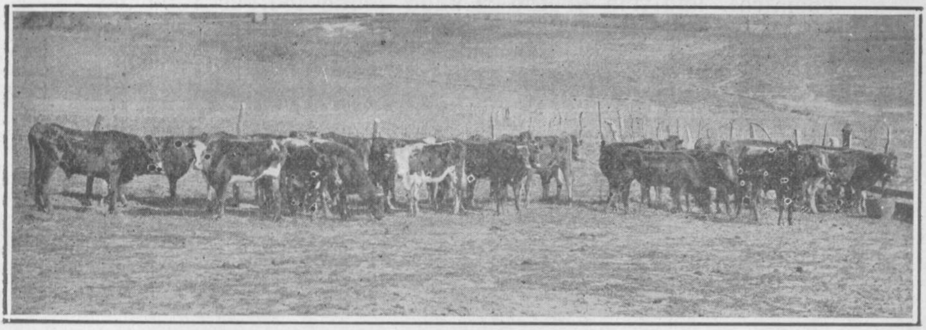
LOT 2.—*End of winter* 1908. *Feed, cottonseed hulls and cottonseed meal plus range. Total winter gain of each steer,* —6 *pounds. Total cost of wintering each steer,* **$4.70.**

PRICE OF FEEDS USED.

When the feeds were purchased upon the market, the market price plus the expense of hauling to the farm, was used in making up the financial statement. When the feed used was grown upon the farm an assumed market price was placed upon it. Local conditions determine to a large extent, the farm prices of feeds. Any prices that the authors might assume would not meet all conditions, but the following prices have been taken as a basis upon which to rest the financial estimates:

Cottonseed meal	$26.00	per ton
Cottonseed	14.00	per ton
"Caddo" cake	23.00	per ton
Cottonseed cake	25.00	per ton
Cottonseed hulls	6.00	per ton
Damaged hay	5.00	per ton
Cowpea hay	10.00	per ton
Pasture	.50	per month per steer

The above represents the prices of the purchased feeds laid down on the farm; the farm was fourteen miles from the railroad station. The cottonseed cake, which had been broken into nut size and sacked, was purchased from the Epes Cotton Oil Co. of Epes, Alabama. This cake can be purchased in the large cake size, just as it comes from the



LOT 3.—*End of winter* 1908. *Feed, peavine hay and range. Total winter gain of each steer,* —9 *pounds. Total cost of wintering each steer,* $3.57.

press, for about two dollars a ton cheaper than in the nut size. Some feeders find that it pays to break the cake on their own farms. The cake is the same thing as the cottonseed meal, except that it is not ground into a meal. There are several advantages in feeding cake in place of cottonseed meal—especially in summer feeding. A rain does not render the cake unpalatable; but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days; cottonseed meal, when fed in the open pasture, is wasted on account of the winds. Furthermore the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. In feeding cottonseed meal the greedy steer often scours on account of the fact that he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

The "Caddo" cake was purchased from the Caddo Cotton Oil Company of Shreveport, Louisiana. "Caddo" cake is the cake left after extracting the oil from the cottonseed by the cold process. That is, it is made up of both the cake and the hulls; or it consists of everything in the seed except the oil. These tests do not show it to be as valuable for feeding purposes as the ordinary cottonseed cake. The chemical, analysis of the "Caddo" cake fed, as reported by the State Chemist, Dr. B. B. Ross, of Auburn, was as follows:

Moisture	9.75 per cent.
Ash	4.70 per cent.
Fibre	21.18 per cent.
Protein	27.62 per cent.
Ether Extract (oil)	8.78 per cent.
Carbohydrates	27.97 per cent.

The mixed hay was a second or third class hay that could not be sold upon the market at all. It consisted of a mixture of Johnson grass, crab grass, and some alfalfa. The price placed upon it was all it was worth.

The cow pea hay was bright and of good quality.

PART I.

WINTERING THE CATTLE.

As previously stated, the steers were bought in the fall of the year as they could then be secured cheaper than at any other date. In fact, in western Alabama where the work was done, the cattle could not be purchased in the spring at all. The object was to get these steers through the winter months as economically as possible and fatten them on pasture the following summer. Farmers are not agreed as to what is the best way to handle and feed mature steers during the winter months. Some farmers claim that the animals should be "roughed" through the winter upon a very small amount of feed in addition to the winter range; some hold that the range needs no supplementary feed at all; still others believe that the steer should be fed liberally so that he will be kept gaining all through the winter months.

The cattle used in the winter work were dehorned, tagged, and divided into lots (Three lots in the winter of 1907-'08, and four lots in the winter of 1908-'09) so that a study could be made of the amount of feed that should be fed during the winter time, and also to learn the value of some of the Southern feeds for carrying cattle through the cold months.

GAINS DURING THE WINTER MONTHS.

The winters of 1907-'08 and 1908-'09 were both mild ones. There was no weather cold enough to make the steers suffer, although, as before mentioned, there was no shelter at all, except a few trees. The following table shows the ration fed, total weights, and gains of each lot for the two winters:

TABLE 1. *Gains During Winter* 1907-'08—(84 *days.*)

Lot	No. of animals	RATION	Initial weight each steer Dec. 9	Final weight each steer March 3	Average total gain each steer	Average daily gain each steer
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
1	26	Range alone	722.	625.	—97.	—1 15
2	29	Range plus half ration cotton-seed meal and hulls	726.	720.	— 6.	— .07
3	24	Range plus half ration peavine hay	724.	715.	— 9.	— .11

Gains During Winter 1908-'09—(98 *days*).

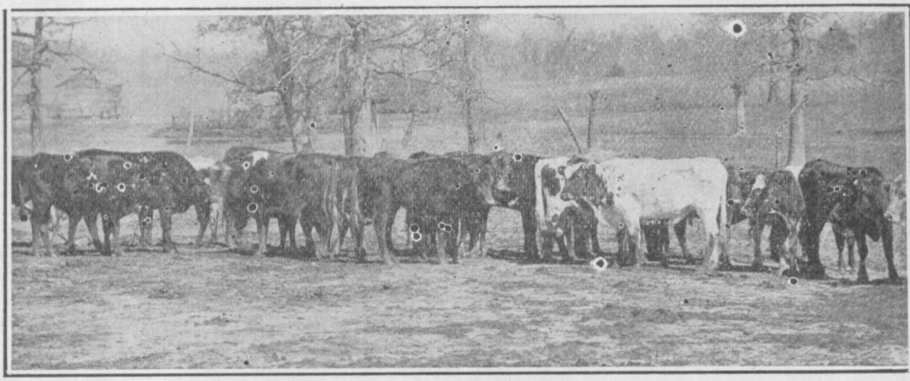
Lot	No. of animals	RATION	Initial weight each steer	Final weight each steer	Average total gain each steer	Average daily gain each steer
			Dec. 4	Mch. 12		
1	25	Range alone	705.	599 0	-106.	-1.08
2	25	Range plus half ration cotton-seed meal and hulls	705.	708.	3.	.03
3	25	Range plus half ration cotton-seed	706.	666.	—40.	—.40
4*	25	Range plus half ration cheap hay	689.	649.	—40.	—.57

*This lot started in test January 1st, so fed only 70 days.

It was intended that the steers which received some feed in addition to the range should suffer no loss in weight during the winter months, but in some cases the loss was considerable during the latter part of the winter period when the range afforded very little grazing. The object was to give just enough feed, in addition to the range, to enable the cattle to hold their fall weight. No gains in live weight were desired. It should be remembered that these were all practically mature cattle, varying from two to four years in age.

During the first winter the experiment continued from December 9 to March 3, a period of 85 days. During this time the range cattle (Lot 1) lost 97 pounds each in live weight while the steers in Lots 2 and 3 practically held their fall weights. All of the cattle came through the winter in excellent health. While the cattle in the range lot were thin at the end of the winter season, still they were in good condition for grazing; they evidently had not been weakened in any way. At the opening of the spring the steers in the peavine hay lot (Lot 3) seemed to be in better thrift than those in Lot 2, (the cottonseed meal and hulls lot), but they made practically the same gains in weight during the following summer. The hay used in 1907-'08 was of good quality.

During the winter of 1908-'09, the test continued from December 4th to March 12th—a period of 98 days. There were practically the same loses in live weight as the previous winter in Lots 1 and 2. In the range lot each steer lost 106



LOT 1.—*End of winter* 1909. *Feed, range alone. Total winter gain of each steer,* —106 *pounds. Total cost of wintering each steer,* (?).

pounds. The steers in Lots 3 and 4 lost rapidly in weight the last month of the test, due to the fact that the grazing on the range was not good at the end of the season; it was not intended that they should shrink in weight. Lot 4 was not started in the test until January 1, so the cattle in this lot were fed only seventy days. The hay used by Lot 4 was a very cheap hay; it was made up of a mixture of Johnson grass, crab grass, and some alfalfa, but had been damaged by rain to such an extent that it could not be sold at all.

Amount of Winter Feeds Used.

During the winter of 1907-'08 a comparson was made between feeding on the range alone and the same range when supplemented in one lot with a part ration of cottonseed meal and hulls, and in a third lot with a good quality of cow pea hay. The following winter (1908-'09) the same comparison was again made as regards Lots 1 and 2, while in a third lot cottonseed was used and in a fourth lot some damaged mixed hay was used to supplement the range.

Table 2. *Feeds used Winter* 1907-'08—(84 *days*).

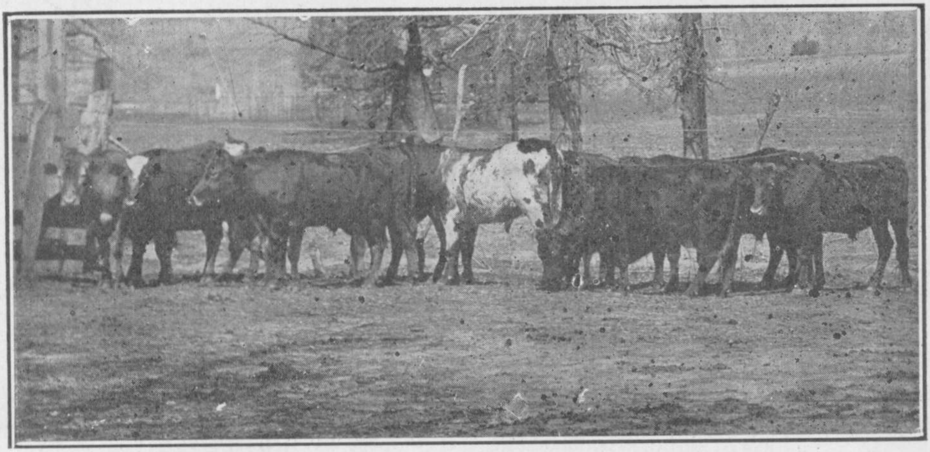
Lot	No. of steers	RATION	Total amount consumed per steer		Daily amount feed consumed per steer	
			Concentrates	Roughage	Concentrates	Roughage
			Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
1	26	Range alone	None	None	None	No e
2	29	Range plus half ration cottonseed meal and hulls	197	714	2.35	8.5
3	24	Range plus half ration cow pea hay	None	714	None	8.5
		Feeds used Winter 1908-'09—(98 *days*).				
1	25	Range alone	None	None	None	None
2	25	Range plus half ration cottonseed meal and hulls	236	854	2.41	8.71
3	25	Range plus half ration cottonseed	462	......	4.71	......
4*	25	Range plus mixed hay	......	826	......	11.8

*This lot was fed only 70 days—January 1st to March 12th.

There was no way to determine how much feed was secured from the range as far as pounds were concerned. Each steer had ten acres as winter range. The steers in Lot 1, the range lot, had to be turned out upon the general range each winter about a month before the end of the test, as their range of ten acres each had become exhausted about thirty days earlier than was the case with those lots which were receiving supplementary feeds.

During the first winter each steer in Lot 2 consumed, in addition to the range, 197 pounds of cottonseed meal and 714 pounds of hulls, while each steer the second winter ate 236 pounds of cottonseed meal and 854 pounds of hulls. In 1908-'09 the animals were fed fourteen days longer than they were in the winter of 1907-'08. Each steer's daily ration was kept a little below 2.5 pounds of cottonseed meal and 8.5 to 8.71 pounds of hulls.

During the second winter the steers in Lot 3 were carried



LOT 2.—*End of winter* 1909. *Feed, cottonseed hulls and cottonseed meal plus range. Total winter gain of each steer,* 3 *pounds. Total cost of wintering each steer,* $5.63.

through the winter on cottonseed as a supplement to the range. It was learned that 4.71 pounds of cottonseed per steer per day was not quite sufficient to keep the animals from losing weight. Each steer lost 40 pounds in weight during the winter period of 98 days.

In the first winter's work it is seen that 8.5 pounds of good peavine hay, along with the range, afforded the steers sufficient daily feed to allow them to maintain a practically uniform weight. Or, when Lots 2 and 3 (1907-'08) are compared, it is seen that 714 pounds of cowpea hay were practically equal in feeding value to 197 pounds of cottonseed meal plus 714 pounds of cottonseed hulls. In other words, the cowpea hay was worth $13.02 per ton for wintering mature cattle compared with cottonseed meal and hulls, when the meal is valued at $26.00 a ton and the hulls at $6.00 a ton.

During the second winter (1908-'09) each steer in the cottonseed lot (Lot 3) lost about 42 pounds more in live weight than did the animals in the cottonseed meal and hulls lot (Lot 2); but still, when cottonseed is valued at $14.00 a ton it is probably cheaper than cottonseed meal and hulls for wintering steers.

The daily expense of feeding each steer on cottonseed meal and hulls was 5.7 cents, while the daily cost of the cottonseed per steer was only 3.3 cents. While not enough cottonseed was used to prevent loss in weight, still the amount fed daily to each steer (4.71 pounds) would probably not have to be increased very much to make the steers hold their fall weights. It would require 8.2 pounds of cottonseed, at $14.00 a ton, to cost as much as the 2.41 pounds of cottonseed meal plus the 8.71 pounds of hulls which were fed to each steer daily in Lot 2.

When this test was made cottonseed cost but $14.00 a ton. Since that time they have advanced about one hundred per cent in value, so that it would now be unwise to use cottonseed as a winter feed for steers.

It should be remembered that these were mature steers, and that such steers are capable of making use of the rough waste feeds during the winter months. Cattle of this age can use feeds that would be entirely unsuited to young growing animals. In handling and feeding mature steers during the winter months the object should be to make use of all the rough feeds and unsalable hays before any high priced feeds, as cottonseed meal, are used.

Winter Gains of Steers by Months.

Every farmer has old corn and cotton fields which afford some winter feeds for the cattle. As the winter advances the range usually affords a smaller and smaller amount of feed. The following table shows the gain of the various lots from month to month. From this the reader can gather some idea of when the heavy losses usually occur, and regulate the amount of supplementary feeds accordingly.

TABLE 3. *Gains of Steers by Months* 1907-'08—(84 *days*).

Lot	RATION	Gains 1st month, Dec. 10 to Jan. 7th	Gains 2nd month, Jan. 7 to Feb. 4th	Gains 3rd month, Feb. 4 to March 3rd	Gains 4th month
		Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
1	Range alone	—4.	—38.	—55.	
2	Range plus half ration cottonseed meal and hulls	16.	—10.	—12.	
3	Range plus half ration peavine hay	15.	—16.	— 8.	

1908-'09—(98 *days*.)

		Dec. 4 to Jan. 1st	Jan. 1 to Jan. 29	Jan. 29 to Feb. 26	Feb. 26 to Mch. 12
1	Range alone	—40.	—43.	— 7.	—16.
2	Range plus half ration cottonseed meal and hulls	18.	—12.	— 5.	2.
3	Range plus half ration cottonseed	0.	—16.	—46.	22.
4	Range plus half ration mixed hay	......	—13.	—23.	— 4.

During each year's work those steers which received feed in addition to the range were started on a very small daily allowance. This amount was increased every few days for 28 days, when it was held uniform for the remainder of the winter. During the first winter's work the range cattle (Lot 1) practically held their initial weight during the first 28 days. As time went on and the range became shorter they lost more and more in weight. This is what should be expected. But the heaviest losses in 1908-'09 were experienced at the early part of the winter. However this winter was an unusual one. It was very rainy and muddy during the early months, so that the cattle were very uncomfortable and could not graze well. During the last of the winter very little rain fell, spring set in early so as a matter of fact, the grasses put up early and the range cattle had some green feed during the last month in addition to the range.

As stated elsewhere, all of these cattle came through to spring in good grazing condition; they were strong and active, although the steers in the range lots (Lot 1) had fallen off in live weight about 100 pounds each.

LOT 3.—*End of winter* 1909. *Feed, cottonseed plus range. Total winter gain of each steer,* —40 *pounds. Total cost of wintering each steer,* $3.23.

FINANCIAL STATEMENT FOR WINTER WORK.

In the fall of 1907 the steers cost $2.50 per hundred weight, but the next fall, 1908, feeders had advanced some in price, making the fall price average $2.56 per hundred weight. The following spring cost was of course considerably greater than the fall price for two reasons. First, the cattle were not as heavy as they were the previous fall, and second, the cost of the winter feed had to be added to the fall price. The fall cost, plus the depreciation in live weight, plus the cost of winter feed made the steers cost around $3.00 per hundredweight in the spring. The following table, No. 4, shows the spring cost by lots. The average of these spring costs was taken as the initial cost of the steers in the summer feeding work which followed. The average cost of wintering each steer in the various lots, together with the difference in value between fall and spring, are as follows:

TABLE 4. *Financial Statement.*

1907-'08.

Lot 1. Range alone:

To 722 lbs. steer at $2.50 per hundred wt.	$18.05	
By value of same steer in spring, 625 lbs. at $2.89 per hundredweight		$18.05
	$18.05	—$18.05

Lot 2. Range plus cottonseed meal and hulls:

To 726 lbs. steer at $2.50 per hundred wt. .	$18.15	
To 714 lbs. cottonseed hulls at $6.00 per ton	2.14	
To 194 lbs. cottonseed meal at $26.00 per ton	2.56	
By value steer in spring 720.5 lbs. at $2.89 per hundred weight		$20.82
By required increase in value over range steer to break even, 28c per hundredweight		2.03
	$22.85	—$22.85

Lot 3. Range plus peavine hay:

To 724 lbs. steer at $2.50 per hundred wt.	$18.10	
To 714 lbs. peavine hay at $10.00 per ton	3.57	
By value steer in spring, 715 lbs. at $2.89 per hundred weight		$20.65
By required increase in value over range steer to break even, 14c per hundredweight		1.02
	$21.67	—$21.67

1908-'09

Lot 1. Range alone:

To 705 lbs. steer at $2.56 per hundred wt.	$18.05	
By value same steer in spring, 599 lbs. at $3.01 per hundredweight		$18.05
	$18.05	—$18.05

Lot 2. Range plus cottonseed meal and hulls:

To 705 lbs. steer at $2.56 per hundred wt.	$18.05	
To 854 lbs. cottonseed hulls at $6.00 per ton	2.56	
To 236 lbs. cottonseed meal at $26.00 per ton	3.07	
By value steer in spring, 708 lbs. at $3.01 per hundredweight		$21.31
By required increase in value over range steer to break even, 33c per hundredweight		2.37
	$23.68	—$23.68

Lot 3. Range plus cottonseed:

To 706 lbs. steer at $2.56 per hundred wt.	$18.08	
To 462 lbs. cottonseed at $14.00 per ton .	3.23	
By value steer in spring, 666 lbs. at $3.01 per hundredweight		$20.05
By required increase in value over range steer to break even, 19c per hundredweight		1.26
	$21.31—	$21.31

Lot 4. Range plus cheap hay:

To 703 lbs. steer at $2.56 per hundred wt.	$18.00	
To 826 lbs. waste hay at $5.00 per ton ..	2.06	
By value steer in spring, 649 lbs. at $3.01 per hundredweight		$19.53
By required increase in value over range steer to break even, 8c per hundredweight		.53
	$20.06—	$20.06

LOT 4.—*End of winter* 1909. *Feed, coarse hay plus range. Total winter gain of each steer,* —40 *pounds. Total cost of wintering each steer,* $2.06.

The total cost to winter each steer in 1907-'08 was $4.70 and $3.57 in Lots 2 and 3 respectively. The range has no price placed upon it, although the results show that it has a very great value. The total cost to winter each steer in 1908-'09 was $5.63, $3.23 and $2.06 in Lots 2, 3 and 4 respectively.

After the cost of wintering the cattle and the winter shrinkage were added to the fall buying price the spring cost was obtained. The spring costs in Lots 1, 2, and 3 in

1907-'08 were $2.89, $3.17 and $3.03 per hundred weight respectively. In 1908-'09 the spring costs were $3.01, $3.34, $3.20, and $3.09 per hundred weight in Lots 1, 2, 3, and 4 respectively.

It is seen that the cheap coarse feeds produced about as good results as the high priced feeds, and at the same time the steers were carried through the winter much more economically with the cheap than with the expensive feeds. It will always pay to make use of the coarse or cheap winter feeds for the mature steers and save the high-priced feeds for the young animals of the farm.

It is well known that the effects of feeding mature cattle through the winter months continue throughout the following grazing season. Those mature cattle which make the most gain through the winter may be expected to make the smallest gains the following summer. This has been found to be true in this work, but a detailed presentation of this point will be found in later publications.

TABLE 5. *Total Summary of Winter Work.*

	1907-'08—84 days			1908-'09—98 days			
	Lot 1 Range alone	Lot 2 Range and cottonseed meal and hulls	Lot 3 Range and peavine hay	Lot 1 Range alone	Lot 2 Range and cottonseed meal and hulls	Lot 3 Range and cottonseed	Lot 4 Range and waste hay
Average weight of steers at beginning of test	722 lbs.	726 lbs.	724 lbs.	705 lbs.	705 lbs.	706 lbs	689 lbs.
Total gain per steer for whole winter	—97. lbs	—6. lbs.	—9. lbs.	—106 lbs.	3. lbs.	—40. lbs	-40. lbs.
Average daily gain per steer	lbs. —1.15	lbs. —.07	lbs. —.11	lbs. —1.08	lbs. .03	lbs. —.4	lbs. —.57
Concentrates consumed per steer per day	....	2.35 lbs.	....	....	2.41 lbs.	4.71 lbs.	....
Roughage consumed per steer per day	....	8.5 lbs	8.5 lbs.	....	8.71 lbs.	......	11.8 lbs.
Average expense to winter each steer	....	$4.70	$3.57	....	$5.63	$3.23	$2.06
Initial, or fall cost of steers per cwt.	$2.50	$2.50	$2.50	$2.56	$2.56	$2.56	$2.56
Total cost steers per cwt in spring	$2.89	$3.17	$3.03	$3.01	$3.34	$3.20	$3.09

PART II.

Fattening Cattle on Pasture.

INTRODUCTION.

As a rule the ordinary permanent pasture in Alabama can be depended upon to furnish grazing from about April 1 to some time in October. The frosts usually kill the pastures in October. By making use of winter growing plants, such as burr clover, the grazing season can be opened about February 1 and sometimes even earlier.

A common mistake is to overstock the pastures. When this is done the grass often becomes short in August and September, and the cattle actually lose in weight instead of making a gain. The South often experiences a drought in August and September, therefore the farmer should have no more cattle on hand than can be well cared for during the grazing period.

The pastures used in this test, as stated before, were made up of several kinds of grasses. No one kind of plant was depended upon entirely. Johnson grass, Japan clover, and Melilotus were the most important grazing plants used. In addition to these some bermuda and crab grass were also found. If the pastures are to be improved each year, and the grazing season extended over as many months as possible, several plants must be made use of.

The cattle used in the summer feeding work were the same ones as had been used in the preceding winter's experimental work. When grass appeared in the spring the winter work was discontinued, the cattle redivided into lots, and the summer feeding work was begun immediately. Some steers, which had not been in the winter experiment, were added to the summer work. These extra steers had been fed nothing through the winter months except what they obtained on the open range. They were of the same quality as the steers which had been used in the winter tests.

All of these cattle had been dehorned the previous fall.

DETAILS OF THE EXPERIMENT.

Gains During the Summer Feeding.

The gains as recorded in the following table will show that the pastures used were good ones. It should be remembered, too, that as a result of feeding upon these pastures they are getting better and better as time goes on.

The following table sets forth, in a tabulated form, the total and daily gains of the steers for the summers of 1908 and 1909:

Table 6. *Total and Daily Gains During the Pasture Feeding Test.*

1908—(112 *days*).

Lot	No. of steers	RATION	Average initial weight per steer	Average final weight per steer	Total gain per steer	Average daily gain per steer
			Lbs.	Lbs.	Lbs.	Lbs.
A	26	Pasture alone	732	902	170	1.52
B	26	Pasture plus cottonseed cake	739	999	260	2.32
C	26	Pasture plus "Caddo" cake	738	944	206	1.84
D*	54	Pasture plus cottonseed cake	532	713	181	1.62

1909—(154 *days*).

Lot	No. of steers	RATION	Average initial weight per steer	Average final weight per steer	Total gain per steer	Average daily gain per steer
A	40	Pasture alone	647	915	268	1.74
B	75	Pasture plus cottonseed cake	639	929	290	1 88
E	25	Pasture plus cottonseed	653	970	317	2.06

*The cattle in Lot D were not of the same grade as those in Lots A, B, and C, so really Lot D can not be compared with the other lots. Lot D was made up of a bunch of mixed cattle with no special breeding, and ranging from two to five years in age. The object in handling this bunch was to see if money could be made on such cattle. They had not been dehorned.

It is seen that, in every case, those cattle that received some supplementary feed gained more rapidly than those which received no feed but pasture. Of course, the more rapid a steer gains the quicker he can be gotten in shape for the market, and this is a very important point, as the early fall steer does not come into competition with the fall stuff that is being brought into the market off grass.

As far as gains were concerned, the cattle did reasonably well both years. They were not grazed through the whole summer season, so the total gains, as represented in the sixth column, do not represent as great gains as can be made during a whole summer's grazing season. In 1908 they were grazed only 112 days, and in 1909 the test continued for 154 days. The best portion of the grazing season had been used however, as the cattle were sold from the first of August to the first of September.

In both years the cattle which received cottonseed cake in addition to the pasture gained more rapidly than did the

LOT A.—*End of summer* 1908. *Feed, pasture alone. Average daily gain of each steer,* 1.52 *pounds. Cost of* 100 *pounds of gain,* $1.18. *Total profit per steer,* $2.86.

pasture cattle. In 1908 the difference in favor of the cattle which had been fed was very marked, but in 1909 the difference between the two lots was not very pronounced. In 1909, Lot E the cottonseed lot, made the most satisfactory gains, it making an average daily gain of 2.08 pounds, while Lots B and A made average daily gains of 1.88 and 1.74 pounds respectively.

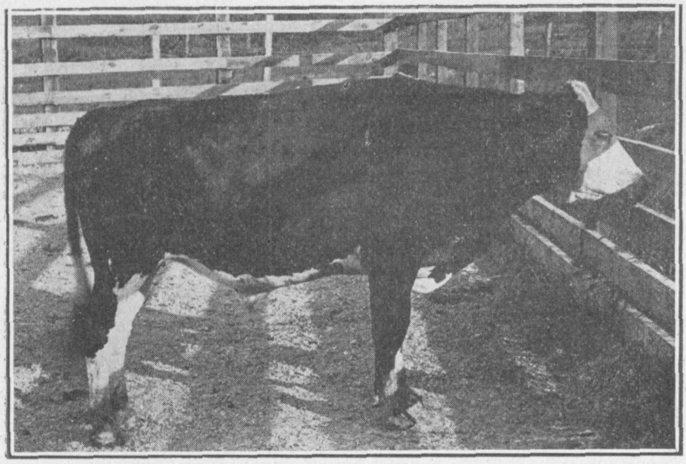
FEEDS CONSUMED.

The cattle were fed but once a day; this was done each afternoon about sundown, or in the cool of the evening, in order that the steers would all come out to the feed troughs. The steers were started upon a small amount of feed, and as they became accustomed to it the amount was gradually increased. The following tables will show that the concentrates were fed sparingly all through the tests.

The following table (table 7), shows the total amount of concentrates fed each steer for each year, the average daily feed, and the amount of concentrates required to make one hundred pounds of gain:

TABLE 7. *Feeds Consumed* 1908—(112 *days*).

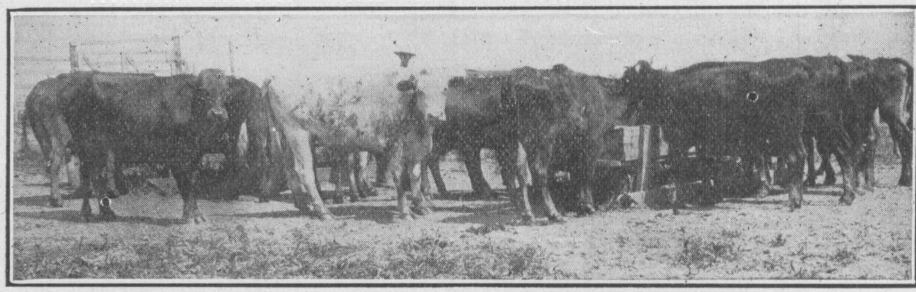
Lot	Number cattle	RATION	Total amount feed consumed per steer	Amount feed eaten per day per steer	Pounds feed to make 100 pounds gain
			Lbs.	Lbs.	Lbs.
A	26	Pasture alone	......	....	....
B	26	Pasture plus cottonseed cake	371	3.31	143.
C	26	Pasture plus "Caddo" cake	371	3.31	180.
D	54	Pasture plus cottonseed cake	309	2.76	171.
		1909—(154 *days*).			
A	80	Pasture alone	......	....	....
B	75	Pasture plus cottonseed cake	524	3.40	181
E	25	Pasture plus cotton seed	691	4.49	218



STEER OF LOT B.—*End of summer* 1908. *Feed, cottonseed cake and pasture.*

Lot A received no feed in addition to the pasture as one object was to learn whether it would pay to supplement the pasture with a concentrate. During the summer of 1908 each steer in Lot B was given daily 3.31 pounds of cottonseed cake in addition to the pasture: in 1909 each steer in this lot was fed 3.4 pounds of the cake per day in addition to the pasture. In 1908 "Caddo" cake was used in one lot so that its value as a feed could be compared to cottonseed cake. The steers in Lot D in 1908 (these were a mixed bunch of steers and cannot be compared directly to the other three lots), on account of being smaller than the ones in the other lots, were fed only 2.76 pounds of cottonseed cake per head per day. In 1909 cottonseed was fed to Lot E.

When looking at the last column it is seen that the cot-

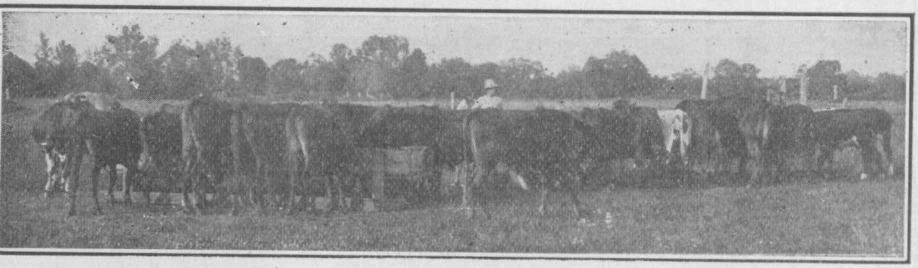


LOT B.—*End of summer 1908. Feed, cottonseed cake and pasture.*
Average daily gain of each steer 2.32 *pounds.*
Cost of 100 *pounds of gain* $2.56
Total profit per steer 10.42

tonseed cake was more efficient than the "Caddo" cake for making gains. In 1908 only 143 pounds of cottonseed cake were required to make one hundred pounds gain, while 180 pounds of the "Caddo" cake were required to make the same number of pounds gain. Lot D cannot be compared to Lots B and C. It is true that the "Caddo" cake did not cost as much as did the cottonseed cake, but it will be seen later, when the cost of the feeds are taken into consideration, that the cottonseed cake was the more economical feed to use. Under the conditions of this test one pound of cottonseed cake was equal, in feeding value, to 1.28 pounds of "Caddo" cake.

During the summer of 1909 a direct comparison was made between cottonseed cake and cottonseed as feeds to be used to supplement pastures. Under the conditions of this test one pound of cake proved to be equal to 1.21 pounds of the seed. The seed proved to have an exceedingly high feeding value when used as a feed to supplement the pastures.

The steers in Lot D were a bunch of mixed scrubs varying from one to five years in age. There was very little improved blood among these cattle. They were not dehorned so they were always restless at the feed trough, as the timid ones were afraid of the steers with long sharp horns. This lot was fed as a side issue to the main experiment to determine whether a profit could be made upon this class of cattle.



LOT C.—*Middle of summer* 1908. *Feed, "Caddo" cake and pasture.*
Average daily gain of each steer 1.84 *pounds.*
Cost of 100 *pounds of gain* $3.03
Total profit per steer 6.62

There was no way, of course, to determine just how much pasture grass was consumed, except as to the area measured off for each lot. But it is interesting to note that the amount of concentrated feeds required to make 100 pounds increase in live weight was exceedingly small. This was due to at least two factors. First, the steers had a green feed to go along with the concentrated feeds. Second, the amount of concentrated feeds fed daily was held down to only a few pounds, thus requiring the steers to obtain the major part of their feed from the pasture. Where lands are cheap pasture is cheaper than the too liberal use of concentrated feeds. It is impossible, at the present time, to say whether the amounts fed in these tests were the correct ones or not. It is hoped that some light may be thrown upon this point during the progress of the work.

Cost of Summer Gains.

It is always unsatisfactory to discuss the cost of gains as it depends largely upon the cost of the feeds, the cost of which varies greatly under different conditions. In this discussion the price placed upon the feeds is the actual market quotations plus the expense of hauling them from the depot to the farm. The hauling distance was fourteen miles. Pasture is charged at fifty cents per month per steer; this is the prevailing price placed upon pasture throughout the western part of Alabama.

TABLE 8. *Cost to Make* 100 *Pounds of Gain.*

1908—(112 *days*).

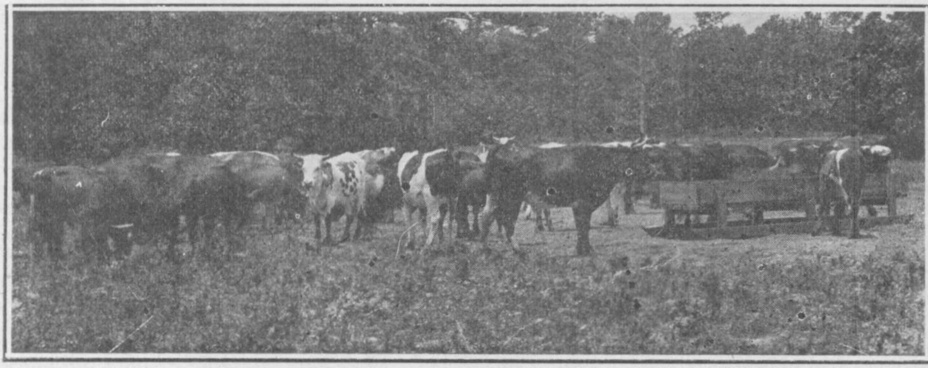
Lot	RATION	Pounds feed to make 100 pounds gain	Cost 100 lbs. gain, pasture not charged	Cost 100 lbs. gain, pasture charged *
A	Pasture alone........................	....	......	$1.18
B	Pasture plus cottonseed cake	143	$1.79	2.56
C	Pasture plus "Caddo" cake	180	2.07	3.03
D	Pasture plus cottonseed cake	171	2.14	3.24

1909—(154 *days*).

Lot	RATION	Pounds feed to make 100 pounds gain	Cost 100 lbs. gain, pasture not charged	Cost 100 lbs. gain, pasture charged *
A	Pasture alone............	....	....	$1.03
B	Pasture plus cottonseed cake	181	$2.26	3.21
E	Pasture plus cottonseed.............	218	1.53	2.39

*Price of feeds: Cottonseed cake ....$25.00 per ton
"Caddo" cake .... 23.00 per ton
Cottonseed .... 14.00 per ton
Pasture .... .50 per month.

In every case above, the cost to make one hundred pounds increase in live weight was very low. When steers are fattened during the winter time each pound of gain is put on at a loss, as each pound put on may be expected to cost from 8 to 12 cents; and the profit is dependent upon the enhancement of the value of the steer over and above the selling value of pounds of gain made. In these tests each pound put on during the fattening period was put on at a profit, a very unusual occurrence in fattening beef cattle. These cheap finishing gains made the feeding operations comparatively safe as far as profits were concerned. As stated before, these cheap gains were due to two factors: First, the cattle had a cheap and succulent roughage;—pas-



LOT D.—*End of summer* 1908. *Feed, cottonseed cake and pasture.*
Average daily gain of each steer 1.62 *pounds.*
Cost of 100 *pounds of gain* $3.24
Total profit per steer .... .43

ture. Second, the amount of concentrated feeds used was kept down to a comparatively small figure: from 2.76 to 3.31 pounds of cottonseed cake and 4.48 pounds of cottonseed were fed to each steer daily. At the Missouri Station (Bulletin 76) the average of the summer trials show that 814 pounds of grain were required to produce one hundred pounds of gain, while in the Alabama test only 143 to 218 pounds of concentrate were required to make the same gains. At Missouri the steers were given an approximate daily feed of 20 pounds of grain in addition to the pasture.

While the Missouri cattle were fed a much heavier grain ration than the Alabama cattle, still the records of this test show the Alabama cattle to have made almost as large daily gains as did the Missouri steers.

When Lots B and C (1908) are compared it is seen that the cottonseed cake is superior to the "Caddo" cake, as one hundred pounds of increase in weight were made at a cost of \$2.56 when the cottonseed cake was used, whereas when the "Caddo" cake was fed the same gain cost \$3.03. When the cottonseed cake sells at \$25.00 a ton the "Caddo" cake is not worth \$23.00 a ton; when cottonseed cake sells at \$25.00 a ton this test shows the "Caddo" cake to be worth only \$20.54 a ton.

LOT A.—*End of summer* 1909. *Feed, pasture alone.*
Average daily gain of each steer 1.74 *pounds.*
Costs of 100 *pounds of gain* \$1.03
Total profit per steer 7.06

The common or mixed bunch of cattle (Lot D) make a very poor showing when compared with Lots B and C, although, as will be seen later, the steers in Lot D returned a small profit.

In comparing Lots B and E (1909) it is seen that the cottonseed produced gains more cheaply than did the cottonseed cake—that is, when the cottonseed is valued at

$14.00 a ton and the cake at $25.00 a ton. When cottonseed cake is valued at $25.00 a ton this test shows the cottonseed to be worth $20.73 a ton for fattening cattle on pasture. Cottonseed had this disadvantage however: during the latter part of the feeding period they were not relished as much as the cottonseed cake, and some trouble was experienced in keeping the steers "on feed." There was no trouble from scours when the seed were fed in the above amounts.

Financial Results of Summer Feeding.

Although those cattle which received pasture alone made cheaper gains than the ones which received some feeds in addition to the pasture, it must not be inferred that the grass cattle were the most profitable ones; the cost of the gains alone does not determine the final profits. While it is desirable to make the gains as cheaply as possible, still the selling price of the cattle at the end of the feeding period must also be taken into consideration before the final profit can be determind.

Table 9. *Financial Statment.*
1908.

Lot A. Pasture alone:		
To 26 steers, 19031 lbs. at $2.92 per cwt.	$555.71	
To pasture at 50c a month per steer ..	52.00	
To freight, commission, feed and yardage	94.12	
Total expenditures	$701.83	
By sale of 26 steers at $3.66 per cwt.		$776.29
Total profit on lot	$74.46	
Profit per steer	2.86	
Lot B. Pasture plus cottonseed cake:		
To 26 steers, 19199 lbs. at $2.92 per cwt.	$560.61	
To pasture at 50c a month per steer .	52.00	
To 9646 lbs. of cottonseed cake at $25.00 per ton	120.57	
To freight, commission, feed and yardage	94.12	
Total expenditures	$827.30	
By sale of 26 steers, 24245 lbs at $4.53 per cwt.		$1098.30
Total profits on lot	$271.00	
Profit per steer	10.42	

Lot C. Pasture plus "Caddo" cake:		
To 26 steers, 19176 lbs. at $2.92 per cwt.	$559.94	
To pasture at 50c a month per steer ..	52.00	
To 9646 lbs. of "Caddo" cake at $23.00 per ton	110.93	
To freight, commission, feed and yardage	94.12	
Total expenditures	$816.99	
By sale of 26 steers, 22740 lbs. at $4.35 per cwt.		$989.19
Total profit on lot	$172.20	
Profit per steer	6.62	
Lot D. Pasture plus cottonseed cake:		
To 54 steers, 28754 lbs. at $2.50 per cwt.	$718.85	
To pasture at 50c a month per steer ..	108.00	
To 16686 lbs. of cottonseed cake at $25.00 per ton	208.57	
To freight, commission, feed and yardage	195.48	
Total expenditures	$1230.90	
By sale of 54 steers, 36450 lbs. at $3.44 per cwt.		$1253.88
Total profit on lot	$22.98	
Profit per steer	.43	
1909.		
Lot A. Pasture alone:		
To 40 steers, 25879 lbs. at $2.95 per cwt.	$763.43	
To pasture at 50c a month per steer .	110.00	
To freight, commission, feed and yardage	144.80	
Total expenditures	$1018.23	
By sale of 40 steers, 34314 lbs. at $3.79 per cwt.		$1300.50
Total profit on lot	$282.27	
Profit per steer	7.06	
Lot B. Pasture plus cottonseed cake:		
To 75 steers, 47916 lbs. at $2.95 per cwt.	$1413.52	
To pasture at 50c a month per steer ..	206.25	
To 39325 lbs. of cottonseed cake at $25.00 per ton	491.56	
To freight, commission, feed and yardage	271.50	
Total expenditures	$2382.83	
By sale of 75 steers, 66514 lbs. at $4.37 per cwt.		$2906.66
Total profit on lot	$523.83	
Profit per steer	6.99	

Lot E. Pasture plus cottonseed:

To 25 steers, 16328 lbs. at $2.95 per cwt.	$481.68	
To pasture at 50c a month per steer .	68.75	
To 17265 lbs. of cottonseed at $14.00 per ton	120.85	
To freight, commission, feed and yardage	90.50	
Total expenditures	$761.78	
By 25 steers, 22858 lbs. at$4.25 per cwt.		$971.46
Total profit on lot	$209.68	
Profit per steer	8.39	

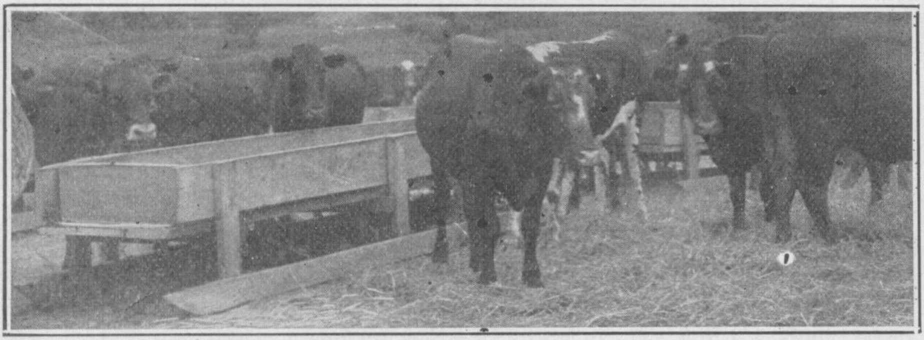
It should be noted that the total profits shown above are based on estimates after pasture rent, freight, commissions, feed and yardage are taken from the total sales.

In 1908 it cost $3.85 per head to get the steers to the New Orleans market and in 1909 the expense was $3.62 per head. These cattle were shipped from western Alabama to New Orleans, a distance of about 500 miles; many farmers in the South are not required to ship their cattle this distance.

In 1908 the greatest profits were realized upon Lot B, the lot which received cottonseed cake in addition to the pasture; in this lot a net profit of $10.42 per steer was made. Lot C, the "Caddo" fed lot, returned a net profit of $6.62 per steer. The pasture lot, Lot A, made a profit of only $2.86 per steer. It paid to feed the cattle some feed in addition to the pasture, because when they were offered for sale those steers which had been fed the concentrated feeds were in much better condition than those that received pasture only, and consequently sold for more money per hundred weight. The grass cattle sold for $3.66 per hundred weight, the cottonseed cake cattle for $4.53 per hundred weight, and the "Caddo" cattle for $4.35 per hundred weight. The above represent the New Orleans prices. It cost about 60 cents per hundred weight, including shrinkage, to ship the steers to New Orleans.

In 1909 there was not such a marked difference in favor of the lots which received feed in addition to the pasture. In fact, the pasture lot, Lot A, and the cottonseed cake lot, Lot B, made practically the same profit, the former making a net profit of $7.06 per steer and the latter a net profit of $6.99 per steer. But the cottonseed fed lot, Lot E, was decidedly more profitable than either of the other lots, it making a net profit of $8.43 per steer. The profits in every case were exceedingly satisfactory.

In 1908 it proved to be exceedingly profitable to supplement the pasture with a concentrated feed. In 1909 no extra profit was made as a result of the use of the cotton-



LOT B.—*End of summer* 1909. *Feed, cottonseed cake and pasture.*
Average daily gain of each steer 1.88 *pounds.*
Cost of 100 *pounds of gain* $3.21
Total profit per steer 6.99

seed cake, but when cottonseed was fed along with the pasture the profits were greater than when pasture was used alone. The data so far collected warrant the statement that it pays to supplement our Southern pastures with a concentrated feed when cattle are being finished for the fall market. Additional experimental work will determine what concentrated feeds can be used to the greatest advantage.

Slaughter Results.

The cattle were shipped to New Orleans for sale and slaughtered, where complete individual slaughter records were secured. The authors have presented only a part of the slaughter records in the following table; the point will be discussed more fully in a subsequent publication.

Table 10. *Slaughter Data.*

1908.

Lot	RATION	Average farm weight each steer	Average New Orleans weight each steer	Average shrinkage in shipping per steer	Per cent. dressed out by farm weights
		Lbs.	Lbs.	Lbs.	Per ct.
A	Pasture alone	902	816	86	49.5
B	Pasture plus cottonseed cake	999	932	66	53.8
C	Pasture plus "Caddo" cake	944	874	70	53.6
D	Pasture plus cottonseed cake	724	686	38	52.7

1909.

Lot	RATION	Average farm weight each steer	Average New Orleans weight each steer	Average shrinkage in shipping per steer	Per cent. dressed out by farm weights
A	Pasture alone....................	916	859	57	51.8
B	Pasture plus cottonseed cake	941	899	42	54.2
E	Pasture plus cottonseed	1001	946	55	53.9

It is seen by the above table that the steers which were given some feed in addition to the pasture suffered less loss in live weight in transit than did the ones which had nothing to eat but pasture. In 1908 each pasture steer (Lot A) lost 86 pounds in transit, while those which had been fed some concentrated feeds lost from 38 to 70 pounds each. The common cattle, Lot D, suffered a very small shrinkage which was due, in part, to their being smaller steers than the other cattle. The cattle did not shrink as much in

1909 as in 1908, but in 1909 the grass cattle lost considerably more weight in transit than did those that had been fed.

In both years the steers which had been fed the cottonseed products dressed out several per cent higher than the grass cattle. In 1908 the grass cattle dressed out 49.5 per cent; in 1909 a similar lot dressed out 51.8 per cent. The cattle which had been given some concentrated feeds along with the pasture dressed around 54 per cent. It should be noted that the last column is based on the farm weights of the cattle. If the New Orleans live weights were taken it would raise the figures in the last column from 2 to 2.5 points in each case.

LOT E.—*End of summer 1909. Feed, cottonseed and pasture.*
Average daily gain of each steer 2.06 *pounds.*
Cost of 100 *pounds of gain* $2.39
Total profit per steer 8.39

TABLE 11. *Complete Summary of Summer Feeding.*

	1907-'8				1908-'9		
	Lot A Pasture alone	Lot B Pasture plus cottonseed cake	Lot C Pasture plus "Caddo" cake	Lot D Pasture plus cottonseed cake	Lot A Pasture alone	Lot B Pasture plus cottonseed cake	Lot E Pasture plus cottonseed
Average weight each steer at beginning test	732	738	738	532	647	639	653
Average daily gain per steer	1.51	2.32	1.84	1 62	1.74	1.88	2.06
Average amount concentrates consumed per steer per day	......	3.31	3.31	2.76	......	3.40	4.49
Average amount concentrates to make 100 pounds gain	......	143	180	171	......	181	218
Cost 100 pounds gain, pasture charged	$1.18	$2.56	$3.03	$3.24	$1.03	$3.21	$2.39
Initial cost of steers per 100 pounds	2.92	2.92	2.92	2.50	2.95	2.95	2.95
Selling price (N. O.) of steers per 100 pounds	3.66	4.53	4.35	3.44	3.79	4.37	4.25
Total profit per steer	2.86	10.42	6.62	.43	7.06	6.99	8.39

BULLETINS

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Agricultural Experiment Station

AUBURN

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BULLETIN No. 152 FEBRUARY, 19 I

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

SELF BOILED LIME SULFUR and ITS USE

By

P. F. WILLIAMS

and

J. C. C. PRICE.

Opelika, Ala.:
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1911

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Plate 1.—Showing a barrel outfit in operation with 2 lines of hose. This winter treatment should always be given to secure successful summer treatment.

SELF BOILED LIME SULFUR WASH AND ITS USE

With the exception of the late spring frosts the *brown rot* of the peach causes a higher percentage of loss to the growers than does any other agency. It is practically impossible to work out consistent percentages with sprayed and unsprayed trees year after year, but the growers will testify that unsprayed trees suffer losses of from 25 per cent. to 100 per cent. each season, depending of course, very much upon the season. During the season of extreme humidity, or when we have excessive rains just prior to the picking season, the greatest losses are incurred.

The disease works such havoc with the peach crop that in some sections the growers have applied the axe to the orchard, having found no method of successfully controlling the trouble. This rot continues to develop in the fruit while in transit from the orchard to the market. If the disease is present in the orchard, the healthy fruit becomes affected by handling. The portions of the fruits coming in contact in the crates, produces a so called "sweating," which creates moisture enough to germinate the spores. It frequently happens that the fruit reaches the market in a "spotted" condition.

At the suggestion of Prof. M. B. Waite, of the Bureau of Plant Industry, experiments were carried on by Prof. W. M. Scott, of the same Bureau, commencing in 1901, to determine, if possible, if a substitute for Bordeaux Mixture could be found. Although Bordeaux Mixture had been used successfully in combatting the apple diseases, it could not be used on peach trees. Even with apples there are still many objections to the Bordeaux treatment, as it injures the foliage of some varieties and also causes a "russetting" of the fruit. In 1907, Prof. Scott experimented with the various self boiled lime-sulfur mixtures on the apple and peach. Before discussing the results obtained with this mixture, which has now been tested in practically all the large peach growing sections, let us consider the nature of Brown Rot itself, together with the chief means by which it is spread.

Brown Rot (*Sclerotinia fructigena*) is a fungus disease attacking the fruit either on the tree or in transit to market. Great losses are also caused at blooming time, and the disease penetrates the bark and causes a canker to appear which often girdles the twig. The diseased blossoms turn brown and become dried and adhere to the twigs for several weeks. Many blooms and twigs are destroyed on trees in low, poorly drained lands even in dry seasons, but of course, the damage is much greater during wet seasons. Some of the diseased peaches may hang on the tree through the winter, and endanger the life of the twigs as well.

Although the fruits may rot when less than a half an inch in diameter, the trouble usually appears nearer the maturing period of the fruit. From the first appearance of the small brown circular spot on the fruit until it is entirely decayed, often consumes less than two days. For this reason many unnecessary losses are met as the grower starts his spraying too late. There are but few people who are not familiar with the latter stages of the disease when it has enveloped the fruit in a grayish brown moldy coat. Many of the rotted fruits shrivel up on the trees and pass the winter as "mummied fruits." In this form the disease is carried over winter. Many of the mummied fruits fall to the ground and lie exposed or are partially covered with soil through the winter. During the spring and summer, especially in wet seasons, spores developed from these mummied fruits are blown about and infect the crop. Again, during wet seasons the fruit becomes tender and watery, making it easier for the spores to attack it. Where the twigs become infected from the attached rotten fruits the fruit buds are of course destroyed, thus materially diminishing the crop for the next season. These diseased twigs appear very much the same as twigs on the pear or apple affected with "fire blight," and during the pruning these should be cut out and destroyed.

The mummied fruits which lie on the ground partially covered with soil develop another stage of the disease and form brown, cup shaped bodies, which produce millions of ascospores. These rise and float about in the air infecting the blossoms, where in turn there develops a summer crop of spores which later infect the young peaches. From this we clearly see the necessity of early spraying, and as the mummied fruits play such an important roll these should be carefully removed and destroyed. However, this alone cannot suffice, as one or two unnoticed mummied fruits will be enough to affect the next crop.

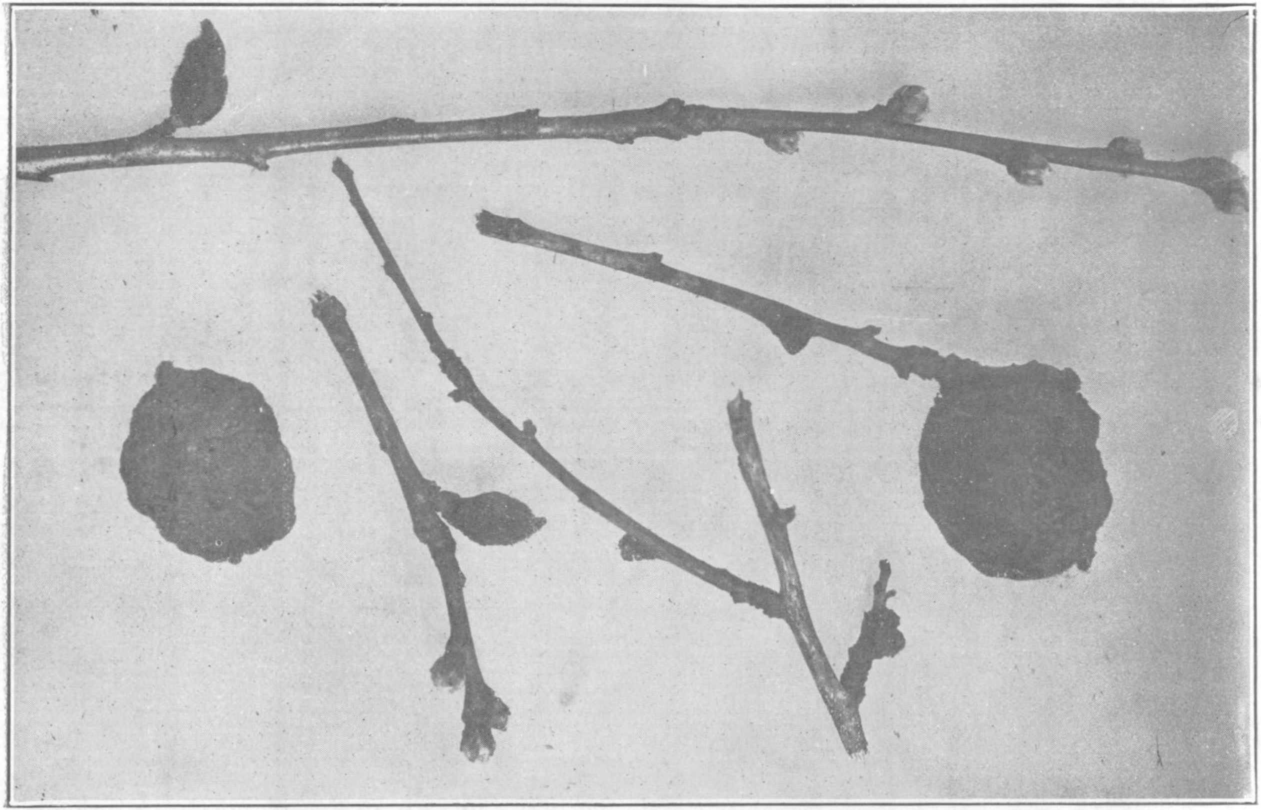


Plate 2.—Showing "mummied fruits" and blackened twigs attacked by Brown Rot.

PLUM CURCULIO.—Another enemy must be spoken of in this connection. What often appears to be a perfect peach when broken open displays the yellowish white grub of the Plum Curculio. Wormy fruit is worthless, however little the fruit may have been injured. It is usually considered that brown rot holds second place in the percentage of loss to the peach growers of Alabama, but from the fact that 93 per cent. of the fruit attacked by brown rot becomes infected through the punctures of the curculio, we might more properly assign this troublesome insect to second place.* Since the curculio and brown rot are so closely associated in peach injury, we may fight them both at the same time. To do this requires the application of an insecticide and also a fungicide. For the insecticide the following material is used:

2 lbs. Arsenate of Lead.
3 lbs. Pure Rock Lime.
50 gals. Water.

The arsenate of lead should be mixed into a paste in a bucket before adding it to the solution. Slowly slake 3 lbs. of rock lime in water. If the lime were not added there might occasionally be enough free arsenic in the solution, even with this insecticide to cause serious injury to the foliage. Some lots of commercial arsenate of lead may contain enough water soluble arsenic to burn the very sensitive foliage of the peach, so lime is added to combine with and neutralize it. This insecticide is applied just as the petals or so called "shucks" are falling.

For the second spraying we will simply add the 2 pounds of arsenate of lead to a self boiled lime sulfur spray solution. The fight against the rot must commence early or the work will be worthless.

Many are familiar with the preparation of the concentrated lime sulfur wash for the winter treatment of fruit trees in controlling the San Jose scale. The same ingredients are used for the self boiled wash, but the method of preparing it is radically different. It is very easy to confuse the two methods. The object in using the self boiled mixture is to obtain a solution which can be applied in summer without injuring the foliage. The winter wash used even at the rates of 1 to 50 and 1 to 100 caused injury to the fruit and foliage.

*See Georgia State Board Entomology Bult. 32, p. 38, 1910.

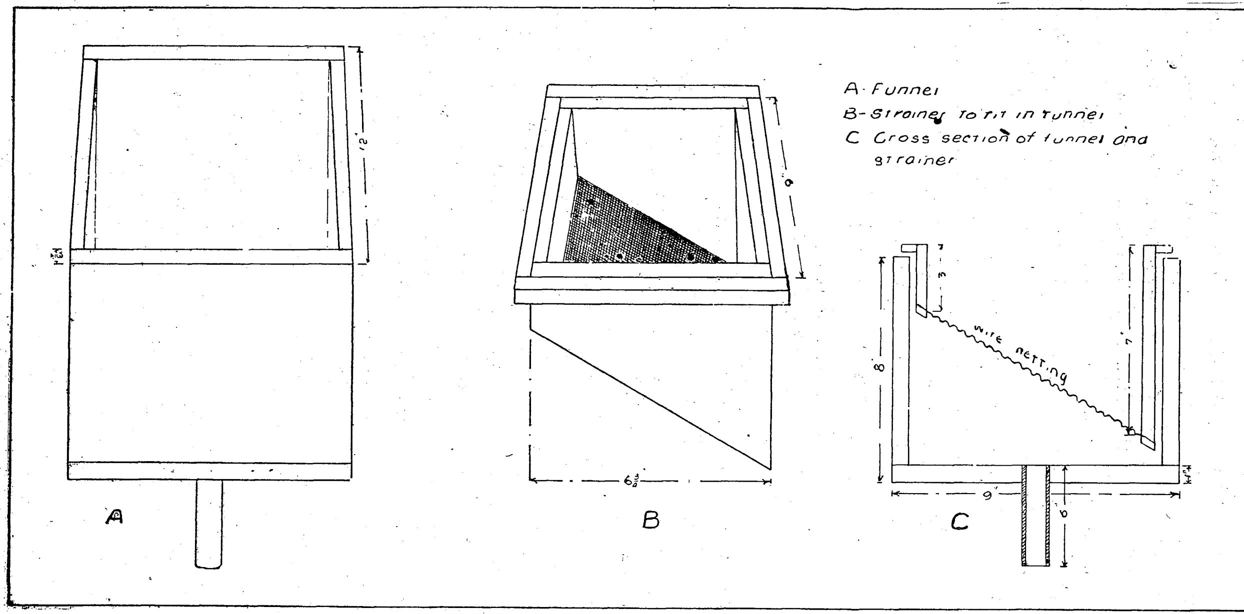


Fig. 1—Showing diagram for making a home-made strainer.

In the formula for the summer wash the amount of lime and sulfur is considerably reduced and consists of the following formula:

8 lbs. of pure unslaked lime.
8 lbs. of flour or flowers of sulfur.
50 gals. water.

In the preparation of the above no fire is used under the vessel in which the material is placed.

PREPARING THE SELF BOILED MIXTURE.—Into a strong barrel or an iron kettle place the 8 pounds of lime in 4 to 6 gallons of water which has previously been brought up to a temperature of 190 to 200 degrees. (In using warm water the lime begins to slake much quicker than in cold water.) As soon as the lime begins to slake pour in the sulfur, which has been freed from lumps by being passed through a screen, and stir vigorously for about 30 seconds. Cover the barrel with a heavy piece of bagging. Occasionally examine the mixture to see that it does not become too dry. If this happens add a little more water. Allow the boiling caused by the slaking lime to continue for about 10 minutes. At this point add sufficient cold water to stop the boiling. If boiling is allowed to continue too long an excess of sulfur will be dissolved, causing injury to the foliage. The mixture is now strained through a wire gauze having 20 meshes to the inch. (See Fig. 1). Wash and rub all the particles of sulfur through into the barrel during the straining.

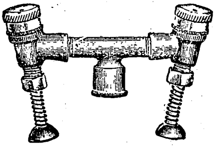


Fig. 2.—Showing a good type of nozzle.

With the best equipment and the best prepared mixture the results of the application will vary with different operators. In the case of the winter wash every portion of the tree should be covered with the spray. In applying the summer wash as just described, the drenching of the tree is not to be recommended. The object is to cover the peaches and twigs as expeditiously as possible.

Fifty gallons of summer wash will cover about 35 to 40 six year old trees. About 30 of the same aged trees can be covered with the winter wash if the trees have been previously well pruned. Pruning and spraying are both essentials in successful fruit growing.

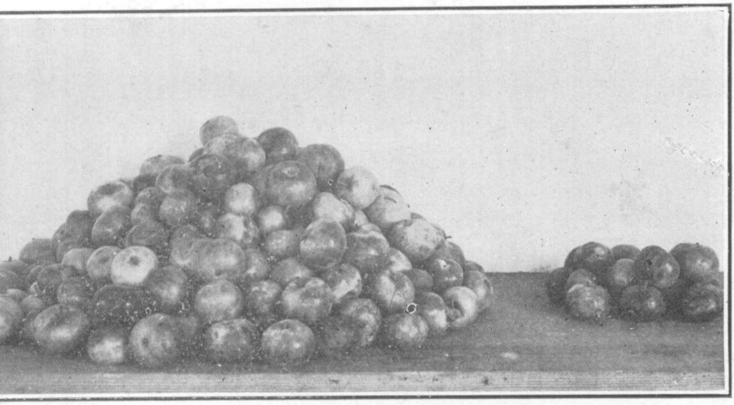
The first application of this self boiled preparation should contain 2 pounds of arsenate of lead, as the latter will still be effective against the Curculio. This mixture is known as the "self boiled lime sulfur arsenate of lead" solution. The time for applying it should be between two and three weeks later than the application containing the arsenate of lead and lime, which, as stated above, goes on just as the "shucks" are falling; or about 5 or 6 weeks from the time the trees bloomed.

The third application should be made about four weeks later than the second, and this time consists of simply the self boiled wash. Some varieties, such as Greensboro, Carman, Waddell, McKinnel and Hiley, which are all early or medium early ripeners, will mature on two sprayings in favorable seasons.

According to Scott the figures given on cost of spraying in using four men, one to prepare the mixture and three to spray, 500 to 800 trees can be covered in a day with a 200 gallon tank. With hand power the above cost per tree would vary from 1 1-2 to 2 cents, or 6 cents per tree for the three sprayings. Prof. Scott states that with a power sprayer four applications can be put on for about 5 3-4 cents per tree. Here at Auburn we have been using a 50 gallon barrel outfit. With two competent men 3 applications cost approximately 10 cents per tree. In a ten hour day with these two men the material has been prepared and applied to 300 trees averaging 7 years in age; this, of course, with every condition favorable.

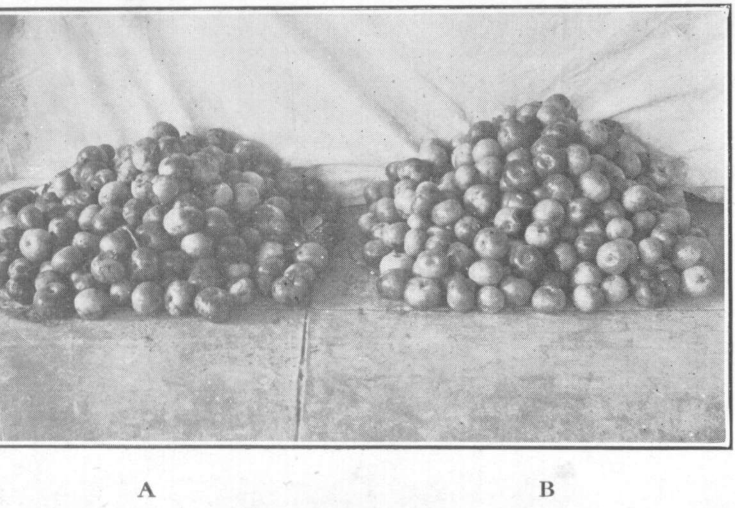
Peach Scab (*Cladosporium carpophilum*), commonly known as "black spot" or "freckles," is another fungus disease attacking the peach. The spots are about one-eighth of an inch in diameter, and are dark brown or blackish in color. This often causes the fruit to split or shrivel along the suture and gives it a very unattractive appearance. The brown rot readily finds entrance through these spots and cracks. This fact should be considered in fighting the brown rot. Self boiled lime sulfur is a positive remedy for controlling scab.

Prof. Scott and co-workers do not recommend the self boiled lime sulfur wash as a positive remedy for apple "*scab*," and particularly the *bitter rot* of the apple. Where these troubles prevail, Bordeaux should be used in the spraying operations following the self boiled lime sulfur treatment. The mild cases of *scab* and the severe cases of *leaf spot, fruit spot,* and the *sooty fungus*,



A B

Plate 3.—Apples sprayed. (A) Good fruit. (B) Rotten fruit.



A B

Plate 4.—Apples unsprayed. (A) Rotten fruit. (B) Good fruit.

were controlled and prevented in the respective cases in the experiments conducted in 1909 at the Virginia Station. In these experiments the standard commercial concentrated lime sulfur solution was used at the rate of 1 1-2 gallons to 50 gallons of water, or by using the home prepared mixture at the rate of 4 pounds of sulfur and 2 pounds of lime to 50 gallons of water, with apparently no damage to the foliage.

The self boiled mixture was also used, and no damage whatever was done to the foliage; in fact, the report states that the leaves put on a healthier appearance.

In combining an insecticide with the self boiled lime sulfur, Paris Green was found to be injurious, burning the foliage badly. With the addition of 2 pounds of arsenate of lead to either the 1 1-2 to 50 commercial Lime Sulfur or the Self Boiled solution, there was no apparent injury to the foliage.

The results obtained at Auburn with lime sulfur on apples showed that where the trees were sprayed 98 per cent. of the fruit was perfect. (See Plates 3 and 4). The applications were made as follows:

FOR CODLING MOTH.

Arsenate of Lead, consisting of—

2 lbs. arsenate of lead.
3 lbs. pure rock lime.
50 gals. water.

This should be applied just after the petals drop.

FOR BLACK AND BITTER ROTS.

Self Boiled Lime Sulfur—

8 lbs. pure rock lime.
8 lbs. flowers or flour of sulfur.
50 gals. water.

This should be applied six weeks after the petals drop and at twenty day intervals.

The apple trees were treated with three sprayings. Although many varieties of apples can be successfully grown even in Central Alabama, it is certain that this cannot be done without proper attention being paid to spraying.

Prof. Scott's experiments showed that with the lime sulfur arsenate of lead mixture applied three times to peaches the percentage of perfect fruits was 81 per cent. The first spraying of arsenate of lead and lime and with the two following, the self boiled lime sulfur, with two pounds of arsenate of lead, 85 per cent. of the fruits were perfect. These tests were conducted with the Elberta and Belle of Georgia varieties.

The results at Auburn showed even higher percentages of perfect fruit. The notes were taken on Carman, Elberta and McKinnel varieties, and were as follows:

Sprayed	14 Carman	Average perfect 97.6 per cent.
Unsprayed	3 Carman	Average perfect 48.6 per cent.
Sprayed	6 Elbertas	Average perfect 92 per cent.
Unsprayed	2 Elbertas	Average perfect 75 per cent.
Sprayed	2 McKinnel	Average perfect 89 per cent.
Unsprayed	2 McKinnel	Average perfect 00 per cent.

With the last named variety the records show that in the past four years no fruit matured owing to the attacks of the rot. There were many other trees treated as above, but no actual count could be made in all cases. However, the high percentages of perfect fruit prevailed on all treated trees.

In an experiment with 1500 peach seedlings, the entire orchard was left unsprayed the past season. As a result only 2 per cent. showed resistance to brown rot, the remainder showing about 95 per cent rotten fruit.

With the work with peaches and apples alike much of the success with the summer treatment depends upon previous pruning and thorough winter spraying with the concentrated lime sulfur. The results would indicate this from the work done with both peaches and apples here at Auburn.

Dr. Powell, of the Bureau of Plant Industry, states that the advent of the self boiled lime sulfur wash has placed the peach industry of the East once more on its feet.

Some contend that there will now be an over supply of peaches. This may be true, but those who study market conditions carefully and endeavor to put out first class fruit year after year, will always be able to dispose of their fruit at good prices.

There were differences of from 20 to 36 cents in the prices offered on crates in the New York market in favor of the sprayed fruits. This alone pays for the spraying, but in addition it must be remembered that there are many more crates gathered from the sprayed than the unsprayed trees. This should persuade more Alabama growers to spray faithfully each year.

A barrel outfit similar to the one in use at the Experiment Station costs approximately $22.00 with the necessary accessories.

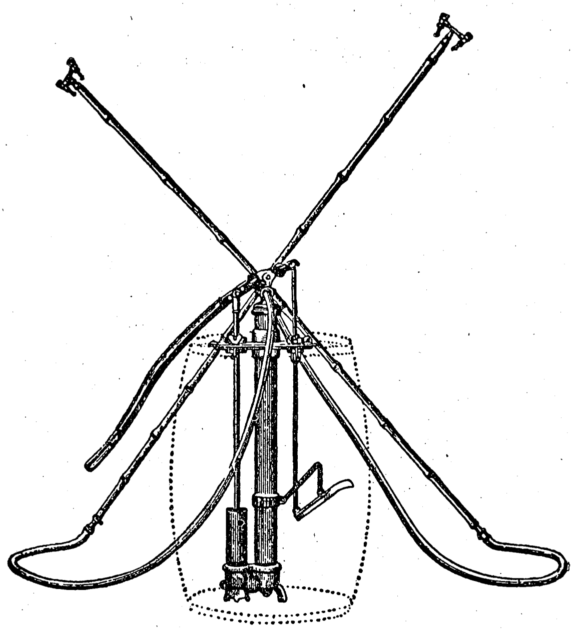


Fig. 3—Showing a good type of barrel outfit.

Dealers in Lime are as follows:

Newala Lime Works, Calera, Ala.
Calera Lime Works, Calera, Ala.
Keystone Lime Works, Calera, Ala.
Longview Lime Works, Calera, Ala.

Wholesale Sulfur Dealers:

Durr Drug Co., Montgomery, Ala.
Griel Bros., Montgomery, Ala.
Jacobs Pharmacy, Wholesale Dept., Atlanta, Ga.
Mobile Drug Co., Mobile, Ala.

Manufacturers of Spraying Machinery:

Morrill and Morley, Benton Harbor, Mich.
(G. W. Barnett Hardware Co., Agent, Montgomery, Ala.)

Goulds Mfg. Co., Seneca Falls, N. Y.
(Beck and Gregg Hardware Co., Atlanta, and
Ala. Machinery and Supply Co., Montgomery, Agents).

The Deming Co., Salem, Ohio.
Frost Insecticide Co., Arlington, Mass.
(W. B. Douglass Co., Mr. Turner, Birmingham, Agent).
Dayton Supply Co., Dayton, Ohio
F. E. Meyers & Bro., Ashland, Ohio.
Agencies—Barney-Cavenaugh Hardware Co., Mobile, Ala.
Selma Hardware Co., Selma, Ala.
Ala. Machinery and Supply Co., Montgomery, Ala.

Cushman Power Sprayer Company, Lincoln, Nebraska.
Peerless Power Sprayer, American Sprayer Company of
Minneapolis, Minn.
Beck Power Sprayer Co., Lansing, Mich.
H. L. Hurst Mfg. Co., Canton, Ohio.
E. H. Childs & Co., Ithaca, N. Y.
Hardie Mfg. Co., of Hudson, Mich.
Champion Mfg. Co., Pontiac, Mich.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

EXPERIMENTS WITH COTTON

VARIETIES
BOLL ROT
WILT
PHOSPHATES

By

J. F. DUGGAR, Director,

and

E. F. CAUTHEN, Farm Supt. and Recorder.

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1911

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EXPERIMENTS WITH COTTON

BY

J. F. DUGGAR, Director,

AND

E. F. CAUTHEN, Farm Superintendent and Recorder.

SUMMARY.

Of the many varieties of cotton tested in plots in 1910, Cook, Dillon, Hardin and Triumph made the largest yields; of those tested in observation rows, Bate Early Victor, New Triumph, Excelsior Wilt-Resistant, Triumph from Alabama, and Franklin, all yielded well.

The earliest varieties of cotton were Early Mammoth, Broadwell, Bank Account, Trice, Sugar Loaf King and Shelley; medium early were the Cooks, Triumph, Covington-Toole, Cleveland, Hite, Money Maker, Berry and Franklin; and among the latest varieties were Hardin, Dillon, Poulnot, Russell, etc.

Acid phosphate afforded larger yields than either ground rock phosphate or basic slag.

Anthracnose damaged all the varieties of cotton to some extent, but more especially the Cooks, Brown No. 1, Hardin, Trice, Gold Coin, and Early Mammoth. Some of those only slightly damaged were Rowden, Cleveland, Dixie, Simpkins, Dillon, and Poulnot.

Varieties differed greatly in the amount of boll-rot.

The amount of boll-rot or anthracnose was perceptibly reduced by treating the seed before planting them. Seed immersed in water at 170 degrees Fahrenheit for ten minutes produced a crop having only 4.9 per cent. of diseased bolls, while untreated seed had 11.3 per cent.; seed treated for twenty-two minutes in water at a temperature of 150 degrees Fahrenheit had 2.4 per cent. of boll-rot, while the adjacent plot of untreated seed had 9.9 per cent. of affected bolls. Charring the seed coat with concentrated sulphuric acid reduced the percentage of diseased bolls from 11.3 to 5.9.

Varieties of cotton were tested on soil at Loachapoka, Alabama, badly infected by wilt, or black root, and some of them showed

remarkable resistance to the disease. Cook, No. 307-6, yielded 269 per cent. more lint per acre than the nearest plot of common cotton; Covington-Toole yielded 227 per cent. more lint than the check; Cook from Hall afforded 185 per cent. more lint; Excelsior Wilt-Resistant 164 per cent. more, and a hybrid cotton 115 per cent. more lint than the check plot.

For wilt-infected lands it is recommended that the crop be changed from cotton to some other crop, as corn, grain, etc.; but in case it is found necessary to grow cotton, that some wilt-resisting variety be planted.

WEATHER CONDITIONS.

The growing season of both 1909 and 1910 was marked by extremes. In 1909 there was an excess of rain throughout May and June and an abundance during July and August. In 1910 a rainy season began in June and continued through most of the month of August.

The effect of the wet weather prevailing during the greater part of each summer was to cause the development, on the Station Farm and in many other localities throughout Alabama, of an abnormally large amount of boll rot, in such fields as had become contaminated with the germs of this disease.

The latter part of the summer of 1909 was also distinctly unfavorable to the cotton crop, through the occurrence of a period of extreme heat, causing the shedding of a large proportion of the squares and young bolls.

In 1910 a killing frost occurred at Auburn and throughout most of the State on October 29, an unusually early date. However, on the fields where the tests here recorded were made, no variety was materially reduced in yield by frost.

The harvesting season in both years was highly favorable, as indicated by the slight rainfall in September and October.

On the whole, both 1909 and 1910 must be regarded as years highly unfavorable to cotton in this part of Alabama, and indeed throughout a large proportion of the Cotton Belt. The table below gives the rainfall at Auburn for the growing season of each of the past three years.

Rainfall at Auburn in the growing season in 1908, 1909, and 1910.

MONTH	RAINFALL IN INCHES		
	1908	1909	1910
	In.	*In.*	*In.*
May	2.74	7.40	3.04
June	2.48	8.64	5.63
July	4.65	5.01	4.41
August	3.71	4.07	6.17
September	1.50	.86	2.97
October	1.61	1.42	1.97

VARIETIES OF COTTON.

Soils and fertilization for the variety test.—The number of varieties and strains of cotton compared in 1910 on the farm of the Alabama Experiment Station at Auburn was fifty. There was available only enough suitable land to accommodate twenty-two varieties on plots of sufficient size to determine accurately the yield per acre. The other twenty-eight varieties were necessarily confined each to a single row, not to determine their yields, but to make observations on their peculiarities and apparent good qualities, so that the most promising of them might be tested on a larger scale the following year.

The land used for the twenty-two varieties of cotton, grown on plots in 1910, is a poor, dry, upland, sandy loam, but fairly uniform in fertility. The preceding crop was drilled soy beans, the mature soy bean plants having been cut and removed from the land for threshing. About the middle of March, the land was plowed eight to ten inches deep, turning under the soy bean stubble and fallen leaves. The rows for cotton were marked off three and one-half feet wide, the fertilizer drilled in. and low beds formed. The cotton seed were dropped in checks, so that each row would have the same number of hills, and each plant the same space, namely, twenty-one inches by three and one-half feet. The stand of single plants spaced twenty-one inches apart was very uniform.

The first planting was made April 15. Owing to cold weather and heavy rains, germination was so imperfect that a second planting became necessary. On May 2 the cotton beds were freshened with a spring tooth harrow and a second planting made.

A complete fertilizer was applied before planting. It was a home-mixture, consisting of 240 pounds acid phosphate, forty pounds muriate of potash, and 120 pounds nitrate of soda per acre. The fertilizer was mixed with the soil by means of a small shovel-plow before the beds or ridges were formed. Frequent rains in June and July caused a postponement of an intended application of nitrate of soda until July 22. At this date, which was doubtless too late, the nitrate of soda was so damp that it became necessary, in order to absorb its moisture and permit its easy distribution, to mix thirteen and one-third pounds of cotton seed meal with the sixty-six and two-thirds pounds of nitrate of soda. These amounts per acre were drilled on one side of each row, July 22.

Clean, shallow cultivation was given the cotton at such frequent intervals as to prevent injury from grass or from the crusting of the soil. Cultivation was continued until August 1.

The most common form of boll rot, anthracnose, reduced the yield of all varieties of cotton grown on the Station farm in 1910. Some of the varieties were severely injured by this disease, while others were only slightly hurt. None was entirely free from it. Some strains, grown from seed picked in fields where this disease was very destructive the previous year, were injured more severely than plants of the same variety grown from seed from healthier fields. It is believed that cotton seed from fields where boll rot prevails is one means of scattering this disease; therefore, the Station prefers not to send out seed grown on the Station farm until further selection has been made with the special aim of decreasing the amount of boll rot. However, the disease is quite widely prevalent over the Cotton Belt, but, as a rule, its effects are conspicuous only in wet seasons.

Varieties of cotton in 1910, ranked according to total value of seed and lint per acre.

VARIETIES	Actual yield per acre (stand variable)		Corrected to uniform stand	
	Lint Lbs.	Percentage of Lint	Lint per acre Lbs.	Total value per acre; lint 14c.; seed $26.00 per ton
Cook (from J. E. Stone)	496	40.3	497	$79 05
Dillon	443	39.5	463	73 95
Hardin	438	39.2	446	71 33
Cook (from M. R. Hall)	422	38 8	432	69 29
Triumph	412	38 0	426	68 62
Russell	384	33 4	407	67 49
Dixie	395	34 5	409	67 32
Cleveland	406	36.4	413	67 14
Poulnot	401	36 5	406	65 99
Ruralist	374	33.9	384	64 74
Covington-Toole	396	40.6	404	64 21
Cook No. 304	360	38.3	366	58 84
Cook No. 313	360	42.7	373	58 68
Broadwell	343	35.9	350	57 06
Early Mammoth	349	36.7	351	56 97
Bank Account	338	36.7	344	55 77
King Big Boll	322	37.0	325	52 62
Sugar Loaf King	323	38.5	323	51 88
Cook No. 354	301	39.2	318	50 73
Cook No. 307	308	40 4	318	50 55
Cook No. 333	308	42.0	310	48 95
Trice	228	30 7	232	39 25

From this table it may be seen that Cook, grown from seed obtained from J. E. Stone, Sylacauga, Alabama, afforded the largest yield of lint, 497 pounds, and the highest value of total product, $79.05 per acre. Dillon was second; Hardin, third; Cook from M. R. Hall, James, Alabama, fourth; and Triumph, fifth in total value per acre and in yield of lint per acre.

The varieties of cotton which ranked among the five most productive in each of the tests of the last five years are mentioned below in order of productiveness each year.

Most productive varieties of cotton in last 5 variety tests.

Rank in productiveness	1910	1909	1908	1906	1905
1	Cook (S.)	Cook (206)	Dillon	Cook	Toole
2	Dillon	Cook (221)	Gold Coin	Cleveland	Cook
3	Hardin	Dixie	Dixie	Layton	Cleveland
4	Cook (H.)	Hardin	Cook	Toole	Bancroft
5	Triumph	Poulnot	Hart	Poulnot	Christopher

Rank in productiveness of five most productive varieties of each year.

	1910 Rank	1909 Rank	1908 Rank	1906 Rank	1905 Rank	Total number tests	Number times among 5 best
Cook	1, 4	1, 2	4	1	1	5+	5+
Dillon	2	..	2	..	abs.	4	2
Toole	..	..	abs.	4	1	4	2
Cleveland	..	..	..	2	3	5	2
Dixie	..	3	3	..	abs.	4	2
Hardin	3	4	abs.	abs.	abs.	2	2
Poulnot	..	5	..	5	..	5	2

From the last two tables it may be seen that the list of varieties standing first to fifth in productiveness in some one or more of the last five tests at Auburn contains thirteen different names. Of these, Cook occurs five times among the winners; while Dillon, Toole, Cleveland, Dixie, Hardin, and Poulnot each occurs twice among the five most productive varieties.

Brief descriptions of varieties tested in 1910.—Cook Improved, whether from the originator, J. R. Cook, Ellaville, Ga., from J. E. Stone, Sylacauga, Ala., from M. R. Hall, James, Ala., or from the Alabama Experiment Station, is a productive, well-limbed variety of medium earliness. Its chief faults are special liability to boll-rot (anthracnose) and a tendency for the seed cotton to fall from the burs. The bolls are of medium to large size and the percentage of lint is very high.

Cleveland is somewhat similar to Cook in form of plant, large size of bolls, and in being early for a big boll variety. It has proved here to be less liable to boll-rot than has Cook. Its chief fault lies in the falling of the seed cotton from the burs; hence, picking should be done promptly.

Toole is well supplied with limbs and bolls. The per cent of lint is high. Its chief fault is the small size of bolls.

Hardin is a variety with medium-sized bolls and a rather high per cent of lint.

Poulnot is a semi-cluster variety with rather large bolls.

King (here received as Sugar Loaf King) is a variety with small plants and small bolls. King and its equivalents, or varieties apparently selected from it, Simpkins and Broadwell, are the earliest varieties tested at Auburn. Reference to the long table below shows that King and similar early varieties have usually been somewhat less productive than the varieties described in the paragraphs above. However, the results may be reversed in regions where the boll weevil is present. The seed cotton of the King group of varieties easily drops from the burs.

Dixie is a variety well supplied with fruiting limbs and with bolls of small size. Its special value lies in having been selected by the United States Department of Agriculture as being largely resistant to cotton wilt. Its failure to show decided resistance in our tests in 1910 is not understood.

Dillon is a tall cluster variety, similar to the Jackson, from which it is a selection. It is strongly wilt-resistant.

Where to obtain seed.—The Alabama Experiment Station can not supply seed of any variety; it is believed that seed from a crop as badly damaged by anthracnose, or boll rot, as was all the cotton on the Station farm in 1910 may serve to increase this disease, although it is already present in most or all parts of the State. The Station obtained its seed from the following:

Cook (Stone), J. E. Stone, Sylacauga, Alabama.
Dillon, U. S. Department of Agriculture, Washington, D. C.
Hardin, W. P. Letson, Glen Allen, Alabama.
Cook (Hall), M. R. Hall, James, Alabama.
Triumph, Wade Brothers, Alexander City, Alabama.
Russell, J. M. Chappell, Jr., Route 6, Louisville, Miss.
Dixie, U. S. Department of Agriculture, Washington, D. C.
Cleveland, Alabama Experiment Station.
Poulnot, J. E. Bradberry, Athens, Georgia.
Ruralist, F. J. Merriam, Atlanta, Georgia.
Covington-Toole, W. F. Covington, Headland, Alabama.
Cook No. 304, Alabama Experiment Station.
Cook No. 313, Alabama Experiment Station.
Broadwell, J. B. Broadwell, Alpharetta, Georgia.
Early Mammoth, I. W. Mitchell, Youngsville, N. C.
Bank Account, H. G. Hastings & Co., Atlanta, Georgia.
King Big Boll, J. E. Butts, Ethelville, Alabama.
Sugar Loaf King, I. W. Mitchell, Youngsville, N. C.
Cook No. 354, Alabama Experiment Station.
Cook No. 307, Alabama Experiment Station.
Cook No. 303, Alabama Experiment Station.
Trice, M. N. McFadden, Warren, Tennessee.

SUMMARY OF ALL VARIETY TESTS OF COTTON ON THE FARM OF THE ALABAMA EXPERIMENT STATION.

In the following summary, showing the rank in productiveness in lint, are listed all the varieties grown on *plots* at Auburn. This does not include a large number of other varieties grown on single rows merely for observation and not to determine their yields. This table is intended for reference rather than for reading. The figure 1 after a variety indicates that in a given year it stood first among the varieties tested that year.

Rank in productiveness of varieties of cotton tested by Alabama Experiment Station

	'89	'90	'91	'91	'92	'93	'96	'97	'98	'99	'04	'05	'06	'08	'09	'10
Alex. Allen	--	--	--	--	--	--	--	--	--	--	4	10	8	16	--	--
Allen Hybrid	--	--	--	--	--	--	11	16	--	--	--	--	--	--	--	--
Allen Long Staple	2	--	8	--	21	--	--	14	--	--	14	--	--	31	28	--
Bailey	--	--	--	12	18	--	--	--	--	--	--	--	--	--	--	--
Bancroft	--	--	--	--	--	--	--	--	--	--	--	4	17	26	--	--
Bank Account	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16
Barnett	4	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--
Berry	--	--	--	--	--	--	--	--	--	--	--	21	--	--	--	--
Blue Ribbon Long Staple	--	--	--	--	--	--	--	--	--	--	34	16	--	25	19	--
Broadwell	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	14
Brown No. 1	--	--	--	--	--	--	--	--	--	--	--	--	--	6	11	--
Cameron	--	--	--	--	--	--	--	--	--	--	7	14	--	--	--	--
Cherry Cluster	6	--	4	--	17	--	--	--	--	--	--	--	--	--	--	--
Christopher	--	--	--	--	--	--	--	--	--	--	--	5	12	33	--	--
Cleveland	--	--	--	--	--	--	--	--	--	--	--	3	3	12	7	8
Colthorp Eureka	--	--	--	--	14	4	--	--	--	--	--	--	--	--	--	--
Colthorp Pride	--	--	--	--	11	7	--	--	--	--	--	--	--	--	--	--
Columbia (L. S.)	--	--	--	--	--	--	--	--	--	--	--	--	13	32	--	--
Common	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--
Cook (from Stone)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Cook Improved	--	--	--	--	--	--	--	--	--	--	6	2	1	4	9	--
Cook, W. A. (L. S.)	--	--	4	--	24	1	--	--	--	--	--	--	--	--	--	--
Cook, J. C	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--
Cook No. 206	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Cook No. 221	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--
Cook No. 232	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14	--
Cook No. 239	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--
Cook No. 304	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12
Cook No. 313	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13
Cook No. 354	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19
Cook No. 307	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20
Cook No. 333	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21
Corley	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--
Crossland	--	--	--	--	9	--	--	--	--	--	--	8	--	--	--	--
Culpepper	--	--	--	--	--	--	--	--	--	--	11	16	9	--	--	--
Dalkeith Eureka	--	--	--	--	15	10	--	--	--	--	--	--	--	--	--	--
Dearing	--	--	--	--	--	--	--	4	2	14	--	--	--	--	--	--

Rank in productiveness of varieties of cotton tested by Alabama Experiment Station—Continued

	'89	'90	'91	'91	'92	'93	'96	'97	'98	'99	'04	'05	'06	'08	'09	'10
Defiance (Drake's)	--	--	--	--	--	--	--	--	--	--	--	--	--	22	24	--
Dickson	--	--	2	--	20	--	3	12	--	--	--	24	--	--	--	--
Dillon	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20	2
Dixie (Wilt-Resistant)	--	--	--	--	--	--	--	--	--	--	--	20	18	3	3	7
Doughty	--	--	--	--	--	--	--	--	--	--	10	--	--	--	--	--
Drake (Cluster)	--	--	--	--	--	--	--	--	--	--	20	--	--	22	24	--
Duncan	--	--	--	--	--	--	9	6	--	13	--	--	--	--	--	--
Double Header	--	--	--	--	--	--	--	--	--	--	--	--	--	27	--	--
Early Mammoth	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15
"Excelsior"? (King)	--	--	--	--	--	--	--	--	--	--	--	--	--	8	--	--
Edgeworth	--	--	--	--	--	--	--	--	--	--	27	--	--	--	--	--
Ellsworth	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Florodora	--	--	--	--	--	--	--	--	--	--	33	--	16	--	--	--
Garrard	--	--	--	--	--	--	--	--	--	--	27	--	--	--	--	--
Georgia Best	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--
Gold Coin	--	--	--	--	--	--	--	--	--	--	--	--	--	2	21	--
Gold Dust	--	--	7	--	22	--	--	--	--	--	--	--	--	--	--	--
Grier's King	--	--	--	--	--	--	--	--	--	--	25	--	--	--	--	--
Griffin's Drought Proof	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
Hagaman	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--
Hart	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--
Hardin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	3
Hawkins	9	--	9	--	16	--	8	3	--	3	15	8	7	--	--	--
Herlong	--	--	6	--	23	6	13	--	--	--	--	--	--	--	--	--
Huey's (Big Boll)	--	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--
Hunnicutt, J. B	--	--	1	--	14	--	12	13	--	--	--	--	--	--	--	--
Hutchinson	--	--	--	--	--	--	1	7	7	--	--	--	--	--	--	--
Jackson	--	--	--	--	--	--	--	--	--	1	3	17	--	--	--	--
Johnson Excelsior	--	--	--	--	--	--	--	--	--	--	28	--	--	--	--	--
Jones Improved	5	--	10	--	--	--	10	5	8	7	24	--	--	--	--	--
Jones No. 1	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--
Jones' Long Staple	--	--	11	--	19	5	14	--	--	--	--	--	--	--	--	--
Keenan	--	--	--	--	--	--	--	--	--	--	--	--	--	--	29	--
Keith	--	--	5	--	11	--	--	--	--	--	--	--	--	--	--	--
King	10	--	--	6	8	--	5	--	--	10	17	18	5	--	26	--
King Big Boll	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17
Langford	--	--	--	--	--	--	--	--	--	--	--	--	--	15	--	--
Layton	--	--	--	--	--	--	--	--	--	--	2	5	2	--	8	--
Lealand	--	--	--	--	--	--	--	--	--	--	38	--	--	--	--	--
Lewis Prize	--	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--
Lowry	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--
Mascot	--	--	--	--	--	--	--	--	--	--	18	--	--	--	--	--
Mathews (Long Staple)	--	--	--	--	7	11	--	--	--	--	--	--	--	--	--	--
Meredith	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	--
Mortgage Lifter	--	--	--	--	--	--	--	--	--	--	31	--	--	14	--	--
Nancy Hanks	--	--	--	--	--	--	--	--	--	--	19	--	--	--	--	--
Neeley Early	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	--
Okra	9	--	--	13	12	8	--	--	--	--	--	--	--	--	--	--
Parker	--	--	--	--	--	--	--	--	--	--	33	--	--	--	--	--
Peeler	--	--	--	7	8	--	--	--	--	--	--	--	--	--	--	--
Peerless	7	1	--	4	6	--	4	11	--	--	--	--	--	--	--	--
Peterkin	--	2	--	5	1	--	7	8	3	4	1	12	6	--	6	--
Poulnot	--	--	--	--	--	--	--	--	--	--	8	5	4	11	5	9

Rank in productiveness of varieties of cotton tested by Alabama Experiment Station—Continued

	'89	'90	'91	'91	'92	'93	'96	'97	'98	'99	'04	'05	'06	'08	'09	'10
Petit Gulf	--	--	--	3	3	--	17	--	--	--	--	--	--	--	--	--
Pride of Georgia	--	--	--	--	--	--	--	--	--	--	29	--	10	--	--	--
Red Leaf	--	--	--	--	--	--	--	--	--	--	12	9	11	--	--	--
Rameses	8	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--
Ruralist	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--	10
Russell	--	--	--	--	--	--	--	--	1	8	20	6	15	28	17	6
Rogers	--	--	--	--	--	--	--	--	--	--	23	--	--	--	--	--
Rowden	--	--	--	--	--	--	--	--	--	--	5	--	--	--	22	--
Schley	--	--	--	--	--	--	--	--	--	--	25	5	--	23	--	--
Shine	--	--	--	--	--	--	--	--	--	--	22	20	--	--	--	--
Simms Long Staple	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--
Simpkins	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25	--
Sistrunk	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--
Smith Improved	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--
Southern Hope	--	5	--	8	5	--	--	--	--	--	--	--	--	--	--	--
Southern Wonder	--	--	--	--	--	--	--	--	--	--	--	15	--	--	--	--
Strickland	--	--	--	--	--	--	--	--	--	11	--	7	--	13	23	--
Storm Proof	--	4	--	15	2	--	--	--	--	--	--	--	--	--	--	--
Sugar Loaf King	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18
Sunflower	--	--	--	--	--	--	--	--	--	--	34	--	15	--	--	--
Texas Bur	--	--	--	--	--	--	--	--	--	--	13	13	--	10	10	--
Texas Oak	--	--	--	--	--	--	--	1	6	6	--	--	--	--	--	--
Toole	--	--	--	--	--	--	--	--	--	--	--	1	3	--	15	11
Trice	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30	22
Triumph	--	--	--	--	--	--	--	--	--	--	--	--	--	29	--	27
Truitt	1	3	--	2	4	--	2	9	5	2	24	16	14	17	16	--
Tyler	--	--	--	--	--	--	6	15	--	9	--	--	--	--	--	--
Welborn Pet	3	--	--	11	13	2	15	--	--	5	--	22	--	--	--	--
Whatley Improved	--	--	--	--	--	9	16	10	--	--	--	--	--	--	--	--
Wise	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--
Wonderful	--	--	--	14	16	1	--	--	--	--	--	--	--	--	--	--
Woodfin Prolific	--	--	--	--	--	--	--	--	--	--	23	19	--	--	--	--
Woods	--	--	--	--	--	--	--	--	--	--	--	--	--	18	--	--
Wyche	--	--	--	--	--	--	--	--	--	--	--	--	--	30	--	--
Zellner	11	--	--	1	10	--	--	--	--	--	--	--	--	--	--	--
No. varieties in each test	13	5	13	15	29	11	17	16	8	14	40	30	20	33	30	22

RELATIVE EARLINESS OF VARIETIES.

The matter of earliness is now becoming a desirable quality of any variety of cotton. The first picking of all varieties in 1910 was made September 19. On that date more than 80 per cent. of the total seed cotton of Sugar Loaf King, Trice, Broadwell, and Bank Account was open, and more than 70 per cent. of Triumph, Early Mammoth, and Cook (No. 354). On the other hand, Dillon, Hardin, and Cleveland were among the productive varieties on which less than 60 per cent. of the total crop had opened at the time of the first picking, September 19.

Relative earliness of varieties of cotton as shown by percentages of total yield that opened by October 4, 1909, and by September 19, 1910.

[An x indicates that the corresponding variety was grown only in a row test, and on a part of the field slightly removed from the regular variety tests.]

	1909 Per cent. open Oct. 4-5	1910 Per cent. open Sept. 19-20
King (Sugar Loaf)	69.	92.x
Trice	69.	86.
Broadwell	71.	86.
Bank Account	59.	84.
Shelley	--	84.x
King (from Sims)	--	83.
Triumph	65.	78.
Blue Ribbon	55.	78.x
Bohlus	--	77.x
Rosser No. 1	--	76.x
Toole	--	76.x
Uncle Sam	--	76.x
Mortgage Lifter	76.x	--
Early Mammoth	60.	75.
Franklin	--	75.x
Berry	--	74.x
Brown No. 1	74.	--
Cook No. 354	--	74.
Pride of Georgia	--	74.x
Sistrunk	72.x	--
Triumph (from S. C.)	--	73.x
Money Maker	--	72.x
Cleveland (Stone)	--	72.x
Cleveland (from Georgia)	--	71.x
Gold Coin	53.	71.
Willet Red Leaf	38.	70.x

Peterkin	44.	70.x
Simpkins	69.	70.x
Bailey	--	70.x
Russell	50.	69.
Cook No. 304	--	69.
Covington-Toole	69.	--
Cook Wilt Resistant	--	68.
Hawkins	68.	--
Excelsior	68.	68.x
Edgeworth	68.x	--
Hite	--	68.x
Edgeworth	--	67.
Cook No. 307	--	66.
New Triumph	--	66 x
Truitt	65.	--
Ruralist	--	65.
Drake's Defiance	64.	--
Cook (from Stone)	--	64.
Huey, B. B.	60.x	--
Keenan	61.	--
Poulnot	47.	59.
Dixie	42.	59.
Cook (Improved)	57.	--
Cook No. 313	--	57.
Mexican B. B.	57.x	--
Dillon	38.	57.
Cleveland (from Ala. Sta.)	59.	55.
Columbia	58.	--
Texas Bur	58.	--
Georgia Best	58.	--
Bates	--	55.x
Rowden	53.	--
Allen Long Staple	52.	--
Layton	52.	--
Hardin	55.	50.
Strickland	44.	--

VARIETIES ADAPTED TO BOLL WEEVIL CONDITIONS.

As the boll weevil spreads, the demand for earlier cottons increases. The varieties that set the largest number of bolls early in the season give the largest yield because the weevils become more numerous as the season advances and destroy all the late maturing portion of the crop.

If earliness can be coupled with largeness of boll and fairly high per cent. of lint in any variety, that variety becomes more desirable. The station is endeavoring to breed that type of cotton and has some promise of success; but seed are not yet available.

In the boll weevil sections, Triumph has generally given satisfaction. It has large bolls, is fairly early, yields a good per cent. of lint, and is storm-resistant. The plant is vigorous and grows to a medium size. Its foliage is heavy.

Cleveland and other big boll varieties have also proved satisfactory on many farms in the boll weevil region.

Some strains of Cook will probably suit boll weevil conditions fairly well. It is an early variety, has medium sized bolls, and picks easily. The per cent. of lint is high. The plant grows fairly large, puts on long fruit limbs and makes an open top, which admits sunlight among the branches and fruit.

King, Simpkins, and Broadwell all belong to one group and are the earliest kinds tested by this Station. The plants are not large; the bolls are small; the locks drop badly from the burs; the per cent. of lint is medium.

Toole is a productive variety having sufficient earliness for boll weevil conditions, though not so early as the King group. It should be tried where its small size of boll is not objectionable.

Some of the large-yielding varieties, like Dillon and Hardin are late in putting on a crop of fruit, and in consequence of the lateness may fail to produce a large crop under boll weevil conditions. Another popular variety is Russell, which, however, is too late for best results in the presence of the boll weevil.

FIELD NOTES ON ANTHRACNOSE, THE MOST COMMON FORM OF BOLL-ROT.

Description.—This disease appears in tiny spots on the bolls. At first the spots look dark-green or brownish and make slight depressions on the surface of the boll; later they take on a darker tinge and make a black spot. The center of this spot may become grayish and finally pinkish. The pink color is caused by the numerous spores, or tiny bodies that serve the purpose of seed, and these may spread this disease to other bolls.

When the boll is cut through the diseased portion, the lint and seed are often found to be dark and decayed. If there is much damp weather, the boll may be soft; if there is not much dampness, the lint and seed are likely to be dry and hard.

When the disease attacks very young bolls, it often kills them. It may damage only one or two locks in a boll and make the picking of the remaining locks difficult. The stained lint cotton from the diseased locks lowers the market value of the entire sample of cotton. Boll rot is widespread and in wet years causes a great loss in yield in most of the cotton-growing states, especially east of the Mississippi River.

Conditions favoring anthracnose.—The amount of boll rot on the Station Farm was excessive in 1909 and again in 1910. Some varieties lost heavily from its ravages. No variety has yet been found to be entirely and continuously free from anthracnose.

Wet weather during June, July and August favors the development of boll-rot, while dry weather checks its spread. The dampness makes anthracnose more severe by affording favorable conditions for the development of the fungus that produces this disease. Moreover, wet weather increases the size of cotton plants and thus keeps the bolls largely shaded and damp, and may possibly make the bur more tender, and hence more easily entered by the anthracnose fungus.

For the same reason, cotton planted on low land, where it grows rank, suffers more from anthracnose than that grown on uplands.

Likewise, cotton heavily fertilized with nitgrogenous fertilizer, as excessive amounts of nitrate of soda and cotton seed meal, is apt to suffer severely from anthracnose, if the seed be from a diseased crop and if the summer be wet. Where boll rot is expected, the proportion of nitrogen in the fertilizer should not be very high and the rows should be wide, so as to permit an abundance of sunlight.

A. C. Lewis (Georgia Board of Entomology, Bul. No. 24, p. 58) has shown that merely rubbing a diseased boll against an uninjured one results in communicating anthracnose to the latter. However, it is highly probable that insects may yet be found to play a part in conveying the disease, either by merely spreading the spores or by introducing them into wounds made by the insects.

Susceptibility to anthracnose.—Varieties differ greatly in the extent to which they are damaged by boll rot. Whether these differences in susceptibility are due to some inherent weakness of certain varieties, for example, to the possession of a softer or thinner bur, is not fully known. However, our observations through a number of years seem to indicate that the wide variation in the damage wrought on different varieties grown side by side is at least partly due to the fact that some seed planted were from fields free from anthracnose, while the seed of other varieties or strains were badly infected with anthracnose, having been picked from fields where this disease was severe. At least one of the most important means of spreading boll-rot is by means of seed from a diseased crop.

Among the fifteen strains of Cook cotton that have been separated in the cotton breeding work on the Experiment Station Farm (all from a single lot of seed obtained from the originator of this variety), there is one strain that has a much larger percentage of boll-rot than any of the other strains. This fact and other data seem to indicate that it may be possible to decrease the amount of boll-rot by selection of the most resistant plants.

Susceptibility of Different Varieties to Anthracnose.

Counts of bolls attacked by boll-rot, whether severely, or slightly, were made after opening began. The results are recorded in the following table:

Percentage of diseased bolls (almost all attacked by anthacnose, slightly or severely), in varieties of cotton tested at Auburn in 1909 and 1910.

	1909 Per cent. of diseased bolls	1910 Per cent. of diseased bolls
Allen Long Staple	11.	[illegible]
Blue Ribbon	3.0	[illegible]
Bailey x	....	.9
Broadwell	8.4	2.6
Berry Big Boll x	....	2.3
Brown No. 1	33.2	....

Bates ....x........	....	.9
Bank Account......	...	3.3
Bohlus Triple Joint ....x........	....	.7
Cook (Stone)...........	....	5 8
Cleveland	4.6	3.4
Cleveland (Stone) ....x........	....	1.5
Cook Improved	23.1	....
Cook No. 206	8.	....
Cook No. 221...........	28.	....
Cook No. 239	33.	....
Cook No. 232	35.3	....
Cook (Hall)	....	9 4
Cook No. 304	....	17.7
Cook No. 313	....	23.2
Cook No. 354	....	28.3
Cook No. 307	....	28.6
Cook No. 333	....	25 2
Covington Toole.................	9.4	1.7
Dillon..........................	11.5	3.3
Drake's Defiance	7.	....
Dixie	5.	3.2
Edgeworth... ....x......	....	.7
Early Mammoth	....	9.3
Excelsior, from Georgia ..x......	....	.7
Excelsior, from South Carolina.x	....	2.2
Franklin x	....	.5
Gold Coin.....................	7.7	....
Georgia's Best..................	15.4	....
Hite............	....	.4
Hardin	16.9	3.7
King Big Boll	....	4 3
Keenan	10.7	....
Layton Improved................	11.2	....
Poulnot	9.7	2.8
Peterkin	8.9	....
Pride of Georgia ....x......	....	1.2
Rowden	4.7	....
Russell	....	3.4
Ruralist	....	3.9
Rosser No. 1.............x......	....	.6
Strickland.....................	6.3	....
Sugar Loaf King...............	7.	5.8
Simpkins	5.2	1.1
Shelley ....x......	....	1.6
Texas Bur	7.8	....
Trice	3.9	15.4
Toole (Ga.) ....x......	....	1.

Truitt	7.2	....
Triumph	8.7	3.3
Triumph (S. C.) ....x......	....	2.3
Triumph (Ga.)............x	....	.8
Trook ....x......	....	1 4
Uncle Sam ....x......	....	2.3

x Varieties marked (x) were grown in rows in a different part of the same field where boll-rot was less prevalent than on the plots on which the usual variety test was made.

From the above table, giving the percentages of diseased bolls for fifty-nine varieties and strains, it may be seen that in the last two years, when anthracnose was especially prevalent on the Station Farm, the varieties having the largest percentages of diseased bolls were the following:

1909.

Brown No. 1.
Various strains of Cook.
Hardin.

(All having 17 per cent. or more of diseased bolls.)

1910 (Plots).

Various strains of Cook.
Trice.
Early Mammoth.
Georgia Best.

1910 (Observation Rows)

Gold Coin.
Triumph (from South Carolina)
Excelsior (from South Carolina)
Uncle Sam.
Berry Big Boll.
Blue Ribbon.

In the same tests, the varieties having the least boll-rot were the following:

1909.

Rowden.
Cleveland.
Dixie.
Simpkins.

1910 (Plots).

Covington-Toole.
Broadwell.
Poulnot.
Bank Account.
Dixie.
Dillon.
Triumph.
Russell.

1910 (Observation Rows).

Hite.
Franklin.
King.
Rosser No. 1.
Edgeworth.
Excelsior from Georgia.
Bohlus.

Methods of picking cotton for seed, to reduce boll rot.—When practicable, avoid planting cotton in fields where there is much anthracnose. However, if seed must be saved from such fields, it is believed that the following method of picking, adopted by the Alabama Experiment Station in 1910, will greatly lessen the disease in the next year's crop.

In making that picking from which seed is to be saved, only healthy bolls are picked; no boll with a single diseased lock and no boll with a single lock that has failed to expand is picked. Future experience may show that it may be necessary to supplement this with disinfection of the seed to destroy spores of anthracnose that may be lodged on the outside of the seed while being ginned.

Treatment of cotton seed for boll-rot.—In 1910 an experiment was made at Auburn in treating cotton seed to ascertain whether any treatment would reduce the amount of anthracnose in the resulting crop. On account of the nature of the infection of the seed, it was not expected that a treatment of the seed by disinfectants would entirely destroy the fungus, but that the amount of boll-rot might be reduced by destrcying the spores that might be on the outside of the seed.

The seed used were chosen as representing a strain of Cook cotton that had been one of the most severely damaged by boll-rot in 1909.

There were only two rows per plot, each row three and one-half feet wide, and all plots were adjacent. The plants made rather luxuriant growth, the limbs lapping slightly across the middles.

The treatments compared were scalding at two temperatures, the use of commercial sulphuric acid, copper sulphate solution, and two strengths of formalin solution.

Treatment of cotton seed for boll-rot (anthracnose).

Plot	TREATMENT OF SEED	Percentage of total bolls attacked by boll rot; counted Sept. 22, 1910	Treatment ranked according to freedom of crop from boll rot
		Per cent.	
1	Hot water, 170 degrees Fah.; 10 min........	4.9	2
2	Formalin, 4 per cent solution; 30 min.......	7.2	5
3	Untreated	11.3	9
4	Charred seed coat with pure sulphuric acid	5.9	3
5	Copper sulphate, 10 per cent solution; 1 hour	7.3	6
6	Fumigated with carbon bisulphide..........	7.4	7
7	Formalin solution, 5 per cent; 30 min	6.4	4
8	Untreated	9.9	8
9	Hot water, 150 degrees Fah.; 22 min........	2.4	1

All treatments seem to have had at least some slight value. The results show that when the seed were scalded twenty-two minutes with water at 150 degrees Fahrenheit, the percentage of bolls attacked by anthracnose was reduced from 9.9 to 2.4; and when scalded for ten minutes at 170 degrees Fahrenheit, the reduction of diseased bolls was from 11.3 down to 4.9 per cent.

The hope in scalding the seed was that some temperature and length of treatment might be found which would destroy that part of the fungus which had penetrated the seed coat. The results justify the hope that such a result may here have been attained, and that laboratory experiments may determine definitely the temperature and time of scalding necessary to effect the destruction of that part of the fungus, without impairing the germination of the seed.

No definite recommendations for farm practice can be based on the result of one year's test. The field experiments here described will be continued and amplified in 1911.

Field Notes on Cotton Wilt, or Black-Root.

Description.—When a plant is attacked by cotton wilt, or black-root, all the leaves may suddenly wilt, beginning with the tender leaves at the tip of the main stem or branches. Or the disease may come on more slowly, revealing itself by causing that part of the cotton leaf between the large veins to turn yellowish and the edges of the leaf to shrivel. The plant usually dies, or a part of it may die and the remaining part take on a new growth, giving the plant a dwarfed, or one-sided appearance.

The disease develops in spots in the field and re-appears in the same spots from year to year. The infected area is irregular in shape and grows larger each year. All the plants in an infected area may not die; sometime in the same hill, one plant dies and another remains healthy.

Wilt may appear about the time that cotton plants reach the squaring stage and it may continue to kill them throughout the growing season. In 1910, wilt was more injurious during June and July, which were wet months.

Cause.—The cause of wilt is a fungus, which enters the cotton plant through the root, and blocks up the channels that convey food and water from the soil to the leaves. The plant then wilts and may die.

If a cross section through a dying stem is made near the ground, the woody portion shows dark specks or becomes brown or black. This dark color is due to the wilt fungus, which has blocked up the water-carrying vessels. (Fig. 3).

Cotton wilt appears most frequently in sandy soil. Cotton on clay soil is less apt to be attacked. In Alabama black root is most prevalent in the southeastern part of the state.

Means of spreading.—The germs of wilt are in the soil of infected fields. Anything that carries even a little of the soil from one part of the diseased field to another, or from one diseased field to another, scatters the disease; for example, plows or the feet of livestock. Regions in which some field contains the germs of wilt may expect in time to have black-root spread to almost every cotton field, if livestock are permitted to range over the fields in winter. During the time of heavy rains, the overflow

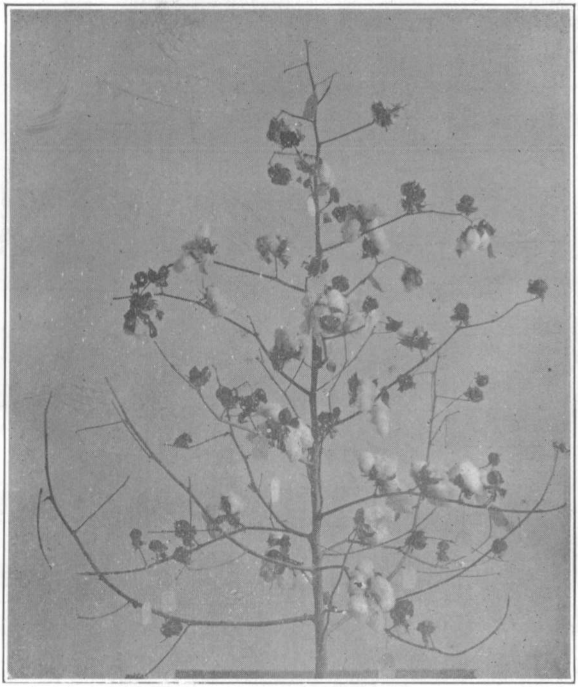

Fig. 1.--A cotton plant badly attacked by boll-rot or anthracnose.

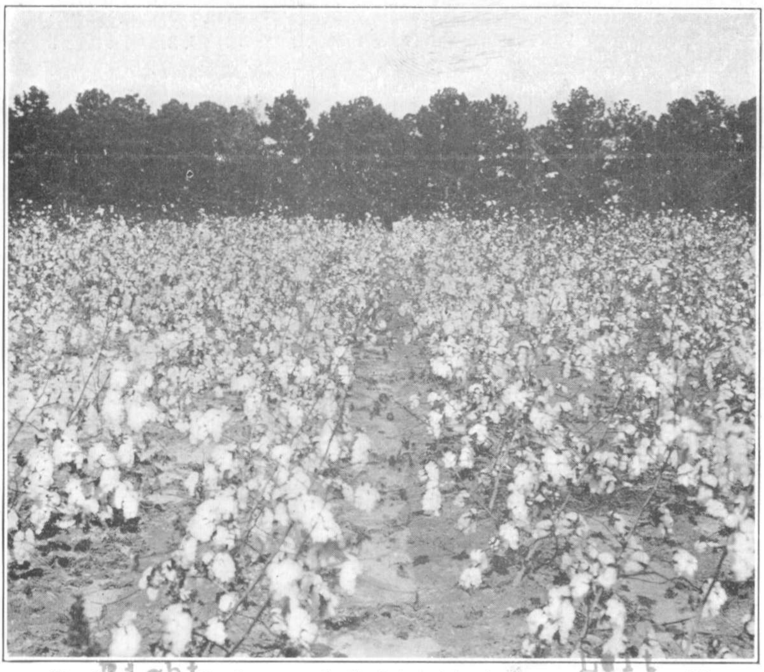

Fig. 2.—On left Cook cotton badly injured by boll rot; on right, a different strain of the same variety having only a medium amount of boll rot.

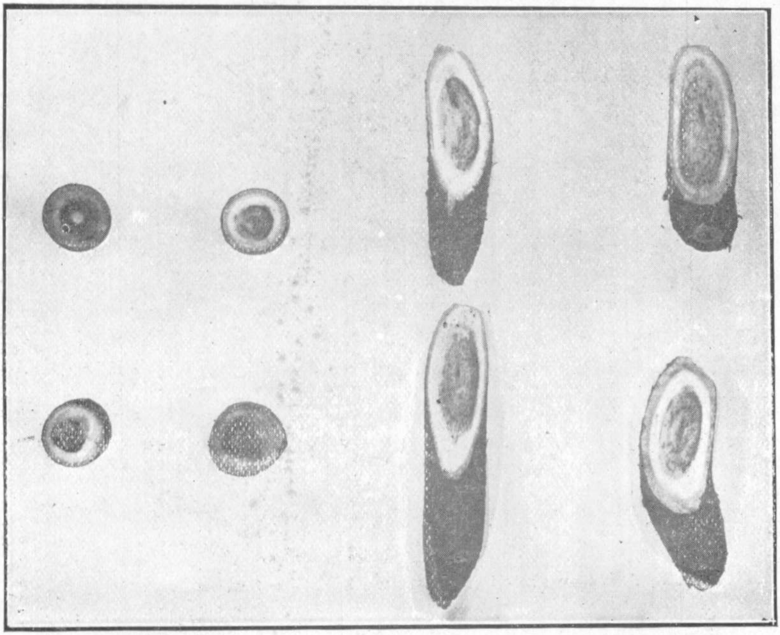

Fig. 3.---Cross-section through cotton stalks injured by wilt. (U. S. Dept. Agr.)

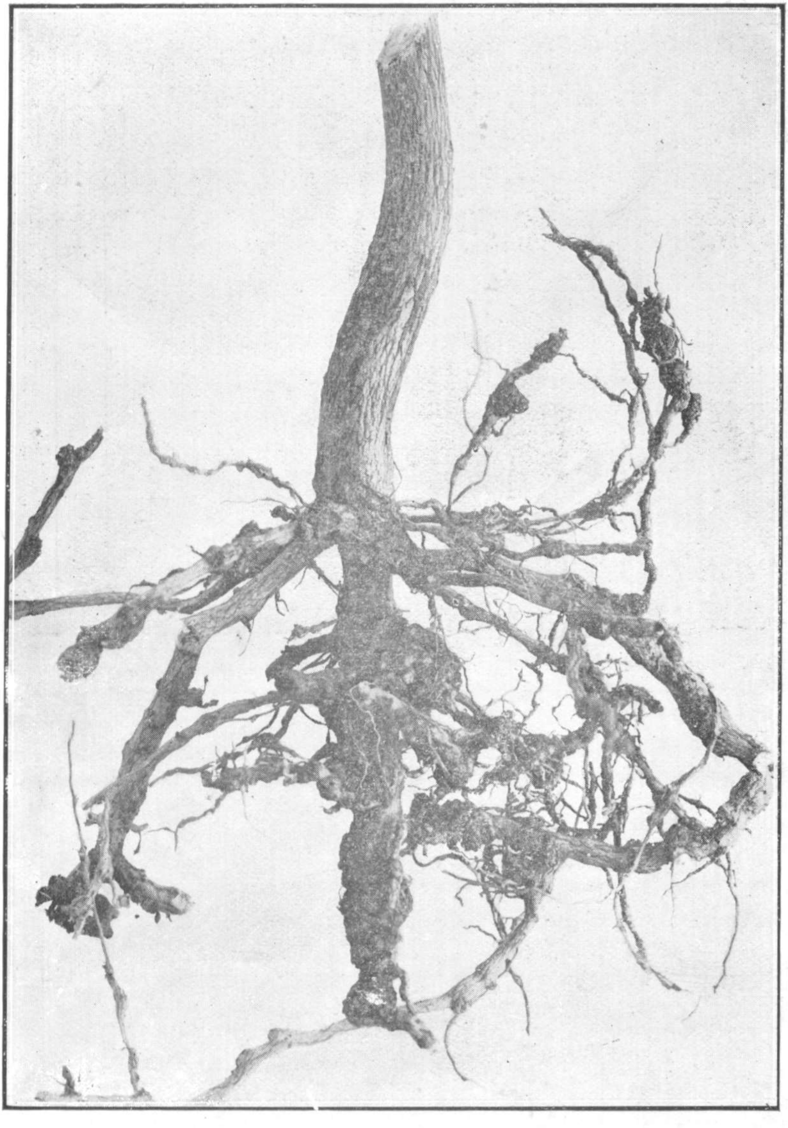

Fig. 4.---Cotton root injured by root-knot or mematodes. (U. S. Dept. Agr.)

Fig. 5.—Rows of Cook cotton from Alabama Experiment Station tested on wilt land; middle row proved immune to wilt, while another strain of Cook in rows on either side was largely killed by wilt.

Fig. 6.—Wilt resistant Cook cotton (from Hall) on the right; common cotton on left.

water may carry the disease to lower parts of the field. The disease may spread from small spots to entire fields, if cotton continues to be grown on the diseased areas. Once in the soil, the germs of wilt may remain for many years, even though no cotton be grown.

Treatment for wilt.—The continuation of cotton on wilt-infected soil means the continuation of the disease. When wilt appears in a field, that part of the field having wilt should be devoted to some other crop, or abandoned.

In 1906, the Station found two places in the fields used for variety tests where a few plants died. The wilted plants were carefully dug and every particle of each burned; the soil for several feet around was thoroughly saturated with a solution of four ounces of formalin to one gallon of water. This disease was not again noted in this part of the field. It is not certain that such treatment of the soil is thoroughly effective, though it is considered advisable when only a few plants are affected.

The germs of the cotton wilt fungus more readily enter wounded cotton roots than those that are sound. The wounds made in cotton roots by the minute nematode worms, (which cause knots or enlargements (Fig. 4) on the roots of cotton, tomatoes, cabbages,etc.), permit the ready entrance of the wilt fungus and the consequent loss through black-root. Fortunately those tiny but very injurious nematode worms can be starved.

When these nematode worms are once introduced (and they are present in most old garden spots in sandy soils), they increase in the soil from year to year. Fortunately, these worms can not live on the fibrous roots of corn, oats, grasses, etc., nor do they generally multiply on peanuts nor on the Iron variety of cowpeas. They can be starved by keeping from growing on the field any plant with tender or fleshy roots, such as cotton and many varieties of cowpeas, most vegetables, morning-glories, and certain other weeds. The warfare against cotton black-root is best conducted by getting rid of the root-knot disease, caused by the nematode worms.

Where wilt has become common on a farm, rotation of crops becomes doubly important. If practicable, keep cotton out of that field for a number of years. In case it is considered necessary to grow an occasional crop of cotton, let cotton occupy the diseased field not oftener than once in three years, and then, if possible, plant wilt-resistant varieties. The following is one of several rotations suitable for fields infected with wilt. First year, oats, followed by the Iron variety of cowpeas; second year, corn with either Iron cowpeas or peanuts between the rows; third year, a wilt-resistant variety of cotton. Every third year the field may be planted in some one of the wilt-resistant varieties of cotton, which should then be but slightly attacked by black-root.

Wilt-resistant varieties.—Varieties of cotton differ in their susceptibility to the cotton wilt. There is a difference even in different strains of the same variety. For example, Cook, as a variety, is not at all immune, yet at least two strains of Cook have shown up to this time considerable resistance to black-root. It should be stated, however, that there is no variety that has yet been made entirely proof against wilt, as may be seen from the figures in the next table.

In order to test the resistance of a number of varieties and strains which had previously showed more or less promise in this line, these varieties were tested on a field known to be severely infected by cotton wilt. The field selected was one owned by Mr. Wright, Loachapoka, Ala. The counting of diseased plants, the ginning, etc., were all done by a representative of the Experiment Station. The table shows the results.

Tests of wilt-resistant varieties of cotton on infected soil at Loachapoka, Alabama.

VARIETY	Per cent. of plants wilted: Counted July 6	Per cent. of plants wilted: Counted Sept. 1	Yield per acre: Seed cotton	Yield per acre: Lint	Per cent. of lint.	Per cent. yield of lint over common cotton	Value per acre of Lint at 14c per lb.; Seed at $26.00 per ton.
	Per ct.	*Per ct.*	*Lbs.*	*Lbs.*			
Dixie	39.2	15.9	372	126.0	34	2	$20 89
Dillon	15.2	2.3	885	327.0	37	163	53 08
Common	36 1	46.4	362	185.0	34	.....	20 33
Cook (Hall)	21.8	12.1	965	354.	36 7	166	57 52
Cook 307-6	......	17.9	928	380.	41	269	61 37
Common	31 4	37.3	303	103.0	34	......	17 01
Covington-Toole W.R	20.7	10.5	864	337 0	39	227	57 02
Excelsior W. R.	9.5	4.2	736	272.	37	164	44 14
Hybrid	7.9	3.6	618	222.0	36	115	36 58

Dillon, Excelsior Wilt-Resistant, and the hybrid lost very few plants from wilt. Two strains of Cook and Covington-Toole Wilt-Resistant lost more plants than Dillon, but far fewer than did the common cotton. The increased yield of lint of the wilt-resistant strains, Dillon, Covington-Toole, Excelsior, and two strains of Cook, ranged between 163 and 269 per cent. more than that afforded by common cotton.

The value of lint and seed per acre was, for Cook 307-6, $61.37; for Cook (from Hall), $57.52; for Toole, $57.02; Dillon, $53.08; the average for common or mixed cotton was only $18.67. Here is an extreme difference of $42.70 per acre merely as the result of planting wilt-resistant, highly bred seed instead of common seed.

Dillon is the oldest wilt-resistant variety and has been improved by the Bureau of Plant Industry of the United States Department of Agriculture. Its parent variety was Jackson Limbless and it closely resembles its parent.

Dixie is a variety bred for wilt-resistance by the Bureau of Plant Industry of the United States Department of Agriculture. In the tests made at Loachapoka by the Alabama Experiment Station, Dixie, from seed obtained from the United States Department of Agriculture, showed no notable resistance to wilt. The plant is well supplied with fruit limbs and with bolls of medium size. The percentage of lint is low to medium.

The strains of Cook, Toole, and Excelsior that here proved largely resistant to wilt, closely resemble their respective parent varieties. The station has no seed of these wilt-resistant varieties for sale or distribution this year.

The Dillon and Dixie varieties have been described before.

Cook, selected for wilt-resistance by M. R. Hall, James Bullock County, Alabama, is similar in appearance to other strains of Cook. Cook 307-6, a strain bred by the Alabama Experiment Station, has been selected only one year for wilt-resistance and can not yet be regarded as having fully established its claim to resistance.

Every seed of any kind of this wilt-resistant cotton grown will be needed in the Station's experiments in 1911.

This Experiment Station can not supply seed of any of the above varieties. Limited amounts of seed of Dillon and Dixie may be purchased at the time this is written through W. W. Gilbert, Department of Agriculture, Washington, D. C.

Readers are requested not to apply to this station for either free or purchased cotton seed this year; but on application, the Station will gladly furnish to inquirers the addresses of growers or dealers of standard varieties, if such addresses are not given among those on page 21 of this bulletin.

Excelsior and Hybrid, were obtained from the Georgia State Board of Entomology, Atlanta, Ga.

GROUND ROCK PHOSPHATE COMPARED WITH ACID PHOSPHATE AND BASIC SLAG PHOSPHATE.

Three experiments were made on the Station farm and a fourth in Bullock County to compare these three different phosphates.

On rocky, red, clay-loam soil at Auburn, all three phosphates were used in 1909 in combination with stable manure, supplemented by a complete commercial fertilizer mixture. None of the phosphates notably increased the yield, probably because the large amount of nitrogen and the abundant rainfall in the early summer caused the plants to run too largely to stalk or "weed."

On gray, sandy upland at Auburn (Norfolk sandy loam) the same three phosphates were compared in both 1909 and 1910, the same fertilizer on each plot in 1910 as on that plot in the preceding year.

The tests of ground rock, or raw phosphate, versus acid phosphate and basic slag showed that these different phosphates increased the yields to a profitable extent; yet, owing to the inequality in fertility of the land on which these phosphate experiments at Auburn were conducted, no definite conclusion can be drawn.

However, this experiment was also made for this Station on more uniform land in Bullock county, Alabama; the results follow:

Raw or ground rock phosphate versus acid phosphate and versus basic slag as fertilizer for cotton at James, Bullock County, Ala., in 1909

Plot	Fertilizer per acre		Seed cotton per acre	
	Amount	Kind	Yield	Increase from phosphate
			Lbs.	*Lbs.*
1	240 Lbs. 24	Slag phosphate Bu. stable manure	408	64
2	240 Lbs. 24	Acid phosphate Bu. stable manure	544	200
3	240 Lbs. 24	Raw phosphate Bu. stable manure	368	24
4	200 Lbs. 100	Cotton seed meal Kainit	344	....
5	......	....	256	88
6	240 Lbs. 200 " 100 "	Rock phosphate Cotton seed meal Kainit	424	80
7	240 " 200 " 100 "	Acid phosphate Cotton seed meal Kainit	504	160
8	240 " 200 " 100 "	Slag Cotton seed meal Kainit	392	48

Average from Acid Phosphate **180**
Average from Slag Phosphate **56**
Average from Raw Phosphate **52**

In this experiment, carefully conducted by W. R. Hall, on gray sandy land, near James, Bullock County, acid phosphate afforded a much larger increase in yield than did either raw phosphate or basic slag phosphate.

The stable manure was drilled in the same furrow with the phosphates, in the hope that the decay of the latter might serve to make the raw phosphate more soluble. Probably this result would have been more completely attained if the raw phosphate had been composted with the stable manure.

BULLETIN No. 154 FEBRUARY, 1911

ALABAMA
Agricultural Experiment Station
OF THE
Alabama Polytechnic Institute
AUBURN

Corn, Soy Bean Pastures, Tankage, Cotton Seed Meal for Fattening Hogs.

By

DAN T. GRAY, J. W. RIDGWAY,

E. R. EUDALY.

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1911

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SUMMARY OF BULLETIN.

1. This bulletin records a summary of three years' work in swine production.

2. When corn was fed alone, unsatisfactory results were always secured; when corn was supplemented with a soy bean pasture, satisfactory results were secured.

3. When corn was used alone the average daily gain for each hog was only .375 of a pound. When a soy bean pasture was grazed along with a fourth, a half and a three-fourths ration of corn, the average daily gains were raised to 1.102, 1.006 and 1.329 pounds, respectively.

4. 609 pounds of corn were required to make 100 pounds of pork, when the grain was fed alone. When a soy bean pasture was grazed along with a fourth, a half, and a three-fourths ration of corn, only 68, 138, and 175 pounds of corn, respectively, were required to make the same amount of pork.

5. When nothing was fed except corn, each 100 pounds of pork cost $7.61. When a fourth, a half, and a three-fourths ration of corn was fed along with a soy bean pasture, the same gains were made for $0.85, $1.73 and $2.19, respectively (corn valued at 70 cents); when the cost of the pasture ($8.00 an acre) was also charged, against the gains each 100 pounds of pork was made at an expense of $2.59, $3.36, and $3.17, respectively.

6. The amount of corn that should be fed along with a soy bean pasture depends upon several factors. (See Table 2.)

7. One acre of soy bean pasture afforded grazing for 10 hogs (averaged 45 pounds in weight at beginning of test) for the following number of days:

When a fourth ration of corn was used........43 days
When a half ration of corn was used...........48 days
When a three-fourths ration of corn was used...62 days

8. The total value of pork made on each acre of soy bean pasture varied from $25.84 to $39.13.

9. These experiments show that it pays to inclose the hogs in a dry lot, after the pasture crops are exhausted, and feed them for a short period of time on grain feeds. A ration of

corn and cotton seed meal seems to be the most satisfactory feed for this short dry-lot finishing period.

10. Tankage, a packing house by-product, saved a great amount of corn. Forty-two pounds of tankage took the place of 353 pounds of corn. The 42 pounds of tankage cost only 84 cents; the 353 pounds of corn were valued at $4.41. So an investment of 84 cents saved $4.41. These results were secured with hogs that averaged about 50 pounds, live weight, when the tests began.

11. When a corn ration was supplemented with a fifth part of tankage the results were more satisfactory than when a tenth part was used.

12. If it were not for the fact that cotton seed meal is a dangerous feed for swine, when fed for more than 30 days at a time, it would be a very valuable feed to go along with corn. However, it is an exceedingly valuable feed when used for short periods of time. In these tests 44 pounds of cotton seed meal took the place of 335 pounds of corn. The 44 pounds of cotton seed meal cost 66 cents; the 335 pounds of corn were valued at $4.19, or an investment of 66 cents in cotton seed meal saved $4.19 in terms of corn.

13. Tankage and cotton seed meal, pound for pound, proved to have practically the same feeding value. Cotton seed meal is the cheaper of the two, but tankage has the advantage in that there is no danger of ill results when it is used.

14. Excellent prices were realized on each bushel of corn when the corn was fed along with soy bean pastures. When corn was fed alone the usual market prices were not secured. When hogs sell for 7 cents a pound each bushel of corn was sold, by means of the hogs, for $1.93 to $4.33; when nothing but corn was fed, only 64 cents were realized on each bushel.

CORN, SOY BEAN PASTURES, TANKAGE AND COTTON SEED MEAL FOR FATTENING HOGS.

BY

DAN T. GRAY, J. W. RIDGWAY, E. R. EUDALY.

The people of Alabama are large meat consumers, but small meat producers. It is well known that a large proportion of the meat used in this state is shipped in from other states. It should be known, also, that this imported meat comes from states which do not have as many natural advantages for pork production as has our own state. So far, the farmers of the state have failed to take advantage of their own favorable circumstances. The most of the imported meat comes to us from northern states—states that do not have the advantage of long grazing seasons, mild climate, and cheap shelter, On account of the long grazing season, the mild climate, and the cheap shelter, this state can make pork as cheaply, and no doubt more cheaply, than it can be made in the North.

However, the farmers of our state are rapidly introducing hogs into their system of farming. Several factors are bringing this change about. First, hogs have been selling at a high price for several years; this has raised the price of purchased meats so high that the farmers can hardly afford to buy even the cheap cuts. Second, the boll weevil is advancing and many farmers are preparing for its coming by introducing hogs. Third, the hog is an animal that can be introduced upon almost every farm in the state; he fits into practically any system of farming that can be introduced into the state. He is well adapted to the large planter; but he is especially well suited to the farmer with small capital, as but a small amount of money is required with which to begin the business, and returns begin to come in within a few months after it is started. The sow is a rapid producer. Money is turned rapidly. With $25.00 invested in one sow it is easily possible to make 2,000 pounds of pork (live weight) in a year. In other words, the yearly sales should be about four to five times the amount of investment, when hogs sell at seven cents a pound.

Some sections of the state are now raising sufficient hogs to meet home demands, and other sections have a surplus to ship to the Mobile, New Orleans, and Atlanta markets. But, as a whole, the state is yet a heavy importer of meats.

OUTLINE OF EXPERIMENTS.

This bulletin covers three years' experimental work, during which time 105 hogs were used. The work, in the main, was duplicated year after year, so the conclusions drawn can be relied upon. The lots, during the falls and winters of 1908-'09, 1909-'10, and 1910-'11, received the following feeds throughout the main part of the test:

TABLE 1. *Outline of the Work.*

No. Lot	Period I.	Period II.
1	Corn, 1-4 ration Soy bean pasture	Corn meal alone
2	Corn, 1-2 ration Soy bean pasture	Corn meal, 2-3 Cotton seed meal, 1-3
3	Corn, 3-4 ration Soy bean pasture	Corn meal, 2-3 Tankage, 1-3
4	Corn meal, 9-10 Cotton seed meal, 1-10	Corn meal, 9-10 Cotton seed meal, 1-10
5	Corn meal, 9-10 Tankage, 1-10	Corn meal, 9-10 Tankage, 1-10
6	Corn meal, 8-10 Tankage, 2-10	Corn meal, 8-10 Tankage, 2-10
7	Corn meal, 2-3 Cotton seed meal, 1-3	Corn meal, 2-3 Cotton seed meal, 1-3
8	Corn meal alone	Corn meal alone

It is noted that the first three lots were pasture or grazing lots, soy bean pasture being used in all cases. The hogs in Lots 4, 5, 6, 7, and 8 were confined in dry lots; they had no green or pasture feed at any time throughout these tests.

General view of soy bean pasture used for grazing the hogs in 1908. The hogs had been grazing these beans several days when the picture was taken. It is seen that the beans are beginning to form.

The soy bean pastures afforded grazing 42 days in the fall of 1908, 81 days in 1909, and 80 days in 1910. When these pastures were exhausted one pig from each lot was slaughtered, samples of the fat secured, and taken to the chemist, Prof. C. L. Hare, to have melting point determinations made, and the remaining pigs were placed in dry lots, next to Lots 4, 5, 6, 7, and 8, and fed for three or four weeks upon the feeds outlined in the above table. One lot of hogs was finished on a ration of corn alone, a second lot on corn and cotton seed meal, and a third lot on corn and tankage. The object of this second period of feeding was to study the effect of the above feeds on hardening the meat and fat after they had been rendered soft as a result of the animals grazing the soy bean pasture.

The hogs which were fed in the dry lots (Lots 4, 5, 6, 7, and 8), were continued to the end of the test on their initial feeds. At the end of Period 1 a hog was taken from each of these lots and slaughter data collected.

OBJECTS OF THE WORK.

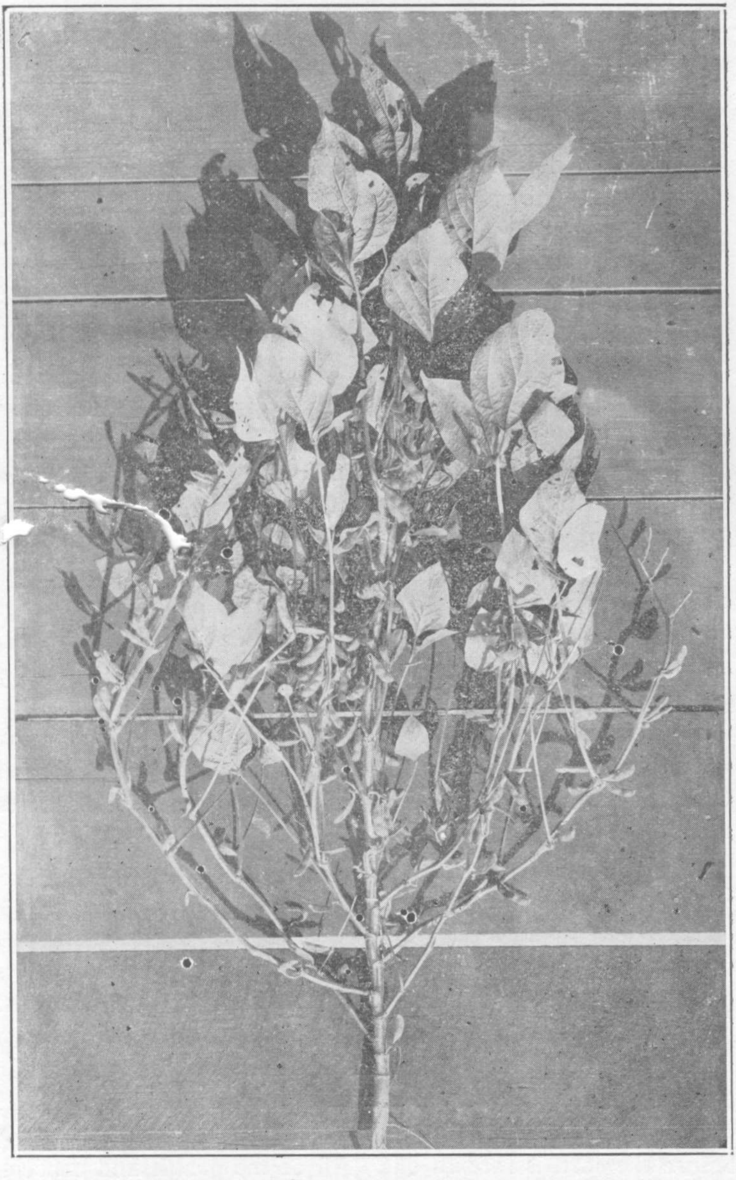
These experiments were planned with the following objects in view:

1. To learn the value of soy bean pastures for fattening hogs.
2. To determine the most profitable amount of corn to use along with these soy bean pastures.
3. To study the question of hardening the lard and meat after they had been rendered soft as a result of the bean pastures being grazed by the hogs.

Other problems were involved in the work, but are not presented in this report.

THE HOGS USED.

The pigs were all purchased from farmers who live within a few miles of the Experiment Station. The animals were no better in quality than the average hogs of the state, but practically all of them carried some improved blood, consisting of Poland China, Berkshire, and Duroc-Jersey crosses. At the beginning of the test the pigs averaged about 45 pounds in



A picture of an individual soy bean plant. The hogs were turned into the field two weeks before the picture was taken. The picture shows that the seed are beginning to assume some size.

live weight. They were not fat when the tests began, as they came directly off pastures; the pastures had been supplemented with a little corn, as a rule. However, the animals were all in good growing condition. The pictures show their general appearance and quality. If larger hogs had been used the daily gains would have been greater than the ones here reported. As a rule the gains were satisfactory.

SHEDS, LOTS, AND FENCES.

The pasture lots, (Lots 1, 2, and 3), were given no artificial shelter at all until the soy beans were eaten down. The soy bean plants afforded ample protection from the sun for the first 40 days, after which time temporary wooden shelters were erected. The pigs which received no pasture were confined in small lots: each lot was 20 x 60 feet. Across the east side of these lots was a good shed which afforded ample protection from the rains and the hot sun. All of the hogs were made comfortable. The different areas of pasture were measured and hurdled off by temporary fences, so that an exact account could be kept of the area of soy bean pasture grazed by each lot of hogs: this was done so that the cost of the area grazed could be charged against the gains of the hogs. The hogs were not given the run of the whole field at one time; small areas (about 1 acre to 10 hogs) were fenced off and when the inclosed patches were consumed the fences were moved forward onto new plots.

METHOD OF FEEDING.

Each lot of hogs was fed twice a day. The corn was ground into a coarse meal: this meal was mixed with sufficient water to make a thin slop and poured into deep troughs. When cotton seed meal and tankage were fed with the corn meal they were mixed with the corn meal and the water. If ear corn is used the cotton seed meal and the tankage should be made into a thin slop and poured into a separate trough before the corn is thrown out. All of the grains and concentrated feeds were fed fresh: that is, none of the feed was fermented, soaked, or cooked.

The soy bean pastures were gathered by the hogs them-

LOT 1—1908—(Showing some individuals). End of soy bean pasture period. Received a three-fourths corn ration along with pasture. Made an average daily gain of 1.67 pounds. Each 100 pounds of pork cost $3.08 when both pasture and corn were charged against gains. When corn meal alone was fed (See Lot 7, page 59) each 100 pounds of pork cost $5.64.

selves. When this method of harvesting is followed the crop is never lost on account of rains or unfavorable weather. The hogs were turned into the pastures three or four weeks before the beans themselves were ready to be eaten: in fact, they were turned into the beans about one week after full bloom, or just about the time the first pods began to appear. Some farmers report unsatisfactory results with cowpeas and soy beans when used for grazing purposes, and it is probably true that these unsatisfactory results were due to the fact that the hogs were turned into the fields at too late a stage of maturity.

The lower leaves should not be wasted. It should be remembered that the leaves of the soy bean and cowpea plants are approximately equal in feeding value to wheat bran, pound for pound. The only way to make use of the leaves that ripen and fall early is to turn the hogs into the field when these leaves first begin to ripen. Care must be taken, though, not to overstock the pasture: if too many hogs are turned into the field at this immature stage the whole crop will be torn down within a few days. In the tests reported in this were turned onto each acre.

Some corn was used to supplement the pastures. As one of the objects was to learn the most profitable amount of corn to use along with a green pasture, various amounts of corn were used. In Lot 1, one-fourth of a full ration of corn was used; that is, an amount of corn equal to 1 per cent of the total live weight of the lot was fed each day; or, one pound of corn to each 100 pounds of live weight was given daily. In Lot 2, two pounds of corn to each 100 pounds of live weight were fed each day. (This is a one-half ration of corn.) And in Lot 3, three pounds of corn to each 100 pounds of live weight were given daily. (This is a three-fourths ration of corn).

The amount of feed given the pigs confined in the dry lots was determined by their appetites. No feed was left in the troughs from one feeding time to the next. The aim was to give just enough feed so that the troughs would be clean within 30 minutes after feeding. If the ration is a palatable one, dry-lot-fed hogs will eat daily, an amount of grain equal to about four per cent of their total live weight.

PRICE OF FEEDS.

It is, of course, realized that the prices placed upon the feeds below do not meet all conditions of the state, but it is believed that the following prices closely represent the average conditions of the state:

Corn	$ .70 a bushel.
Tankage	$40.00 a ton.
Cotton seed meal	$30.00 a ton.
Soy bean pasture	$ 8.00 an acre.

All financial statements are based on the above quotations.

SLAUGHTER DATA.

At the end of each period one animal from each lot was slaughtered and careful notes taken upon the dressed weights, appearance of the carcasses, rapidity and extent of "setting" of the carcasses, appearance and weights of the internal organs, etc. Samples of fat were taken from each carcass and delivered to the chemist, Professor C. L. Hare, who made melting point determinations to ascertain the effect of each feed upon the fat or lard. The third, fourth, fifth, and sixth ribs were also taken from each animal with a view to making a study of the effects of the various feeds upon the framework of the animals.

LOT 4—1908—(Showing some individuals). Hogs fed corn 9-10 and cotton seed meal 1-10. Picture taken end of 42nd day of experiment. Made an average daily gain of .718 pounds, as compared to 1.67 pounds for the soy-bean-fed hogs. Cost $4.49 to make 100 pounds of pork as compared to $5.64 when corn was fed alone.

DETAILS OF THE EXPERIMENTS.

The general plan was to begin the experimental work the last week of August or the first week in September. To have the soy bean pasture ready for grazing by September 1, the beans must be planted by June 1. The beans may be planted as early as April 15 when grazing would be afforded by August 1. Various lots of hogs, which were being fed in dry lots, were carried along in the work, so that direct comparisons could be made between the soy bean pastures and the various dry lots.

SOY BEAN PASTURE.

General Remarks About the Crop.—The soy bean is a very valuable crop both for hay and for use as a pasture for hogs. The Tennessee station (bulletin 82) has compared the cowpea and the soy bean as to their habits of growth, yields, etc. According to this bulletin the cowpea has the following advantages over the soy bean:

(1). The soy bean may fail to come through a crust which would offer but little resistance to cowpeas.

(2). The germination of the cowpea seed is surer than that of the soy bean seed, which is liable to be spoiled by heating. The cowpea is, therefore, better than the soy bean for broadcasting, especially on land that is heavy and liable to "bake."

(3.) The cowpea is much better suited than the soy bean for planting with either corn or sorghum.

(4). Cowpea hay is more easily cured by the methods in common use, without the increased loss of either leaves or fruit, than soy bean hay.

The soy bean, on the other hand, appears more valuable than the cowpea, (1) as a grain producer; (2) as an intensive farm crop; (3) as an early hay or grazing crop (for which purpose the early and medium varieties will produce either hay or seed several weeks ahead of any variety of cowpeas which had been tested at the Station; (4) the seed decay more slowly than those of the cowpea when left on the ground, so are better adapted to being pastured off by hogs.

Rabbits feast upon the soy bean while they will not bother the cowpea at all. Therefore, the farmer who plants soy beans should plant enough for both himself and the rabbits.

In 1910 the soy bean crop used in these tests was better than the average crop of the state: both the stand and the yield were excellent. But in 1908 and in 1909 the crops were just about what the farmer could expect to grow upon soils of average fertility. The beans were planted in the drill and cultivated. Two hundred pounds of commercial fertilizer, consisting of potash and 16 per cent acid phosphate, were used on each acre. Approximately, one-half bushel of seed was used to each acre: if the planting had been made for a hay crop more seed would have been used. When all of the expenses of making the crop were taken into consideration it was learned that each acre cost $8.00. The crop can be produced for less than $8.00 an acre upon the average farm of the state.

The Southern, or Mammoth Yellow variety, was used in all of the tests. Some varieties, as the Hollybrook, will mature earlier than the Mammoth Yellow, but will not make as large yields as the Southern variety.

Soy Bean Pasture Against Corn Alone.—It is generally considered that there is no other feed equal to corn for pork production. That is true, provided the corn is used judiciously.

LOT 5—1908—(Showing some individuals). Hogs fed corn 9-10 and tankage 1-10. Picture taken end of 42nd day of experiment. Made an average daily gain of .801 of a pound as compared to .527 of a pound when corn was used alone, or 1.67 pounds when corn was used along with a soy bean pasture. Cost $4.18 to make 100 pounds of pork, as compared to $4.39 when cotton seed meal was used, $5.64 when corn alone was used, and $3.08 when soy bean pasture was used.

But, as the following tests illustrate, when corn is fed alone for any length of time there are few feeds which give more unsatisfactory results. If, however, corn is fed in combination with other feeds, its use is to be highly commended, and it can be used to great economic advantage, too, even though it sells upon the market as high as $1.00 per bushel. The growing hog is not adapted to living on corn alone, and when we require it of him we are forcing him to do a thing which is not consistent with his nature. Man likes a mixture of feeds or a change in diet: so do the lower animals.

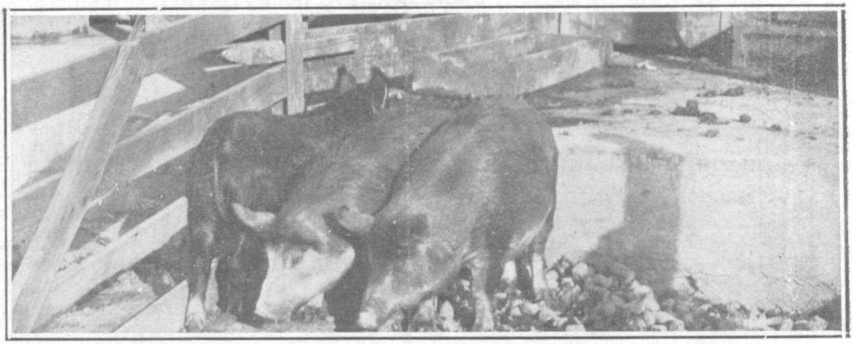
TABLE 2. *Soy Bean Pastures vs. Corn Alone, and the Most Profitable Amount of Corn to Use with the Pasture.* (*Average of three years' work.*)

Lot No.	RATION	Average daily gains	Feed to make 100 pounds of pork	Cost of grain to make 100 pounds of pork	Grain plus pasture cost to make 100 pounds of pork	Value one acre in terms of corn
		Lbs.	Lbs.			Bushels
1	Corn, 1-4 ration Soy bean pasture	1.102	68 0.218 acre	$0.85	$2.59	44
2	Corn, 1-2 ration Soy bean pasture	1.006	138 0.204 acre	1.73	3.36	41
3	Corn, 3-4 ration Soy bean pasture	1.329	175 0.123 acre	2.19	3.17	63
4	Corn alone	.375	609	7.61	7.61	

Price feeds:
Pasture .... $8.00 an acre.
Corn .... $ .70 a bushel.

That soy bean pasture is an exceedingly cheap feed for hogs is the most striking point in the above table. That corn alone is an exceedingly poor feed for hogs is another impressive fact brought out. When the tests began the pigs averaged about 45 pounds in weight. Of course, if they had been more mature the corn would have shown up in a better light than it did, as corn is more suited to old than to young animals. When corn alone was used the average daily gain for the three years was only .375 of a pound, while the hogs that grazed the soy bean pasture averaged more than a pound per day; in one lot, Lot 3, the average daily gain per pig was 1.329 pounds. Or, the hogs which received the small amount of corn made greater gains (in one case 5 times as great) as did the hogs which were fed nothing but corn. The soy bean pasture was responsible for the large gains; it afforded the hogs a green feed and at the same time balanced the corn ration so that the corn which was eaten along with the pasture did the hogs more good than did the corn which was eaten alone. Corn is low in both protein and ash: soy bean pasture is high in both ash and protein. When corn was valued at 70 cents a bushel and the pasture at $8.00 an acre, the cost of 100 pounds of gain varied from $2.59 to $7.61. When corn was used alone it cost $7.61 to make 100 pounds of increase in live weight; when a one-fourth ration of corn was used along with the pasture the same gains cost $2.59. When a one-half ration of corn was fed with the soy bean pasture it cost $3.36 to make 100 pounds of pork, and $3.17 to make the same amount of pork when a three-fourths ration of corn was used. Or, in every case where the soy bean pasture was used pork was made for less than one-half (and in one case almost one-third) of what it cost when corn was used alone.

The last column in the above table shows the value of each acre of soy bean pasture in terms of corn. The figures represent an average of three years' experimentation. In many sections of the state where the soil is good, much greater soy bean yields, than were obtained on the Station farm at Au-



LOT 6—1908—(Showing some individuals). Hogs fed corn 2-3 and cotton seed meal 1-3. Picture taken end of 42nd day of test. Made an average daily gain of 1.1 pounds, as compared to .527 of a pound when corn was used alone, and 1.67 pounds when soy bean pasture was grazed. Cost $3.45 to make 100 pounds of pork, as compared to $5.74 when corn was used alone, and $3.08 when a soy bean pasture was grazed.

burn, can be secured; the soil on the Station farm is naturally a very poor one. However, the field upon which the beans were grown is one of the richest on the farm, so the above results represent what the average farmer may expect to secure after he has become acquainted with the soy bean plant. Each acre of soy beans was equal, in feeding value, to 44 bushels, 41 bushels, and 63 bushels of corn, when a one-fourth ration, a one-half ration, and a three-fourths ration of corn, respectively, were used along with the pasture. If corn had been grown no more than 30 bushels would have been raised, even with a liberal application of commercial fertilizers. In 1910-'11, an extra good crop of soy beans was grown (for the character of soil) and one acre of the pasture took the place of 53.8 bushels of corn in one lot, and 72 bushels in a second lot.

Proper Amount of Corn To Feed With a Soy Bean Pasture.—It is of great interest to the farmer to know just how much grain to feed along with the pasture crops. Feeders are not yet agreed as to the proper amount of corn to use with a pasture. Some claim that no grain at all should be used with a good pasture: others claim that better results are secured when a full ration of corn is used along with the pastures. Of course, all agree that the amount of grain fed depends upon the kind of pasture used and whether the animals are just "being carried along," or are being rushed to a finish. The above work was outlined with a view to determining the proper amount of corn to use along with a pasture, as soy beans. Accurate account was kept both of the amount of pasture consumed by each lot of hogs, and the cost of putting in and cultivating the crops. On the average, it has cost the Station $8.00 an acre, to seed, fertilize, and cultivate a soy bean crop. The average farmer can make the crop cheaper than did the Station, as the farmer can secure labor more advantageously than could the Station.

Looking back to Table 2, it is seen that the largest daily gains were secured when a three-fourths ration of corn was fed along with the pasture. Still there was not a gradual decrease in the daily gains as the amount of grain was reduced, as the hogs which received the one-fourth ration of corn made larger gains than did those animals that were given a one-half ration of corn. So it cannot be said that the gains increased proportionately, with the increase in the amount of corn used. As far as the corn cost is concerned it is seen that the expense to make 100 pounds of gain increased gradually as the amount of corn was increased. But when the cost of making the pasture was also added to the gains it is furthei seen that, while the cheapest gains were made by the lot receiving the smallest amount of corn, still there was not a gradual decrease in the cost of gains as the amount of grain was reduced: it cost more to make the gains on the hogs in Lot 2 (one-half ration of corn) than on the hogs in Lot 3 (three-fourths ration of corn). The authors are unable to state why this should be.

It seems clear that several points must be taken into consideration before one can determine what is the right amount of corn to feed along with pastures when hogs are being finished for the market. A definite answer cannot be given to the question, How much corn shall I use with my pasture? First, the condition of the hogs at the end of the feeding period must be taken into account. The hog that has received a light grain feed along with pasture will not be in as good killing condition at the end as will the hog that has received a heavy grain feed, notwithstanding the fact that the former may have

LOT 7—1908—(Showing some individuals). Hogs fed corn alone. Picture taken end of 42nd day of experiment. Made an average daily gain of .527 of a pound, as compared to 1.67 pounds when a soy bean pasture was used. Each 100 pounds of pork cost $5.64, as compared to $3.08 when a soy bean pasture was used along with the corn.

gained as rapidly as the latter. The first hog is not worth as much as the latter to the butcher. For instance, the hogs killed out of Lot 1 (one-fourth grain ration) dressed only 69.8 per cent, while those killed out of Lot 2 (one-half grain ration) dressed 72.7 per cent. The increased amount of grain had a beneficial effect upon both the carcass and the conformation. The hog which receives but a small allowance of grain, in addition to a pasture, comes through to the end with a big belly region which makes him dress a low per cent. The buyer will be compelled to deduct from the price of the hogs which have received the small grain ration on account of the low dressing per cent; although he may gain as rapidly as the animal which received a heavy grain ration, still he will not be in as acceptable killing condition as will the heavy grain-fed hog. Second, the amount of corn at the disposal of the feeder must also receive consideration. When there are large amounts of corn upon the farm to be disposed of, there is no better way to market it than through hogs on pasture, so the problem may resolve itself into a question of finding a good and high-priced market for corn. When this is the case, it would no doubt be wise to feed the animals liberally of the corn, so that the supply may all be used before the spring months arrive. No farmer can afford, under present conditions, to sell his corn directly upon the market, as corn,—even for $1.00 a bushel. In the above tests from $1.96 to $4.25 were secured for each bushel of corn when hogs sold for seven cents a pound live weight, the larger price being secured when the light ration of corn was used. Some farmers hold that the most profitable method is to feed no grain at all when the hogs have the freedom of a good pasture, but it is seen from the above prices realized on corn that the man who has corn to sell can make more money by feeding it in conjunction with the pasture than by selling it as corn. Third, the amount of available pasture will have something to do with the amount of corn to feed. If the area of pasture is small for the number of hogs on hand, it would pay to be liberal with the corn in order that the pasture may be extended over as long a period of time as possible. The grain will save the pasture, as the above figures show , and all of the hogs will have a greater opportunity to get the benefit of some pasture. That is, it is no doubt better to save the pasture (when pasture is scarce) with an increased amount of grain, than to graze the pasture down rapidly on account of withholding grain. Fourth, the amount of grain used depends also upon the length of time the farmer has to get the animals ready for the market. If the animals must be killed or sold within a few weeks, it may pay to use a heavy grain ration with the pasture, as the hogs will gain much more rapidly upon a full grain than upon a light grain ration. Many farmers claim that hogs while on pasture will gain no more rapidly when a full corn ration is added than when it is withheld, but the results secured in these tests show that when a three-fourths corn ration was used along with pasture the gains were one-third faster than when a one-fourth ration of corn was used. When prices are ruling low, and there is a good prospect for an advance, it may be wise to simply carry the hogs along on the pasture, plus a light grain ration (or no grain at all) until the prices advance. If hogs are selling at a good figure, and there is danger of their depreciating in value on account of prices falling, it would be the part of wisdom to finish rapidly through the liberal use of grain. There is still a fifth factor that has to do with the amount of grain that should be used

LOT 1—1910.—End of soy bean pasture period. Hogs fed pasture and one-fourth ration of corn. Made an average daily gain of .9 of a pound, as against .238 of a pound when corn was fed alone (See Lot 7, page 73). Cost $2.62 to make 100 pounds of pork (pasture $8.00 an acre. corn 70 cents a bushel), as against $9.16 when corn was used alone.

along with the pasture crop. It is well known that our common pasture crops, as peanuts, soy beans, etc. make soft pork. If the hogs are to be sold upon a market which discriminates against soft meat, it would pay to use some corn along with the grazing crop: the corn prevents the meat from becoming as soft as when pastures alone are used; the greater the amount of corn used the harder the meat at the end of the grazing period.

Carrying Capacity Of One Acre Soy Beans.—It should be again noted that the pigs, to begin with, averaged about 45 pounds in live weight. At the end of the grazing tests they averaged about 125 pounds in live weight. Of course, the length of time that one acre of soy bean pasture lasted depended upon the amount of supplementary grain: the more corn used the longer each acre of grazing lasted.

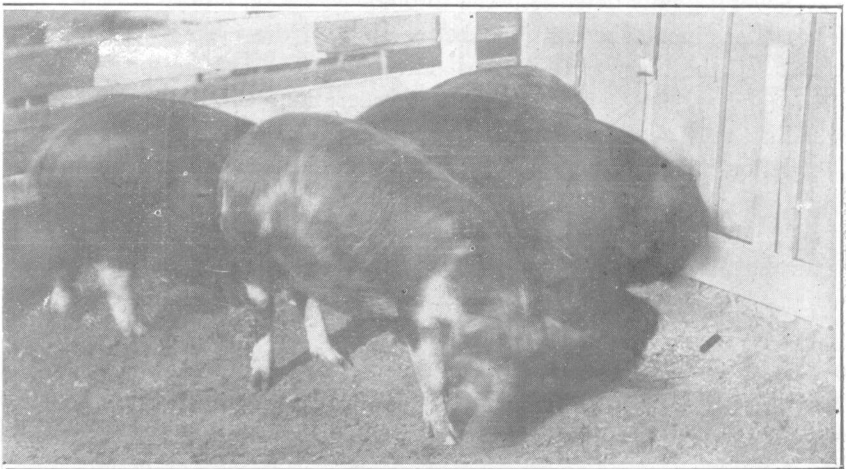
TABLE 3. *Number of Days One Acre of Soy Beans Carried Ten Hogs.*
(Summary of three years).

No. Lot	RATION	Average weight each hog at the beginning	Number days one acre carried ten hogs
		Lbs.	Days
1	Corn, 1-4 ration --- Soy bean pasture --	44	43
2	Corn, 1-2 ration--- Soy bean pasture --	46	48
3	Corn, 3-4 ration--- Soy bean pasture --	43	62

The farmer who has a good soil well adapted to soy beans may expect to get better grazing than was secured on the station farm. In 1910 (the year that an exceptionally good crop was secured) one acre of soy beans afforded grazing for the hogs 55, 57, and 82 days in Lots 1, 2, and 3, respectively. The poorest results were secured in 1908, when in one case one acre afforded grazing for 10 hogs for only 35 days. But, on the average, soy bean pasture has exceedingly satisfactory carrying capacity. It is seen above that one acre of the pasture carried 10 hogs 43, 48 and 62 days when the pasture was supplemented by a fourth, a half, and a three-fourths ration, respectively, of corn. In bulletin No. 143 of this station are reported results where one acre each of peanut, sorghum, and chufa pastures carried 10 hogs for 53, 47, and 32 days respectively, where a half ration of corn was fed along with the pastures.

During the first few weeks of the grazing period the pigs ate no part of the plant except the leaves; but when supplemented with some corn good gains were made. During the last few weeks of the grazing period the animals ate nothing except the beans which had fallen from the plants; during this time excellent gains were always realized.

Pounds of Pork Made on Each Acre of Soy Beans.—Some farmers claim that it is not a profitable method to dispose of a pasture crop, as soy beans, by grazing with hogs: it is often claimed that the crop can be disposed of in other ways, as



.OT 2—1910.—End of soy bean pasture period. Hogs fed pasture and a half ration of corn. Made an average daily gain of 1.16 pounds, as against .238 of a pound when corn was fed alone in a dry lot. Cost $3.09 to make 100 pounds of pork (pasture $8.00 an acre, corn 70 cents a bushel), as against $9.16 when corn was fed alone.

making it into hay, to better advantage. Some hold to the idea that great losses by trampling and riding down the plants are sustained when hogs are turned into a hay crop. The question is, Can the crop be sold profitably through hogs, or should it be made into a hay and used, or sold, as a hay? The following table will, in part, answer the question:

TABLE 4. *Pounds of Pork Made on Each Acre of Soy Bean Pasture.*
(Average of three years.)

No. Lot	RATION	Total pounds of pork made on each acre	Total value pork made on each acre, (7 cents)	Total value pork made on each acre after corn is deducted
		Lbs.		
1	Corn, 1-4 ration ... Soy bean pasture ..	459	$32.13	$28.23
2	Corn, 1-2 ration... Soy bean pasture ..	490	34.30	25.84
3	Corn, 3-4 ration ... Soy bean pasture...	813	56.91	39.13

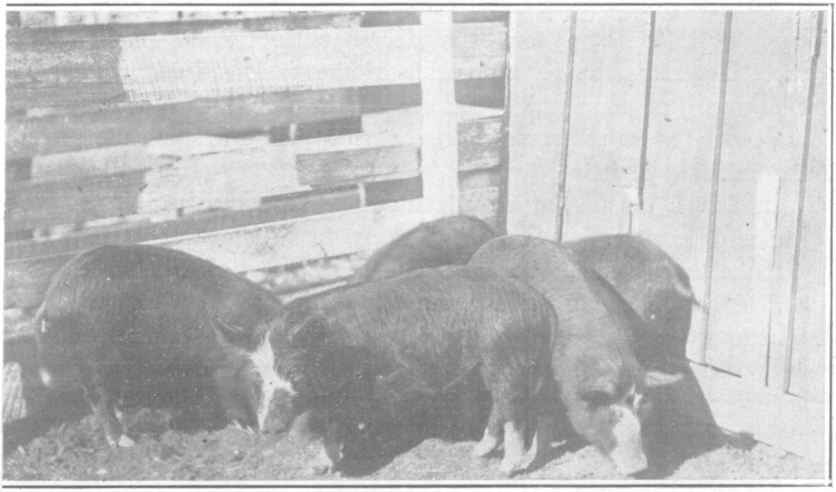
Several points must be taken into consideration before it can be determined whether it is better to feed the crop to hogs and sell the hogs or to make it into hay. The relative prices of hogs and hay enter into the consideration. If hogs were selling at 4 cents a pound and hay at $20 a ton there is no question but that it would be more profitable to make the crop into hay. When hogs are selling at 7 cents a pound there is no doubt but that the crop can be sold for a greater final profit through the hogs than as a hay. In these tests each acre returned a value, in terms of pork, of $28.23, $25.84, and $39.13 in Lots 1, 2, and 3, respectively. This is an average return of $31.07 an acre when hogs are valued at 7 cents a pound.

Grazing a crop by hogs has several advantages over trying to save it as hay. In the first place, the crop when grazed is never lost on account of rains. The hogs gather it rain or shine. In the South a heavy proportion of the hay crops are either totally lost or badly damaged on account of unfavorable weather conditions. In the second place, not as much labor and machinery are required to gather the crop when it is grazed as when it is made into hay. When the fences are good the labor involved in grazing a crop is almost a negligible item. In the third place, the soil is built up very much more rapidly under the grazing than under the haying system. When the crop is grazed practically all of the crop, root and top, are returned to the soil; of course, some fertilizing value is taken off in the body of the hogs. When the crop is removed as hay only the roots and stubble are returned to the soil; the hay, which has a fertilizer value of practically $9.00 a ton, is taken away from the land when the hay is sold from the farm. The effect upon the soil of growing a legume and grazing it off with hogs is remarkable. The Arkansas station did some work upon this point. That station had two plots of land. Upon one plot corn was grown. Upon a second plot soy beans were grown. The corn was gathered in the usual way. The soy beans were grazed off by hogs. The succeeding year cotton was planted upon both plots. The corn plot yielded 1005 pounds of seed cotton. The soy bean plot yielded 1588 pounds of seed cotton. The two plots were identically the same in every respect except that one had had a soy bean

LOT 3—1910.—End of soy bean pasture period. Hogs fed pasture and a three-fourths ration of corn. Made an average daily gain of 1.06 pounds, against .238 of a pound when corn was fed alone in a dry lot. Cost $3.44 to make 100 pounds of pork (pasture $8.00 an acre, corn 70 cents a bushel), against $9.16 when corn was fed alone.

crop upon it, which had been grazed off, while the other had had nothing but corn. When lint is valued at 13 cents a pound and seed at $24.00 a ton the increase in value of the succeeding cotton crop, due to the soy bean crop and the grazing, was $29.92 an acre; this was due entirely to the soy bean crop which had been grazed off by hogs.

Finishing The Hogs in a Dry Lot After the Pastures Are Exhausted.—The majority of the farmers of the South who make use of green crops for fattening hogs sell, or slaughter, the animals when the crops are gone without finishing them upon grain for a short time in a dry lot. It is the usual custom in Alabama to shut the hogs up in a small pen when the fattening time arrives; this is not a wise practice as the preceding figures show. But there is a time when the hogs should be penned up in a dry lot and fed grain alone, but that time is not at the beginning of the fattening operations. They should be inclosed in a dry lot and fed grain alone for a short time after the grazing crops are exhausted. There are two reasons for following this plan. First, the hogs after coming off the pasture are in just the proper condition to make gains rapidly and economically for a short time. The table below illustrates this point. They are in excellent health and, as a rule, their frames not covered with as much fat as they should carry. The pasture, being a feed rich in protein, has tended to develop the frame work and muscles at the expense of fat, especially if they are young animals. After they are fed in a pen from 21 to 28 days they look better, and are better, than when they came off the pasture; they are worth more to the butcher, or consumer, as they are fatter and dress out a higher percentage of marketable meat than if they had been sold directly off the pastures. There is a limit though, to the time hogs can be fed in this finishing period; they soon reach a stage where the gains are made at a heavy expense. Second, when hogs have been grazed upon peanuts, soy beans, and several other crops the meat and the lard have become soft; this makes the carcass objectionable to the butcher as well as for home consumption. The soft meat is hardened very materially when the hogs are fed upon grain for only a short time after the crops are exhausted. Some feeds are better than others during the hardening process. The longer the animal is fed upon a finishing feed the harder becomes the flesh and lard, but, of course, the feeder must give due consideration to the question of economy, so cannot extend this period over a very long period of time. The following table shows that the gains are usually put on at a profit during a short finishing period:



)T 4—1910.—End of soy bean period. Hogs fed a ration of corn 9-10, plus cotton seed meal 1-10. Made an average daily gain of .431 of a pound, as against .400 of a pound when the corn was supplemented with a tenth part of tankage, as against .238 of a pound when corn alone was fed. When soy bean pastures were grazed the average daily gain varied from .900 to 1.16 pounds. In Lot 4 each 100 pounds of pork cost $6.26, as against $9.16 when corn was used alone, and $2.62 when corn was used along with a soy bean pasture.

TABLE 5. *Finishing Hogs In a Dry Lot After The Soy Bean Pastures Are Exhausted.*
(Average of three years.)

No. Lot	Ration during Finishing period	Ration during period preceding finishing period	Average daily gain	Feed to make 100 pounds of pork	Cost to make 100 pounds of pork
			Lbs.	Lbs.	
1	Corn alone	Corn, 1-4 ration Soy bean pasture	.987	503	$6.29
2*	Corn, 2-3 Cotton s'd m. 1-3	Corn, 1-2 ration Soy bean pasture	.900	274 137	5.48
3	Corn, 2-3 Tankage, 1-3	Corn, 3-4 ration Soy bean pasture	1.305	357 178	8.02
4**	Corn alone	Corn alone	.128	1360	17.00

*During the test of 1910-1911 good cotton seed meal could not be obtained just at the time this part of the test was in progress, so the hogs were fed a very poor quality of meal. They would hardly eat it at all so made very poor gains: it cost $14.95 to make 100 pounds of pork. This was very abnormal so only two years' work, instead of three, are incorporated in the above cotton seed meal lot.

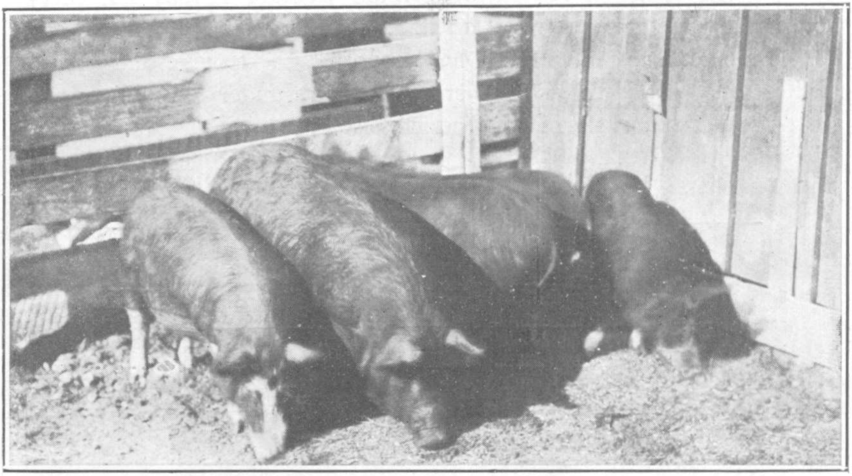
**While this continuous corn-fed lot of hogs made an exceedingly unsatisfactory showing during the second period of 28 days, still the actual results, for the three years, are even worse than shown in the table, as the hogs actually lost in weight one year; that year's data is left out of the above table.

The above lots are not comparable (except that each one is comparable to Lot 4) so the reader should not think that the table illustrates the relative value of the various feeds used. They are not comparable because of the fact that the hogs were not fed on the same rations during the period preceding the finishing period.

In Lot 1, corn is at an advantage when compared to the ration of corn and tankage in Lot 3; this is due to the fact that the hogs, which were being finished on corn and tankage, had had a preceding period of heavy grain feeding (a three-fourths ration of corn along with soy bean pasture), while the ones which were finished on corn alone had had a former period of light grain feeding (a one-fourth ration of corn along with soy bean pasture.)

But the reader will be able to gather some valuable points from the above table. In the first place there were two lots of hogs, Lots 1 and 4, which were finished on corn alone. In Lot 1 it cost $6.29 to make 100 pounds of pork; in Lot 4 it cost $17.00 to make the same amount of pork. Why the difference? It was all due to the different methods of feeding the hogs the 90 days preceding the finishing period. The hogs in Lot 1 had had the run of a soy bean pasture. The hogs in Lot 4 had had no pasture at all; they had been inclosed in a dry lot and fed corn alone. This difference was not due to the fact that the hogs in Lot 4 were fat and finished before the above finishing period began. The pictures show that the hogs in the corn lots were never finished. Corn will not finish a young hog; it retards his development very materially, and often completely stops it.

Cotton seed meal has proven to be an excellent supplement to corn to be used in the short finishing period. It is good for two reasons. First, the gains are made economically when it is used. And, second, the lard and meat are hardened much more rapidly when cotton seed meal is used along with the corn than when corn is used alone. Corn and cotton seed meal harden the lard and meat more rapidly than does a mixture of corn and tankage. Cotton seeed meal, when fed for long periods of time, is a dangerous feed. However, there is no danger of ill results when the cotton seed meal is



.OT 5—1910.—End of soy bean period. Hogs fed a ration of corn 9-10 and tankage 1-10. Average daily gain was .400 of a pound, as against .238 of a pound when corn was fed alone and 1.16 pounds when a half ration of corn was fed along with a soy bean pasture. Cost $7.10 to make 100 pounds of pork, as against $2.62 when a fourth part of corn was fed along with a soy bean pasture.

used for no more than 28 days. If the hogs must be kept in the finishing period for more than 25 to 28 days the cotton seed meal part of the feed should be eliminated; from this time on the ration should consist of corn alone, corn and shorts, or corn and tankage.

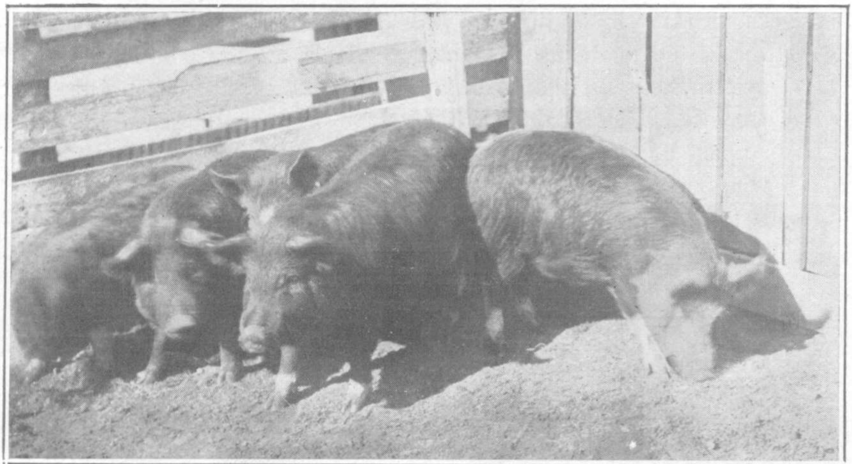
TANKAGE.

Some few farmers of the South are acquainted with the value of tankage as a feed for hogs. The farmer who cannot arrange grazing areas for his hogs is especially interested in feeds that are suitable for supplementing corn. Tankage is extremely rich in protein and ash; corn is naturally poor in both protein and ash. So tankage is especially well suited for supplementing the corn ration. It is a slaughter house by-product, and can be secured from either the large packing houses of the North and West or from the smaller packing houses and abbatoirs of the South. As tankage is an extremely rich feed it should be used in small amounts. Since it is in part produced from the carcasses of dead animals the question often arises in the farmer's mind whether it may not carry diseases to animals fed on it. None of the many stations and farmers who have fed it have reported any trouble of such nature. It is thoroughly steam-cooked under pressure and comes out a sterilized product.

TABLE 6. *Tankage Plus Corn vs. Corn Alone.*
(*Average of three years.*)

No. Lot	RATION	Average daily gains	Feed to make 100 pounds of pork	Cost to make 100 pounds of pork	Value of one ton of the supplement in terms of corn
		Lbs.	Lbs.		Bushels
1	Corn alone	.198	732	$9.15	
2	Corn, 9-10 Tankage, 1-10	.972	379 42	5.58	300

When the above tests began the pigs avergaed about 45 pounds in live weight. They were fed for 110 days. It is seen that when corn alone was fed the pigs made very small daily gains; the gains were extremely unsatisfactory. The photographs show that the corn-fed hogs were unthrifty. Corn does not satisfy a young growing hog. 732 pounds of corn, or 13.1 bushels, were required to make 100 pounds of pork, at a cost of $9.15; money was lost, of course, as the hogs sold for only 8 cents a pound. The hogs in Lot 2 were fed corn with a small amount of tankage mixed with it. The corn meal and the tankage were mixed together and sufficient water poured into the bucket to make a thin slop. When this very small amount of tankage was used (about .4 of a pound daily to each 100 pound of live weight) along with the corn the gains were satisfactory; the average daily gain was .972 of a pound. When corn was fed alone the hogs made a daily gain of only .198 of a pound. When corn was used alone 732 pounds were required to make 100 pounds of pork, but when the tankage was used as a supplementary feed only 379 pounds of corn and 42 pounds of tankage were required to make the same gains. Or, under the conditions of these tests, one pound of tankage took the place of 8.4 pounds of corn; one ton of tankage was equal, in feeding value, to 300 bushels of corn. The ton of tankage cost $40.00. When compared to feeding



LOT 6—1910.—End of soy bean period. Hogs fed a ration made up of corn 8-10, plus tankage 2-10. Made an average daily gain of .608 of a pound, as against .400 of a pound when only one-tenth of the ration was tankage. Cost $5.35 to make 100 pounds of pork, as against $7.10 when a tenth part of the ration was tankage.

corn alone to small shoats, the tankage was really worth $210.-07 a ton. The older the pigs the less valuable the tankage as a supplement to corn. When the hog is mature, when his bones and muscles are fully developed, when he has nothing to do but put on fat, the tankage can probably be dispensed with. But the above data show it to be an exceedingly valuable feed for immature animals as the cost of making 100 pounds of pork was decreased from $9.15, when corn was used alone, to $5.58, when corn was reinforced by the tankage.

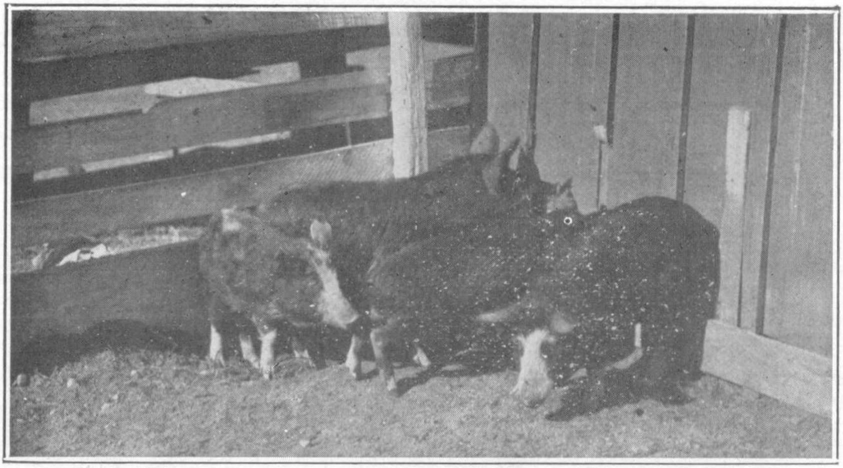
The reader should not be led to believe from these data that the very small amount of tankage used saved the great amount of corn on account of the nutrients contained in the tankage. The small amount of tankage had additional effects. First, it increased the palatability of the corn ration and therefore its digestibility. Second, the tankage increased the amount of feed eaten; therefore a smaller proportion of the ration was used for mere maintenance. Third, the tankage itself added some nutrients to the ration, mainly in the form of the much needed ash and protein.

Amount of Tankage To Use With Corn.—It is of interest to the farmer to know just what part of the whole daily feed should be made up of tankage. It is a comparatively high priced feed and should be used with judgment. If too much were fed the probable profits on the hogs would soon be lost. A part of this experimental work was outlined to determine whether a tenth or a fifth part of the whole ration should consist of tankage.

TABLE 7. *Amount of Tankage To Feed With Corn.* (*One year's work.*)

No. Lot	RATION	Average daily gains	Feed to make 100 ponnds of pork	Cost to make 100 pounds of pork	Value of one ton of tankage in terms of corn
		Lbs.	Lbs.		Bushels
1	Corn, 9-10	.505	475	$7.00	269
	Tankage, 1-10..		53		
2	Corn, 8-10	.843	293	5.12	284
	Tankage, 2-10..		73		
3	Corn alone.....	.117	874	10.93	

In Lot 1, tankage constituted a tenth part of the ration while in Lot 2 it made up two-tenths part of the whole daily feed. Nothing but corn was used in Lot 3. It is seen again that when corn was used alone exceedingly poor results were secured; the corn-fed pigs (which averaged about 45 pounds in weight at the beginning of the test) made a daily gain of only .117 of a pound, and 874 pounds of corn, at a cost of $10.93, were required to make 100 pounds of pork. In Lot 1, 475 pounds of corn and 53 pounds of tankage were required to make a gain of 100 pounds, while in Lot 2, where a fifth part of tankage was used, only 293 pounds of corn and 73 pounds of tankage were required to make the same pounds of pork. The cost to make 100 pounds of pork was $7.00 and $5.12 in Lots 1 and 2 respectively. The heavy ration of tankage proved to be more satisfactory than the light ration of tankage. In Lot 1, where the tenth part of tankage was used, the pigs made an average daily gain of .505 of a pound, but in Lot 2, where a two-tenths part of tankage was fed, the average daily gains were raised to .843 of a pound.



LOT 7—1910.—End of soy bean period. Hogs fed corn alone. Made an average daily gain of .238 of a pound, as against .900 of a pound when a fourth ration of corn was used along with a soy bean pasture. It cost $9.16 to make 100 pounds of pork in this lot; where the soy bean pasture was grazed along with a fourth ration of corn the same pork was made for $2.62.

It should again be noted that these were immature hogs. And when hogs of small size and young age are fed these tests show it to be more profitable to feed a one-fifth than a one-tenth part of tankage along with corn.

The experiment was continued for 110 days.

As the farmer raises the corn upon his own farm and often has as much, or more, than he expects to feed to his hogs, it is often difficult to get him to see that he can profitably buy extra feeds to supplement the corn. But it will almost always pay to sell part of the corn and use the proceeds to buy a good supplement. In comparing Lots 1 and 3 in Table 6, it is seen that 53 pounds of tankage was equal to 399 pounds (7.12 bushels) of corn. The 53 pounds of tankage cost $1.06; the 7.12 bushels of corn were worth $4.98. Or, expressing it in terms of tons, it would have been an excellent business transaction to have sold 268 bushels of corn (worth $187.60) and purchased one ton of tankage (worth $40.00). $147.60 would have been made on the transaction provided, of course, that the feeder could make use of a ton of this supplement.

The deaths that sometimes occur as a result of feeding cotton seed meal to hogs deter the majority of farmers from using it. There is no doubt but that cotton seed meal will often kill hogs; several hogs were killed in these tests. It is a feed that, if used at all, must be used in moderation and with judgment. There is a risk when used for long periods of time, and the man who feeds it must bear in mind the risk. The exact danger point has not yet been determined; it is not yet known just how long cotton seed meal can be fed to pigs with safety, and it is not known, either, how long very small amounts can be fed without injuring the animals. It is reasonably well established, though, that there is no danger to the hogs when it is fed in either large or small amounts for periods of no more than 25 days. This station has killed hogs before the 35th day on a ration made up of two-thirds corn and one-third cotton seed meal. Cotton seed meal is not a feed for the farmer to experiment with.

Aside from the deaths that may occur, cotton seed meal is an excellent feed; it is one of our very best feeds for balancing the corn ration. It is seen from the following table that when cotton seed meal is fed along with corn the cost of the gain is greatly reduced,—provided no deaths occur:

TABLE 8. *Cotton Seed Meal Plus Corn vs. Corn Alone.*
(Average of two years.)

No. Lot	RATION	Average daily gains	Feed to make 100 pounds of pork	Cost to make 100 pounds of pork	Value of one ton of cotton seed meal in terms of corn
		Lbs.	Lbs		Bushels
1	Corn alone	.186	727	$9.09	
2	Corn, 9-10 Cotton seed meal, 1-10	.616	392 44	5.56	272

During the above two years' work no hogs died as a result of eating the cotton seed meal. But one year's work, that of the winter of 1909-'10 is not included in the above average on account of the fact that all of the pigs, except one, in the cotton seed meal lots were dead before the experiment had been in progress 81 days. The experiments continued 110 and 106 days respectively in the years of 1910-'11 and 1908-'09; these are the two years reported in Table 8. The cotton seed meal was mixed with the corn meal and enough water poured onto the mixture to make a thin slop. It was fed sweet.

When no deaths occurred the cotton seed meal proved to be an excellent feed to go along with the corn. When corn alone was fed each 100 pounds of pork cost $9.09, but when cotton seed meal constituted a tenth part of the ration the cost was reduced to $5.56 for each 100 pounds of pork made. Under the conditions of the test one ton of cotton seed meal took the place of 272 bushels of corn. These pigs were young ones; they averaged about 45 pounds in weight at the beginning of the test.

Cotton Seed Meal and Tankage Compared.—Cotton seed meal and tankage are both rich feeds. They are both excellent feeds with which to balance corn. At the present time cotton seed meal is the cheaper feed, but tankage has the advantage in that there is no danger of its killing the hogs. It is hoped that some one will soon evolve a plan for feeding cotton seed meal so that it can be fed for long periods of time with absolute safety. Tankage is considered, by many, to be the ideal supplementary feed for hogs, but the following table shows that cotton seed meal ranks along with tankage.

TABLE 9. *Cotton Seed Meal and Tankage Compared.*
(Average of two years.)

No. Lot	RATION	Average daily gains	Feed to make 100 pounds of pork	Cost to make 100 pounds of pork	Value of one ton of supplementary feed in terms of corn
		Lbs.	Lbs.		Bushels
1	Corn alone	.186	727	$9.09	
2	Corn, 9-10 Tankage, 1-10	.936	390 43	5.74	280
3	Corn, 9-10 Cotton seed meal, 1-10	.616	392 44	5.56	272

When tankage was used as the supplementary feed the daily gains were somewhat larger than when cotton seed meal was used, but the cotton seed meal proved to be the cheaper feed, in the long run. One hundred pounds of pork was made at an expense of $5.56 when the cotton seed meal was used; the same gains cost $5.74 when tankage was fed. Pound for pound, the two feeds, though, have practically the same value as hog feeds.

Amount of Cotton Seed Meal to Feed With Corn.—It is generally known that the larger the amounts of cotton seed meal fed to hogs the greater is the danger of unfavorable results. In the tests reported below no hogs died, although the experiment continued 106 days. As cotton seed meal is a cheap and rich feed, large amounts as possible should be used, but the large amounts must be used for short periods of time. There is danger of ill results when cotton seed meal is fed as long as it was in this test. But, as stated before, it is hoped that some one will soon offer a safe plan for feeding it with absolute safety; then the following facts will be of great value to the feeder.

TABLE 10. *Amount of Cotton Seed Meal to Feed.*
(*One year's work.*)

No. Lot	RATION	Average daily gains	Feed to make 100 pounds of pork	Cost to make 100 pounds of pork	Value of one ton of cotton seed meal in terms of corn
		Lbs.	Lbs.		Bushels
1	Corn alone	.256	581	$7.26	
2	Corn, 9-10 Cotton seed meal, 1-10	.845	350 39	4.96	212
3	Corn, 2-3 Cotton seed meal, 1-3	.780	236 118	4.72	104

In both lots the cotton seed meal saved a great amount of corn. In Lot 2, where the tenth part of cotton seed meal was fed, the gains were better than in Lot 3, where cotton seed meal constituted one-third of the whole ration. But the gains were made cheaper in Lot 3 than in Lot 2. When the ration was made up of one-third cotton seed meal it cost only $4.72 to make 100 pounds of pork; when cotton seed meal constituted a tenth part of the whole feed the same gains cost $4.96.

It is noted in the test that the smaller the proportion of supplementary feed used, the greater was its value per pound, in terms of corn saved. For instance, in the above test one ton of cotton seed meal replaced 212 bushels of corn when it constituted only a one-tenth part of the whole ration; but when it constituted one-third of the ration its replacement value was only 104 bushels of corn. The greater profit, however, was not made in Lot 2, where the replacement value of cotton seed meal was at its highest; pork was made more economically where the large amount of supplement was fed. One pound of cotton seed meal was worth more in Lot 2, than in Lot 3, but there were not enough pounds of the supplement used in Lot 2 to make the pork as cheaply as it was made in Lot 3, where more cotton seed meal was used.

PRICES SECURED FOR EACH BUSHEL OF CORN.

When Pasture Was Used.—The farmer who feeds corn to hogs should realize, at least, the market price for the corn. If this cannot be done, the fattening of hogs cannot be put forward as a means of disposing of the corn crop. In the great corn and hog sections of the country the hog is largely used as a means of marketing the corn; the hog transfers the rough, bulky corn into a compact shape so that it can be placed upon the market easier and cheaper than if the corn were sold in the shape of grain. In many of the great corn sections it is further claimed that greater prices can usually be realized upon the corn when it is fed to hogs than when it is sold as corn. The price realized on the corn depends upon whether the corn is fed alone, or whether it is fed in conjunction with other feeds, and also, of course, upon the selling price of the finished hogs. The following table brings out the point that corn, when used properly, can be sold, through hogs, for high prices.

TABLE 11. *Price Realized Upon Each Bushel of Corn When Soy Bean Pasture Was Used.*

(Average of three years.)

No. Lot	RATION	Selling price of corn when hogs sell at:			
		5 cents	6 cents	7 cents	8 cents
1	Corn, 1-4 ration Soy bean pasture	$2.68	$3.55	$4.33	$5.15
2	Corn, 1-2 ration Soy bean pasture	1.37	1.77	2.18	2.58
3	Corn, 3-4 ration Soy bean pasture	1.29	1.61	1.93	2.25
4	Corn alone	.46	.55	.64	.74
5	Corn, 9-10 Tankage, 1-10	.78	.96	1.15	1.33
6	Corn, 9-10 Cotton seed meal, 1-10	.67	.82	.97	1.12

The cost of making the soy bean crop is taken into consideration in the above table; the crop is charged against the gains at the rate of $8.00 an acre. Even when hogs were sold for only 5 cents a pound high prices were obtained for the corn when it was fed along with the pasture, the price ranging from $1.29 to $2.68 per bushel. But when the corn was fed alone the usual market prices were not obtained, as each bushel sold for only 46 to 74 cents, depending upon the price of the hogs. When tankage and cotton seed meal were used with the corn the value of the corn was raised considerably, as $1.15 per bushel were secured for the corn when the tankage was fed and 97 cents when cotton seed meal was the supplement (hogs 7 cents). When hogs sell for as much as 6 cents a pound a price greater than the market price of corn was realized in every lot except where corn was fed alone. During the past two years hogs have been selling for 8 cents a pound (live weight) on the Auburn market; at this price $5.15 were realized on each bushel of corn fed in Lot 1, where a fourth ration of corn was used along with the soy bean pasture. When hogs sell for 8 cents a pound the market price can be secured upon the corn used even when the corn is not reinforced by other feeds, but the farmer cannot afford to feed the corn alone because it is rendered very much more valuable when these other feeds are used along with it.

The table plainly shows that the farmer cannot afford to sell his corn as grain. It also shows that he cannot afford to feed the corn without a supplement. And it further shows that the most valuable supplement is a good pasture; each bushel of corn was, in one case, increased in value seven times through the use of a good pasture.

Price Realized On Each Bushel of Corn When No Pasture Was Used.—In Table 11 are presented some figures to illustrate the price that can be realized upon each bushel of corn when fed alone, when fed in conjunction with a soy bean pasture and when fed with certain concentrated supplements. The following table shows the prices that can be realized on corn when the hogs are fed in dry lots for periods of 110 days.

TABLE 12. *Price Realized On Each Bushel of Corn When No Pasture Was Grazed.*

Group	No. Lot	RATION	Price realized on each bushel of corn when hogs sell at: 5 cents	6 cents	7 cents	8 cents
A	1	Corn alone	$0.38	$0.46	$0.54	$0.61
	2	Corn, 9-10 Tankage, 1-10	0.61	0.76	0.91	1.06
B	1	Corn, 9-10 Tankage, 1-10	0.46	0.58	0.70	0.82
	2	Corn, 8-10 Tankage, 2-10	0.68	0.87	1.06	1.25
	3	Corn alone	0.32	0.38	0.45	0.51
C	1	Corn alone	0.38	0.46	0.54	0.61
	2	Corn, 6-10 Tankage, 1-10	0.59	0.74	0.88	1.03
	3	Corn, 9-10 C. S. M., 1-10	0.59	0.73	0.87	1.02
D	1	Corn alone	0.48	0.58	0.67	0.77
	2	Corn, 9-10 C. S. M., 1-10	0.68	0.84	1.00	1.16
	3	Corn, 2-3 C. S. M., 1-3	0.77	1.00	1.24	1.48

The various lots in Table 10 are not comparable: the brackets show the lots that can be compared to each other. As in Table 9, the most striking point of the whole table is that when corn was fed alone the usual market prices were not realized. In every case where a supplement was used each bushel of corn was rendered more valuable than when the corn was fed alone. For instance, in Group A the value of each bushel of corn was almost doubled as a result of supplementing the corn with a little tankage, while in Group B the value of the corn was more than doubled when a one-fifth part of the ration was tankage. In Group C only 61 cents were realized for each bushel of corn when it was fed alone and hogs sell for 8 cents a pound; where a tenth part of tankage was fed with the corn each bushel of corn was sold for $1.03. Cotton seed meal proved to be practically equal to tankage as a supplementary feed in the experiments of Group C. In Group D, it is seen that the large amount of cotton seed meal enabled the feeder to sell the corn at a higher price than the small amount; the same thing was found to be true in feeding tankage. Where cotton seed meal constituted one-third of the ration each bushel of corn was sold for $1.48 (hogs 8 cents); when the cotton seed meal made up only one-tenth of the whole each bushel of corn was sold for only $1.16; when corn was fed alone 77 cents were realized on each bushel.

PRICES REALIZED ON THE SUPPLEMENTARY FEEDS WHEN CORN IS VALUED AT 70 CENTS A BUSHEL.

Many feeders refuse to buy high-priced supplementary feeds for hogs. Many farmers believe that the good these extra feeds do will not repay their original cost. The following table shows that the supplementary feeds were usually sold, through the hogs, for more than they originally cost. Rather than feed corn alone it will pay the farmer to sell part of the corn and use the proceeds for buying a supplementary feed, as tankage or shorts.

TABLE 13. *Value Of A Ton Of Supplementary Feed.*

Group	No. Lot	RATION	Price realized on each ton of supplementary feed when oorn sells af 70 cents a bushel and hogs sell at:			
			5 cents	6 cents	7 cents	8 cents
A	1	Corn alone	----------	----------	----------	----------
	2	Corn, 9-10 Tankage, 1-10	$12.50	$60.11	$107.74	$155.35
B	1	Corn, 9-10 Tankage, 1-10	Nothing	2.35	40.10	77.83
	2	Corn, 8-10 Tankage, 2-10	36.64	64.04	91.44	118.69
	3	Corn alone	----------	----------	----------	----------
C	1	Corn alone	----------	----------	----------	----------
	2	Corn, 9-10 Tankage, 1-10	5.81	52.33	98.84	145.35
	3	Corn, 9-10 C. S. M., 1-10	4.55	50.00	95.45	140.91
D	1	Corn alone	----------	----------	----------	----------
	2	Corn, 9-10 C. S. M., 1-10	32.05	83.33	134.62	185.90
	3	Corn, 2-3 C. S. M., 1-3	34 75	51.69	68.64	85.59

It should be noted that the cost of the corn is deducted from the selling prices of the hogs before credit is given the supplementary feeds. In one case, when hogs are valued at 5 cents a pound, it is seen that no price at all was realized on the tankage used; that is, after the cost of the corn was deducted from the 5 cents nothing was left to credit to the tankage. This means that money was lost in this particular instance. But the reader's attention should also be called to the fact that although nothing was left, after the price of the corn was deducted, to credit to the tankage fed, still not as much money was lost when the tankage was used as when it was not used. (See Table 6). This point should be borne in mind in studying the above table. When hogs sell at 5 cents a pound the prices realized on the supplementary feeds seem to be small, but these supplementary feeds saved enough corn to reduce the losses far below what they were when corn was fed alone. When hogs sell at 6, 7, and 8 cents a pound, the prices realized on the supplementary feeds, after the full value of the corn is deducted, show that both the corn and the supplements were fed at a profit. That is, the supplementary feeds enabled the feeder to sell the corn at 70 cents a bushel and at the same time make an excellent profit upon each ton of supplementary feeds purchased. When corn was used alone it was not sold at a profit.

FEEDS SUPPLEMENTARY TO CORN FOR SOUTHERN PORK PRODUCTION.

(*Summary of Alabama Station Bulletin No.* 143.)

Bulletin No. 143, (now out of print) was issued from this station in July, 1908. In it is found the summary of the three years' work in swine production from 1905 to 1908. It was thought wise to summarize the work of that bulletin in the present publication.

Corn was made the basal ration, or check lot. The corn ration was compared to other rations, all of which had corn as a large part of the mixture. A ration of corn alone was first compared to corn when used along with soy bean pastures. A ration of corn alone was also compared to corn when used along with tankage in one case and with cotton seed meal in other trials.

The following table presents in a tabulated form a summary of the three years' pasture work from 1905-1908:

TABLE 14. *Value of Pasture Crops for Hogs. Work Done at Alabama Station from* 1905-1908. (Taken from Alabama Bulletin 143.)

No. of experiment	RATION	Average daily gains	Feed to make 100 pounds of pork	Grain cost to make 100 pounds of pork	* Total cost to make 100 pounds of pork	Value of one acre in terms of corn
		Lbs.	Lbs.			Bushels
1	Corn alone	.69	611	$7.43	$7.43	
	Corn, 1-2 ration Peanut pasture	1.01	148 .45 acre	1.85	5.45	18.4
2	Corn alone	.67	560	7.00	7.00	
	Corn, 1-2 ration Peanut pasture	.91	177 .12 acre	2.22	3.18	56.9
	Corn, 2-3 } 1-2 ration C.S.M., 1-3 } Peanut pasture	1.00	107 51 .08 acre	2.10	2.74	
3	Corn alone	.78	456	5.70	5.70	
	Corn, 1-2 ration Sorghum pasture	.37	437 .57 acre	5.46	10.02	0.6
	Corn, 2-3 } 1-2 ration C.S.M., 1-3 } Sorghum pasture	.51	206 103 .37 acre	4.12	7.08	
4	Corn, 2-3 C. S. M., 1-3	1.18	212 106	4.24	4.24	
	Corn, 2-3 } 1-2 ration C.S.M., 1-3 } Grazed sorghum	.43	314 157 .15 acre	6.28	7.48	Damage
	Corn, 2-3 } 1-2 ration C.S.M., 1-3 } Soiled sorghum	.75	181 90 .13 acre	3.61	4.65	4.3 bus. corn 123 lbs. C.S.M.
5	Corn, 1-2 ration Chufa pasture	.72	305 .41 acre	3.81	7.09	11.9
6	Corn alone	.78	456	5.70	5.70	
	Corn, 1-2 ration Soy bean pasture	1.02	157 .28 acre	1.96	4.20	19.1
7	Corn, 1-2 ration Sorghum pasture	.37	437 .57 acre	5.46	10.02	
	Corn, 1-2 ration Soy bean pasture	1.02	157 .28 acre	1.96	4.20	

* Price feeds:

Corn	70 cents a bushel
Tankage	$40 00 a ton
Cotton Seed Meal	30 00 a ton
Pastures	8 00 an acre

It is seen that several different pasture crops were tested. It is also seen that some of them proved to be excellent hog pastures while some proved to have no value at all. It is stated in Bulletin 143 that the peanut crop in Experiment 1 above was not a good one, being poor both in stand and yield. In Experiment 2 the crop was a good one and the test represents fairly well the results the farmers of the state may expect to secure when the nuts are grown upon sandy soil. The sorghum and chufa crops were average crops. The soy bean crop was a poor one on account of an extremely dry period just before time for the seeds to ripen.

The peanut and soy bean pastures were used with satisfaction and profit, but very unfavorable results were secured when sorghum pastures were used: in fact, in one test, Experiment 4, the sorghum pasture did harm instead of good. Rather unsatisfactory results were secured from the chufa pasture also.

When the peanut crop is charged against the gains at $8.00 an acre, the corn at 70 cents a bushel, and the cotton seed meal at $30.00 a ton, each 100 pounds of gain made by the hogs cost from $2.74 to $5.45. When the soy bean crop was used each 100 pounds of gain made cost $4.20, when both the expense of the crop and the corn were charged against the gains, or only $1.96 when the corn alone was taken into account; when corn was used as the sole feed the same gains cost $5.70. These results were secured with a poor crop of soy beans.

In Experiment 3, sorghum pasture was tried. When the grains and pasture were both charged, as above indicated, the gains were not made as cheaply when the pastures were used as when corn was used by itself. When corn was fed alone 100 pounds of pork were made for $5.70, but when the sorghum pasture was used along with the corn the same gains cost $10.02. It was learned that a small addition of cotton seed meal improved the feed of corn and sorghum pasture, but even when both corn and cotton seed meal were used along with the sorghum pasture the gains were made at a loss, each 100 pounds of pork costing $7.08. In Experiment 4, a test was made to determine whether it would be profitable to cut the sorghum each day and carry it to the hogs; the hogs were confined in a small lot. While the hogs which had the sorghum carried to them made faster and cheaper gains than did the ones that grazed it, yet one acre of soiled sorghum was of very little value to the animals, as one acre of the soiled sorghum took the place of only 4.3 bushels of corn plus 123 pounds of cotton seed meal. Sorghum is a good feed for some kinds of live stock but it has no value as a hog feed. In Experiment 7 is found a direct comparison of sorghum and soy bean pastures. Although the soy bean pasture was a poor one and the sorghum pasture a good one still the poor soy bean pasture was worth approximately 2 1-2 times as much per acre as the sorghum crop.

In Bulletin 143 is also found some experimental work where no pastures were used. Some of the hogs were inclosed in small pens and fed nothing but concentrated feeds. The following table summarizes the dry-lot feeding work:

TABLE 15. *Corn Alone vs. Corn and Other Concentrates.* (Taken from Alabama Bulletin 143).

No. of experiment	RATION	Average daily gains	Feed to make 100 pounds of pork	Cost to make 100 pounds of pork	Value of one ton of the supplementary feed
		Lbs.	Lbs.		
8	Corn alone	.74	478	$5.97	
	Corn, 1-2 Cowpeas, 1-2	.93	395	11.00	$35.00
9	Corn alone	.60	575	7.18	
	Corn, 9-10 Tankage, 1-10	1.04	352 40	5.18	139.50
10	Corn alone	.65	590	7.38	
	Corn, 2-3 Cotton seed meal 1-3	1.00	303 157	6.13	45.60

In Experiment 8, cowpeas (the seed) were used along with corn. When the test was made cowpeas were selling at 80 cents a bushel, at which price they could be used in large amounts as a hog feed. But when they are worth $2.50 a bushel the farmer cannot, of course, use them in large amounts.

When the ration was composed of equal parts of corn and cowpeas each 100 pounds of pork made cost $11.00, or the peas were worth only $35.00 a ton when fed as they were in this test. If cowpeas are to be used at all now they should not make up more than one-tenth of the whole ration.

The tankage was used at a very great profit in the 9th test. When corn was used alone each 100 pounds of pork cost $7.18, but when one-tenth of the whole ration consisted of tankage the same gains cost only $5.18, or, as used in this test, the tankage proved to be worth $139.50 a ton. The cotton seed meal was also used at a profit in Experiment 10, as no hogs died. But there is always danger of deaths when cotton seed meal is used for more than 25 to 28 days. While there were no deaths in this particular test still there was a great risk to run. The farmer who feeds cotton seed meal to hogs for more than 25 to 28 days at a time runs the risk of losing some of them. In this particular test the cotton seed meal proved to be worth $45.60 a ton.

Plate 1. The above shows four of the trees on the Experiment Station grounds at Auburn, Ala. From left to right—Russell, Pabst, VanDeman, and Columbian. These are budded trees eleven years old. This also illustrates too close planting. (Photo by author.)

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

THE PECAN IN ALABAMA

By
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THE PECAN

Modern pecan culture has introduced a profitable industry in the Southern States. Northern capitalists are investing in large plantings and pecan orchards of hundreds of acres in extent are appearing throughout the South. There is no reason why southern capital should not be turned this way and thus be kept at home. The pecan is bound to be a leader among the orchard fruits of the future. All nuts have a great food value and for this reason alone pecan growing should be profitable. There seems to be at present a greater interest in pecan culture than in any other horticultural pursuit.

Native pecans have been found in portions of the following states: Texas, Arkansas, Indian Territory, Missouri, Kansas, Illinois, Indiana, Ohio, Kentucky, Tennessee, Louisiana, Mississippi and Alabama. One of the most interesting collections of native pecans was that exhibited by Purdue University at a recent National Nut Growers' Convention. The size and uniformity of some of these northern grown specimens was noteworthy, and shows the possibilities open for pecan work in the colder sections of the country.

Pecan trees for northern planting should be grown from buds or wood of those varieties particularly hardy and should also be on seedling roots produced from seed nuts grown in the north.

Such varieties as Mantura and Appomattox are being quite generally planted in Eastern Virginia. There are many large pecans grown in South Carolina, and considerable interest in pecan planting is being manifested in North Carolina. The pecan growers of Florida are confined mostly to the northern and western portions of the State. However, successful pecan orchards will be confined to the lower cotton belt as the blooms are less affected by frost in this section.

The staminate blooms are borne on one year old wood and the pistils on the new shoots. Injury to one or both of these flowers from such agencies as frost, excessive rains, or high winds reduces the crop. It is necessary that both the male and female blooms be developed at the same time to insure pollination.

In Mohr's Plant Life of Alabama under *Hicoria pecan* he states that the native habitat is northern Mexico, the Carolinian and Louisianian area, Iowa, southern Illinois, southwestern Texas, Indian Territory, northern Mexico; south from southern Mississippi to Texas and central Mississippi. In Alabama he mentions it in the Central Prairie region, Hale, Dallas, and Marengo counties. It is undoubtedly indigenous to these regions and is extensively cultivated near the coast.

Generally speaking the range of the pecan is confined to the Cotton Belt. However, we have records of pecan trees growing as far north as Niagara Falls and in the Arnold Arboretum, at Boston, Mass. In the latter instances, however, although the trees seem hardy they have not as yet fruited and it is questionable whether they can as far north as this. In New Jersey there are two trees which have been bearing profitable crops for 100 years. This would show that the pecan can be safely planted as a tree in the home grounds in any county in Alabama. It is possible that commercial orchards could be successfully planted in most of the counties of the State but it would not be advisable to set out these large orchards without having more data concerning the

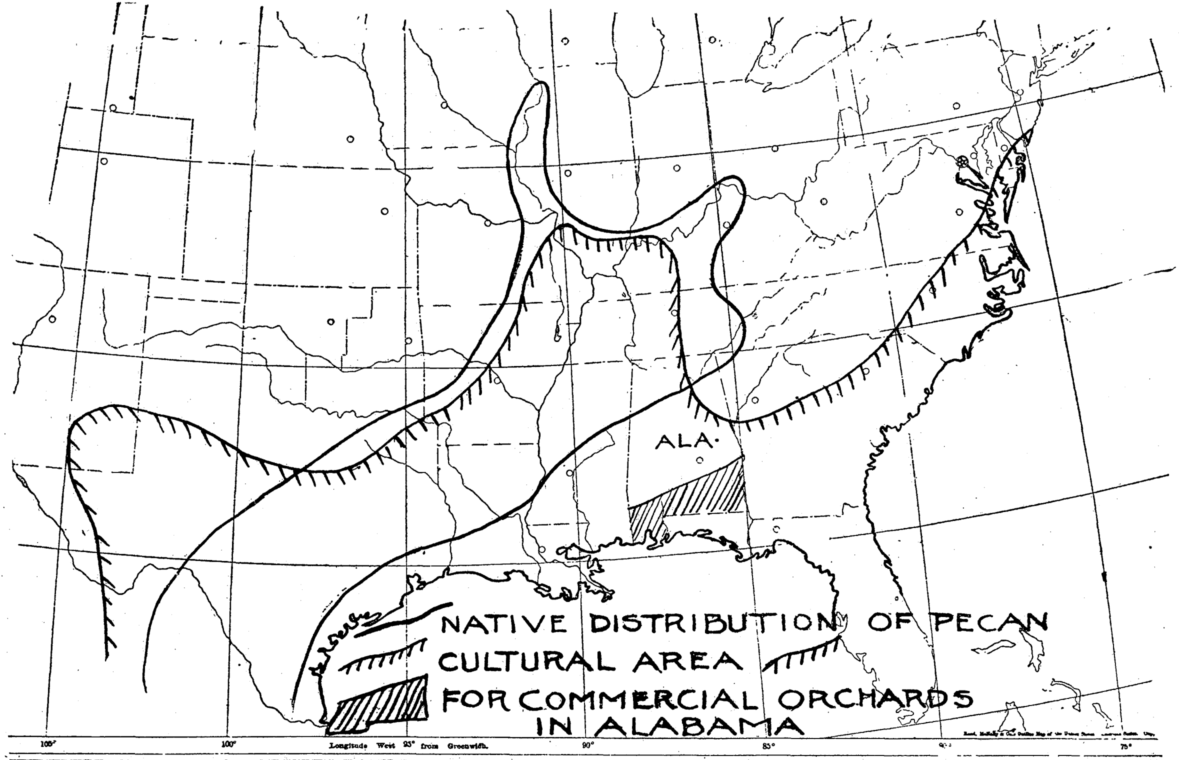

Fig. 1—Outline map showing distribution of the pecan. The single line represents the native distribution and the shaded line the cultural area. The shaded portion of Alabama shows the area where commercial orchards should succeed.

habits of the different standard varieties in each respective county. The larger pecan groves in Georgia, Mississippi and Louisiana are confined to the southernmost sections. In fact from a recent inquiry as to the pecan industry in Alabama which has been made by the United States Department of Agriculture at the urgent request of the Department of Horticulture at the Experiment Station at Auburn, it is found that the counties growing the greatest number of pecan trees are Baldwin, Mobile, Bullock, Lowndes and Autauga. The returns from this inquiry are rather vague at present as the parties planting the varieties seldom keep records of them and the greater number of trees are seedlings. For instance it is found that in Baldwin county there are 41,000 pecan trees and of this number 25,000 are grafted. In Bullock County there are 12,500 trees and only 600 are grafted. In Autauga county only 3,000 trees out of 23,500 are grafted.

Some of the seedling trees in Texas are between 400 and 600 years old. Many of these produce from 5 to 14 barrels of nuts each year. A pecan tree is considered mature which is between 50 and 100 years old.

There are records of splendid seedling trees in about every section of the State and they often attain an age of hundreds of years and in favorable seasons they continue to mature large crops. There is one tree in Mexico which is five feet in diameter and bearing a ton of nuts annually. As to the attainable age of grafted and budded trees it is still a matter of much speculation. One tree in Mississippi is said to be 60 years old from a graft. The general practice of budding and grafting pecans is of relatively recent origin and does not cover a period of over twenty-five years. Sufficient time has not been given to prove whether with the right soil, right varieties, and proper care the budded and grafted varieties will continue to bear profitable crops for an indefinite period. The profit obtained from the above orchards in a number of cases prove that the investment has already been a profitable one.

On page 5 will be found an outline map of the United States showing the range of the native habitat of the pecan, also the area where the pecan is cultivated. On this same page the shaded portion of Alabama shows the area where commercial pecan orcharding would undoubtedly prove a paying proposition.

There are several factors which must be considered in locating a commercial orchard. These may be summed up in the following way:

First, the geographical factor; in this the climate and general conformation of the land is included.

Second, the soil factor, and here we meet one of the most important factors. If we go back to the discovery of the first pecan trees we will find that Illinois is given credit for being the first state where it was found. The general theory is that the waters of the Mississippi carried these nuts down toward the Gulf and they lodged along the shores and sprouted in the rich alluvial soil. The finest seedling trees seem to be on these alluvial soils and on what is generally termed "second bottom" land. The pecan is a gross feeder and requires a constant supply of moisture. This accounts for the extreme length of the tap root. It is natural to suppose that the subsoil is for this reason more important than the surface soil. On some of our stiff clays and hardpans it is practically impossible for the tap root to force its way down below the water table. It would seem important that a thorough examination and analysis of this subsoil should be made before extensive plantings are attempted.

There are scores of inquiries coming into the Horticultural Department at Auburn, concerning the prospects for successful pecan planting in given localities. In the majority of these cases it is a matter of conjecture. The presence of hickories in the locality is not a positive indication that pecans will be successful. Pecan trees may develop rapidly and make splendid specimens, but whether the trees will bear heavily is the important point. Wherever strong growing, prolific seedling pecan trees are found, there is good, strong evidence that pecan planting can be made successful. The hickory will often endure standing water about its base for a considerable period without killing the tree; the pecan cannot stand this and that is one reason why the "second bottom" land is preferred. Here the water table is generally about ten feet below the surface and there is little danger of the orchard being inundated. The richer the soil and the more it is susceptible to improvement the better. As a rule any land that will grow cotton will grow pecans. Deep sandy soil should be avoided and also that which is too wet, sour and soggy to grow an ordinary field crop. Some of the finest trees that the writer has observed are growing on sandy loam, underlaid with sandy clay. Some of the richer soils are apt to produce excessive wood growth at the expense of nut production. Soils may be divided into two classes, those poor in plant food naturally and those made so through continuous and injudicious cropping. Poor land may be brought up to a high state of fertility either before or after planting. This is done by planting either cowpeas or velvet beans. Some of the nurserymen who are growing pecans practice growing a crop of velvet beans on the poorer soils, turning this under in the fall, the year previous to the planting of the pecan seeds. The next summer they grow cowpeas on this land, generally in drills, so that the peas can be cultivated, as this is generally necessary to produce a good crop of peas on the poorer soils. After the peas are cut for hay, the roots containing a large amount of nitrogenous matter are plowed under to enrich the soil. This treatment of the soil supplies it with humus and puts it in such condition that the commercial fertilizers which are applied later become more available. If this is practiced there is no necessity for fertilizing the young trees at the time of planting.

Newly cleared land should be cultivated for at least a year previous to the planting of pecans. There are some who advocate planting pecans on the newly cleared land, but there is little gained by this. A corn crop followed by cowpeas at the last working should be grown, the latter to be turned under in the fall. Deep, thorough cultivation of the land and the incorporation of sufficient vegetable matter to supply humus is necessary for a successful start. For the first four or five years the young trees should be induced to put on a vigorous growth, especially during the first, second and third years. The soil must contain humus to secure this end.

The third factor is experience. There is a tendency at present to organize a number of pecan investment companies especially in the northern and eastern cities. The officers of these companies should be men of unquestionable integrity and they should have complete confidence in the man who is to superintend the planting and subsequent treatment of the orchards. The superintendent should be thoroughly familiar with general horticultural practices and should have had several years experience in pecan orchards. Preference should be given to the man who has been brought up in the South. The demand for these trained men will tax the teaching capacities of the experiment stations and colleges of these states. The propagation of the pecan requires more care and thoroughness on the part of the operator than do most plants. If commercial work is undertaken and success is to be assured, a great deal will depend upon the ability of the man in charge of the orchard. He will have to study the market conditions and be quick to recognize just which varieties are going to be profitable where the orchard is located. As an example of this the writer has seen an orchard of several hundred acres cut back and topworked with a variety more congenial to the location before a great loss had been incurred.

The last factor to consider is that of labor. In many of the orchards in Georgia the negroes become skilled in the various orchard practices. However, for the first few years it requires a very great degree of intelligence to properly set and care for the young orchard and there is a demand for reliable men in this field.

PROPAGATION.

This feature of pecan culture really concerns the nurseryman more than the orchardist. However, the small grower and the commercial orchardist have occasion to know the minutest details of this work.

Pecan propagation is rather difficult, hence the relatively high prices of first class nursery stock. Skilled pecan grafters and budders are scarce, and even these men feel fortunate if they secure a 75% "live" or stand. Seasons have a marked effect upon the success of the operation. The bud worm which attacks the buds on the cions just as they are pushing forth in the Spring has also caused a serious loss to the nurserymen.

The first step is the selection of seed nuts. Here there is some chance for controversy. Some nurserymen will say that Texas seedling nuts are preferable, others that native Louisiana seeds are best, and again the Florida grower may prefer the Florida seed nuts. Whichever are used attention should be given to their selection. It is reasonable to expect the finest seedling nuts to produce the most vigorous and best rooted trees.

The practice of cutting out weak seedlings in the nursery row is to be commended.

The nurserymen in the lower gulf section plant the seed nuts as soon as they mature. This obviates the expense of storing the seed by stratification through the winter. Seed are sown either by hand or by machine. These are planted in rows three feet apart, and the nuts 4 to 6 inches apart in the rows, the nuts being planted about 4 inches deep.

After the seeds are covered, rows should be rolled and if the season is dry a light harrow should be drawn over the rows to conserve the moisture. Intensive cultivation is carried on when the growth starts up in the spring. By fall the seedlings will have attained a height of 12 inches and a tap root of at least 1½ feet in length.

Up to a few years ago there were many who urged the planting of seedlings only for the orchard. However, experience has shown that this is unwise for a number of reasons. Although we have some very fine seedling trees producing a fine grade of nuts it is very difficult to determine just what sort of a nut seeds from these trees will produce. Another point might be mentioned here, that the seedling tree generally takes about twelve to fourteen years to produce a crop. Seedling crops are also intermittent or irregular as we find in Texas. Texas supplies about ninety per cent of the pecans on the market. The crops there are irregular and it is generally every third year that a full crop is expected. With the budded or grafted tree this feature is corrected. Of course there are several things which would cause the budded or grafted orchards to give us irregular crops and some of these conditions cannot well be avoided. For instance, excessive rains at the time the pecan is blooming would tend to produce imperfect pollination. If the trees had to pass through a drought during the summer and the constant supply of moisture cut off from the roots, all of their strength would necessarily be required to mature the crop and the tree would fail to set vigorous buds for the next season's crop. This emphasizes the fact that the orchard should be located where the tap root can always find a supply of moisture.

GRAFTING.

On the two-year seedling roots the cions of the standard varieties are grafted generally about four inches under ground and soil is then banked up to retain mois-

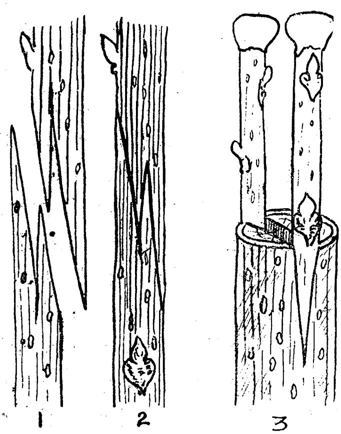

Fig. 2. (1) Showing how cuts are made in whip grafting. (2) Stock and cion united ready for tying. (3) Method of cleft grafting showing proper insertion of cions. Two being placed in stock 2 inches in diameter. Ready for waxing and wrapping. Notice wax placed over cions when cut to prevent evaporation.

Plate 2. Illustrating the operation of cutting the seedling pecan preparatory to inserting a cion.

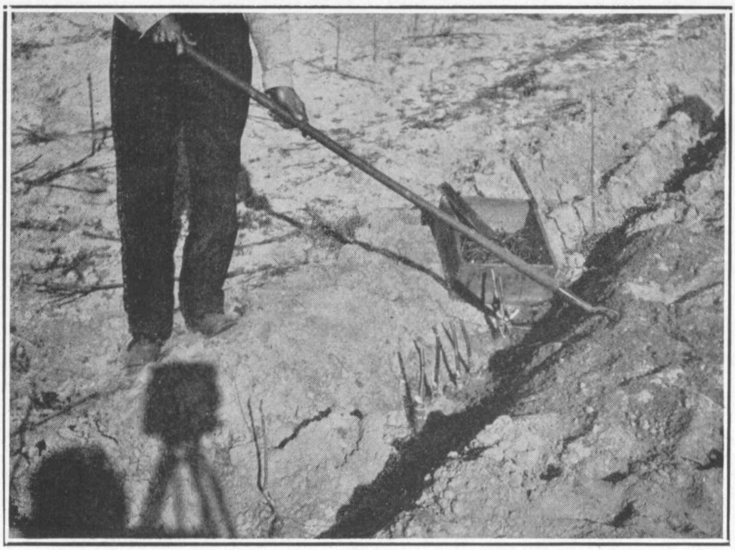

Plate 3. Showing the cions inserted and wrapped and soil being drawn over them to keep them moist. (Photos by author.)

ture about the union. The stock should be a little larger than the cion and the grafts should be tied with waxed twine. Ordinary methods of grafting are used with the exception that we cannot use piece roots, the whole root being necessary. The cions are taken from the bearing wood of known varieties and preferably while dormant. These are kept in this condition by packing in damp sphagnum moss and storing in a cool cellar on the north side of a house where the rain will not bother them. Some of the larger nurserymen have installed a cold storage system for holding the cions dormant.

The whip and tongue grafts are made during December, January and February. Above ground grafting is generally more successful when buds are swelling. One method of establishing standard trees in the nursery is to chip bud the two year old roots. In this method a cut is made with a sharp knife straight into the root for about an eighth of an inch and then the knife is placed about three-quarters of an inch above this and a slanting cut made to meet the horizontal cut. A chip corresponding to this section is removed and carefully placed and tied in the root with waxed twine, care being taken not to cover the bud. When the bud begins to push out cut off the top eight to twelve inches above the bud, leaving very little foliage above the bud, so as to keep up the equilibrium between roots and top but only enough of this to allow the bud to obtain slight nourishment. This work is generally done about two weeks before the sap flows. This method requires very careful fitting and wrapping and wood one-half an inch in diameter is required. Trees up to two inches in diameter are successfully budded in this way.

The ring or annular budding is practiced a great deal in top working trees. Top working is a method employed to completely change the head of a tree. A number of growers plant seedling trees with a view of top working them when the trees have reached a considerable height. This practice should not be encouraged as the trouble and expense involved is greater than the initial cost of standard grafted or budded trees. Again the resulting tops of the trees will be uneven owing to frequent failures of buds to "take." Profitable and interesting work can be done in top working seedling trees in the home grounds. If the seedling tree is not producing a good grade of nuts the main limbs can be cut back, leaving of course two or three of the outside limbs to carry up water and their leaves in turn to assimilate the plant food. Attention should be given to the proper symmetry of the tree. These limbs are cut back in the winter, generally about two weeks or a month before the sap flows. (Fig. 4, No. 4.) From these stumps several sprouts will be thrown out and when they have attained the diameter of an inch or so, which will be during August, buds of the variety desired are inserted in the sprouts about 4 or 5 inches above their union with the stub. Buds are placed in several of the strongest sprouts which insures a sufficient number "taking." The sprouts from these buds will often bear nuts when two years of age. The selected buds should of course be taken only from bearing wood from prolific and vigorous trees. This same principle applies to top working by grafting. Only the very best cion wood should be selected. The entire top of the tree should not be changed over the first year. Trees under 25 feet in height may be completely worked over in two seasons. It will generally take two or three years to accomplish this as a severe cutting back often kills the trees. The stubs are cut cleanly, care being taken that the bark is not torn. (See Figure 4, 2.) This is avoided by making two cuts, one underneath and the other from above a few inches further out on the limb. Cleft grafting should be practiced. Notice in Figure 2 (3) the position of the bud. Where the stock is large two cions may be inserted, one on either side. Having the cambiums of the stock and cion in contact wrap the graft with strips of waxed cloth. See that the cut end of the stock is covered with wax to keep out the moisture. If the cion is devoid of its terminal but cover the end with wax also. Top working can also be done higher up among the branches and with twigs less than an inch in diameter the common whip graft can be employed. (Fig. 2, No. 1.) It is better to select the cion and "stock" that are nearly of a size.

Formulas for Grafting Wax, Waxed Cloth and Waxed Twine.

Grafting Wax.

1. Resin, 6 lbs.; Beeswax, 2 lbs.; Linseed Oil, 1 pint.
2. Resin, 4 lbs.; Beeswax, 2 lbs.; Tallow, 1 lb.

Break wax and rosin into small pieces and melt over a slow fire and stir slowly, when melted pour out into a bucket of cold water. Caution should be taken to grease the hands well before removing the wax from the water. When in shape to handle pull it until light yellow in color. If the wax is not needed for immediate use it can be rolled up in balls, wrapped in oiled, stiff brown paper and put away for future use.

Waxed Cloth.

Melt the wax in a kettle, drop into it sheets or strips of old calico or cotton cloth. As soon as they are saturated remove them from the kettle and stretch them on a board. For use tear them into strips one-quarter or one-half inch wide.

Waxed Twine.

Drop balls of No. 18 knitting cotton into melted wax and stir four or five minutes until wax has penetrated them.

METHODS OF BUDDING.

The annular or ring budding consists of removing a cylinder about one inch wide containing a dormant bud from the variety to be propagated and transferring it to a place of the same size on the stock on which it is to grow. The cuts in each case are made just through to the cambium. Figure 3 will show the operation. The transplanted bud must be handled carefully and put in place expeditiously as exposure of the bud to drying is very injurious. After a close fit is made the bud should be properly tied. Here there is danger of either tying the bud too tight or not tight enough. Secure a happy medium and there will be no difficulty in getting the bud to "take." It requires from 10 to 20 days for the complete union depending on the season. If this union is complete by September 1st the top may be cut back leaving a few leaves to carry on transpiration. The removal of the top will induce growth in the bud, care being taken to rub off all seedling shoots coming out either above or below the union. After the bud has made a growth of a few inches the remaining portion of the seedling stub above the union may be removed, covering the wound with wax.

Patch budding is done by removing a patch from the tree containing the dormant bud of the variety to be propagated and placing it on a corresponding square properly prepared for its reception on the seedling stock. Sometimes these patches are square, oblong or triangular. This method is preferable where there is a difference between the size of the budding wood and the seedling or stock. The term semi-annual is often applied to this form of budding. (Figure 3, 5). A practiced budder will readily make the cuts on the stock and the bud wood the right size and there is a point here which should be especially noticed. Rather than have the vertical edges of the patch touch the vertical edges of the stock a very small space is left (about 1-16 of an inch). This allows for the spreading of both the patch and the stock when tying. Otherwise the pressure brought to bear in tying would tend to split the patch through its weakest portion, viz.: longitudinally along the center of the bud, and thus seriously injure it. In both annular and patch budding great care must be exercised in removing the patch from the bud wood as in pulling or lifting the patch the eye is often destroyed. It is unwise to bud unless the bark slips easily. Waxed cloth is the best material for wrapping the buds.

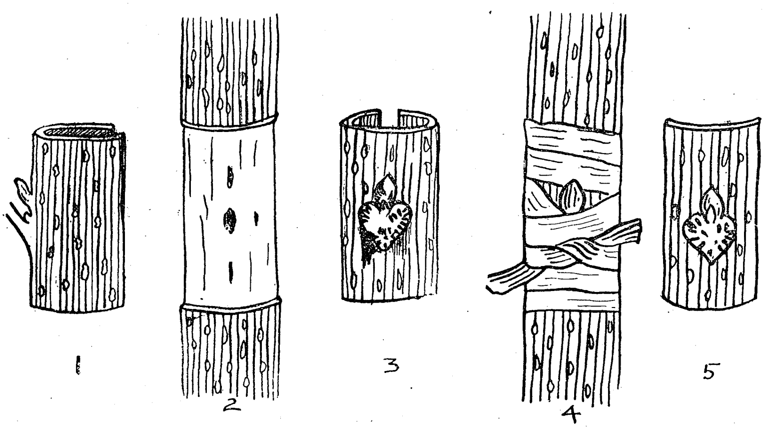

Fig. 3. (1.) Annual cylinder taken from trees for summer budding leaving small portion of petiole of leaf for a "handle." (2) Ring removed and stock ready for reception of same sized ring from another variety. (3) Dormant bud. (4) Bud in place and tied with raffia. (5) Patch or semi-annular bud removed ready for insertion.

Mr. Herbert C. White of Dewitt, Ga., has placed a patented budding tool on the market which is simple and effective. Another successful budding tool has been patented by Mr. Gilbraith of New Orleans and is used quite extensively.

Another method of budding is called the Slip Twig Method where a long sloping cut is made from a cion, sometimes leaving a shoulder and pushing it in between or beneath the bark of the tree and the sap wood. This is practiced after the sap starts in the spring.

Mr. E. W. Kirkpatrick, of McKinney, Texas, has introduced what he calls the Punch Method in budding. This is done by using a punch similar to a harness maker's and is about 1-2 inch in diameter. This simply cuts through the bark to the wood and a similar ring is cut on the stock. The portions within the rings are removed and the one containing the standard bud is placed in the stock. With a stock one-half inch in diameter a punch of 1-4 or 3-8 inches is used. The bud does not stay in the punch but is lifted from the tree with the fingers. This method is used in the spring as the sap begins to flow. It is well worth trying but it has not become a common practice as yet. Mr. H. W. Smithwick has used it successfully at Americus, Ga. The bud should be wrapped with waxed cloth strips.

In selecting all cions and bud wood it is better to take them from the same location if possible as fresh buds "take" best. If a new variety is sought this of course is impracticable. All unions should have the wrappings cut when the cells have filled up all the spaces and as this takes different lengths of time under different conditions it is difficult to say just when the wrapping should be cut. The grower must determine this point by close observation.

Mr. Wm. Nelson was the first to propagate the pecan by budding and grafting on a commercial scale, and Mr. C. E. Pabst of Ocean Springs, Miss., was the first to propagate the pecan by root grafting. There is still some controversy among the nurserymen concerning the relative merits of trees from buds and those from grafts. The followers of the latter system claim that as the union is under ground it has a tendency to withstand winds better than the bud union above ground.

Attention should be called to the fact that many fake or bogus trees are being placed on the market and these can easily be detected where there are grounds for suspicion. With the budded tree the pith would necessarily be discontinuous at the juncture of stock and cion. (See Plate IV.) In the fake budded tree the pith is continuous. Buyers should be cautious of tree salesmen. The latter can do the trade a great deal of harm, and if honest a great deal of good. There are few people who patronize both the salesman and the grower. It is either one or the other and a good, clean, honest agent can build up a good business for his employer. The other fellow not only injures his firm but the good name of the trade at large.

There are so many reliable nurserymen handling pecan trees that questionable tree salesmen should not be given a hearing. The best trees should be purchased, and the buyer must depend upon the honor of the nurseryman, when the latter is filling orders for the standard varieties. The "big" nurserymen in maintaining their integrity, can hardly afford to place trees not true to name on the market. The "smaller" nurserymen can hardly expect to build up their trade without using the greatest care in keeping the varieties true to name. However, in the nursery business, as in practically all other enterprises, some dishonest parties are encountered.

It is important that orders for trees be placed early. Many of the large pecan nurserymen have already sold at least one-half of their 1911-1912 stock. The first orders receive first attention, and those ordering during the planting season must accept "left overs" and are generally unable to purchase select stock.

STAKING THE GROUND.

The common methods of laying off the orchard can be employed. A good plowman can generally run off rows as straight as necessary both ways of the orchard. In the rectilinear system the stakes can be located either by sighting or measuring. Any light stake serves the purpose. Pecans should not be planted nearer than 50 feet each way.

Mr. J. F. Jones of Jeanerrette, La., has used a very rapid method of locating and lining up trees in planting large orchards. This consists in using a steel wire strong enough to withstand stretching. This is cut into 50 foot lengths, each length being connected by small metal rings. Anchors are attached to the ends and one of these is set firmly on a well defined base line. Half as many men do the staking as there are links. The stake farthest from the base line is placed first and the intermediate stakes are lined from this by the men at the anchor. Eight foot stakes are used for sighting and small stakes for the marking of the place for the tree holes. The wire is then lifted to line the next row, being parallel with the first. In this way 75 acres have been staked in one day.

For the hexagonal system, place stakes at the desired distance of planting along one side of the orchard.

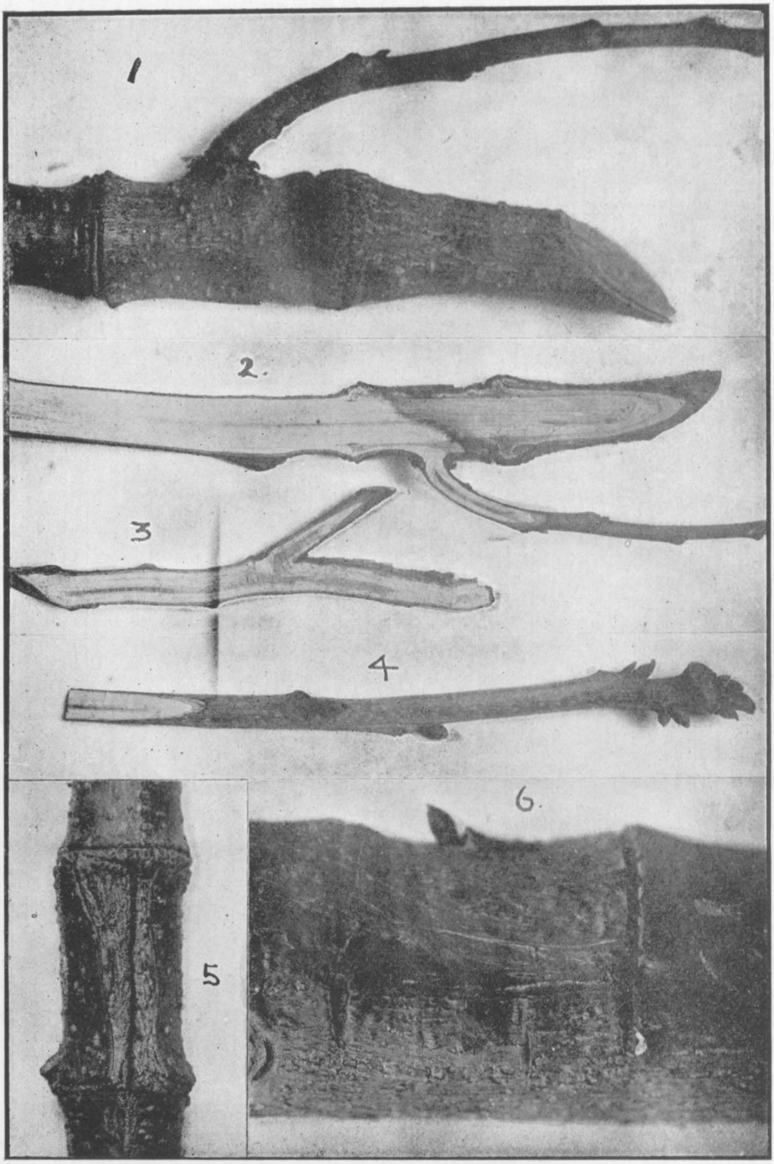

Plate IV.—Fig. 1, Twig growing from an annular bud. Portion above bud not properly cut or protected, and is dying back into bud. Bud tied too tight. Fig. 2 shows appearance of pith in union of bud and stock. Fig 3, Natural union, pith continuous. Fig. 4, Typical cion for grafting. Fig. 5, Rear view of a calloused annular ring. Fig. 6, Perfect union of a patch bud. (Photos by author.)

Provide two cords, chains or wires of the same length as the distance between the stakes and fasten a ring to one end of each. Starting from the first and second stakes of the first line make equilateral triangles and at the points where the rings join, place stakes forming the second row of stakes. Using this as a base line lay off the third, etc. With the double system of planting as with Satsuma oranges, peaches and pecans use the rectilinear system. For just pecans the hexagonal system is preferable as at least 127 more trees could be planted in 50 acres, planting 50x50 than in the rectilinear system.

PLANTING.

Nursery trees are generally sold according to their height, running from 1 foot up to 10 feet. The experience of the older growers points that the 3 to 5 foot trees come out better than the higher trees. Often the tree is small through being stunted. Such a tree will seldom recuperate and should be thrown out at once. This also applies to the orchard and where one is noticed growing very slowly it should be immediately replaced with a thrifty tree. Again we find that there is often a too rapid growth such as 8 to 10 feet in a season. Buy one year budded or grafted trees on 2 to 4 year roots.

The nurseryman usually prunes the root at the proper place in digging the trees. However the cut may not have been made smooth and this should be examined when the trees are ready for planting.

Two year tap roots should be cut back from 18 to 20 inches. Four to five foot trees should have about 10 inches removed from the top and those of other sizes should have their tops and roots cut proportionately.

This cutting back of the top is done to balance the loss of the root system which is made at the time of digging the trees. Some take trouble to dig out holes 4x4 feet in setting the pecan. This is hardly necessary although plenty of room should be given the roots which when pruned take up more room than any other trees from the nursery. To align the trees the planting board should be used. This is made of 7-8 inch material, 5 feet long and 4 inches wide with triangular notches on one edge near each end and at the middle. The young tree rests in the middle notch while the end notches receive the small stakes driven on the line at either side of the tree hole.

The surface soil should be used for filling and where this is not rich it will be well to thoroughly mix about one pound of commercial fertilizer to the soil which is used in filling the hole. Never let the young tree roots get dry and after planting if there should come a drought, water should be given them. Too little attention is generally given to the planting of all fruit trees. It is one time when the quickest way is by no means the best. This care will have to be given for the first two years.

Young trees show a smaller percentage of loss than older ones going through the transplanting process, and they are much easier handled. It takes the trees some little time to readjust themselves. A loss must be expected in transplanting. All the young trees will not start off simultaneously. Some will soon start out a vigorous growth while others will be more backward. Some may take another year to die. Here then is the necessity for expert care and nursing if the trees are in the early stages of their orchard life. A mulch of leaves or straw should be placed around the tree to prevent evaporation.

Time for Setting Trees.

The fall is the best time for this. Dormant trees set in the fall establish themselves through the winter and are ready in the spring to push out their buds. From the latter part of November to the first of February is the best time for Alabama. The earlier in this period the better.

ORCHARD MANAGEMENT.

As previously stated the commercial orchard should have the entire attention of the superintendent. Profits commensurate with the investment cannot be realized otherwise. After the pecan orchard comes into bearing it requires less attention than the peach or apple orchard but should not be neglected.

Do no pruning in the summer as the main object is to establish a strong vigorous root system and an abundance of leaf surface brings this about. Pruning the mature tree should have no further object than to keep the shape symmetrical. The wounds should be painted with white lead. The sketches below indicate some phases of pruning. In making all cuts be sure that they are smooth and with the larger cuts, those over an inch in diameter, do not leave stubs, with the exception of the stubs left for top working.

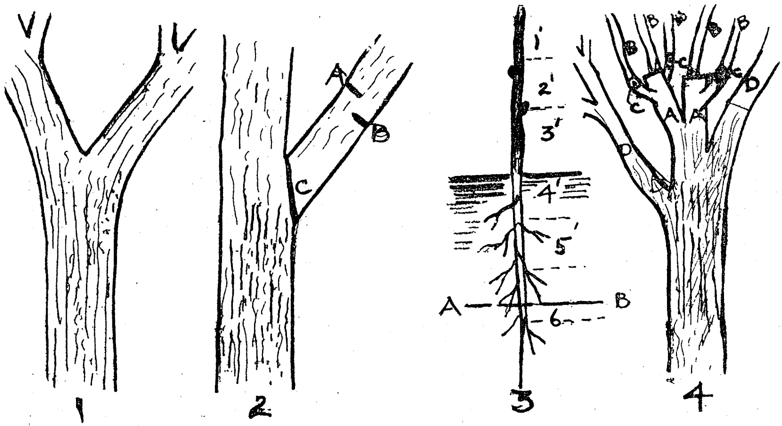

Fig. 4. (1) Avoid crotched trees. (2) Method of cutting larger limbs to save tearing of bark. Note the three cuts at A, B and C. A smooth cut at C insures immediate healing of wound. (3) Young pecan tree showing relative length of top and tap root. Cut root at AB. (4) Top-working—D limbs left for proper transpiration. A stubs cut during the winter. B sprouts from these budded during summer at C.

Small groves generally pay better as they receive more attention. With the small grove however there is a tendency to plant the trees too closely and without skillful pruning the bearing wood of each tree will interlock and tend to scrape off the nuts. Again proper spacing allows for more successful intercropping, especially during the unproductive period.

CULTIVATION.

When the growth starts in the spring, the soil should be plowed and leveled, this to be followed by a shallow cultivation every ten days, until July 10th or 15th. The light harrowing should be practiced, following rains, as soon as the ground can be worked. Where the harrow does not reach the hoe should be employed. Bearing orchards should have cowpeas or velvet beans planted between the rows.

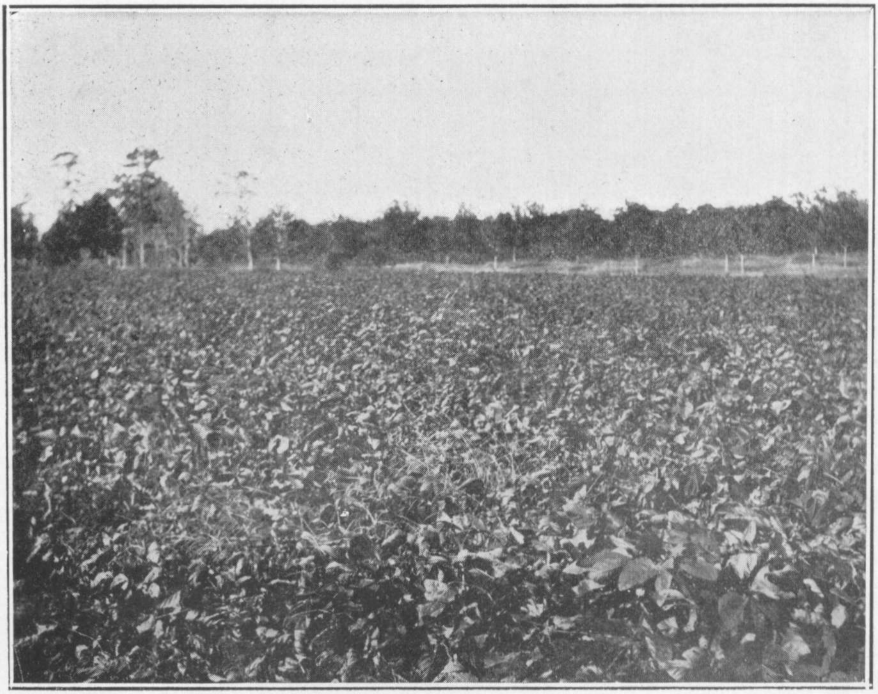

Plate V. Showing a field of velvet beans in the Gulf Coast section. An excellent land builder. (Photo by author.)

Plate VI. Showing thrifty nursery stock.

Care should be taken to keep out weeds and grass between the trees and from 6 to 8 feet on each side of the trees. Four or five rows of cowpeas can be planted along each side of the pecan rows leaving a sufficient space between the trees and the first row of peas to allow plows to pass. The central space may be planted in cotton, potatoes, corn or other crops. This central space will diminish in size each year as there must necessarily be more rows of peas added each year to furnish nitrogen for the extended root system of the trees.

In the management of the grove there is an ideal to be kept in mind and that is the producing tree. With the consumer the nut itself is paramount.

FERTILIZERS.

With a vigorous mature tree the lateral roots spread as far as do the branches. When the fertilizer is applied it should be spread so that it will reach these roots. If manure from the stable is to be used care should be taken to balance it with applications of phosphoric acid and potash. Potash tends to promote healthy wood and to some degree resistence to fungus troubles. Potash will also help to keep the nut clusters from falling before they mature.

Commercial fertilizer shows its effect for early growth and the stable manure later. Wood ashes are beneficial to growing trees. Before any fertilizer is applied the soil should be studied. Good cultivation will often do more good than the most judicious fertilizing. Mr. Pabst of Ocean Springs, Miss., depends on cultivation and intercropping with cowpeas.

But little growth should be expected from the young trees the first season after planting. On rather poor soils a forkful of well rotted stable manure spaded in around it just beyond the roots is beneficial. Some growers use 1 pound of rotted manure and 1 pound of commercial fertilizer for each tree every year. A complete fertilizer hoed in about each tree during the early spring is beneficial, as follows:

First year set	1 pound
Second year set	2 pounds
Third year set	4 pounds
Fourth year set	4 pounds
Fifth year set	12 pounds

The above should be applied in circular bands about the tree increasing the diameter of these bands each year. The older trees in the orchard should have an application of from 500 to 1,000 pounds per acre of a complete fertilizer harrowed or plowed in if the trees are not making sufficient growth (at least a foot per year.)

For bearing trees 750 pounds of the following formula should be used where legumes are grown:

300 lbs. bone meal.
150 lbs potash 50%.
300 lbs. C. S. M.

750 lbs per acre.

If legumes are not grown the following fertilizer should be applied:

400 lbs. bone meal.
200 lbs. potash 50%.
400 lbs. C. S. M.

1000 lbs. per acre.

This same fertilizer contains about the right proportion for truck crops. Different soils will require different quantities of the above mixtures. The poorer soils which leach badly will often require as much as 2,000 pounds of high grade fertilizer per acre when the trees are from 12 to 20 years of age.

Good results are being obtained with Thomas Phosphate as the source of phosphorous. The presence of lime in this has a tendency to neutralize the soil, a fact to be considered in most parts of the State. An application of ground lime is often beneficial.

One-half the fertilizer should be applied just previous to the pushing forth of the buds in the spring and the remainder during June.

The behavior of the trees will indicate to a great degree their need of fertilizers and there is as much danger of over-fertilization as under-fertilization. The potash and phosphoric acid should be applied before the growth starts and the second application consisting principally of the nitrogenous matter can be applied with good effect the latter part of May or first week in June. Applying the nitrogen first induces a too rapid wood growth.

INTER-CROPPING.

There are many systems of inter-cropping the pecan orchard and as this can be done with a considerable profit it makes the time that is generally occupied by the pecans in coming into maturity of relatively little importance. The fact that it does take from eight to twelve years for an orchard to become of commercial importance discourages many prospective planters. Among the crops that may be grown are cotton, cowpeas, corn and truck crops. There are many planters who place a pecan tree every 60 feet running each way in the peach or pear orchard. At the time that peach and pear trees are past their usefulness and are cut down, the pecan orchard is left and is in bearing. The cultivation, fertilization, etc., given to the peach and pear trees are equally as beneficial to the pecan trees. In planting cotton and corn care should be taken not to plant either within eight feet of the young pecan trees and this distance should be increased as the trees grow older.

In the lower sections of the State, especially in Mobile and Baldwin counties, the Satsuma orange is being planted as a "companion" or inter-crop with the pecan and this is highly recommended. Some are planting figs between the pecans but this should not be done as figs will not stand deep cultivation and will eventually retard the development of the pecans.

VARIETIES FOR PLANTING.

Of the thousands of questions asked concerning pecans the greater portion concern varieties. In fact there is more to learn concerning varieties and their adaptability to environment than any other feature of the work. There are at least 150 known varieties which have been recognized to date. There are thousands of others possibly of equal merit and having local names as Seedling No. 1, etc. The National Nut Growers' Association has done a great deal to give us a nomenclature which means something. A few years ago there was a great confusion concerning pecan names but workers in the above association have obviated many of the difficulties.

There are very few people who recognize the difference in the quality of pecans but the time has been predicted when the market will call for special nuts as it now does for Baldwin apples, Bartlett pears, etc. When we realize how few people in the eastern and northern cities know what our standard pecans look and taste like that day seems far distant. Some are led to believe that size is all important. As a matter of fact the medium sized nuts generally have the sweetest meat and fill the best. The external appearances of the nut will deceive the layman but the internal qualities are more important. We find a great difference in shapes. The best fillers are usually blunt at the ends with no space which cannot be utilized by the kernel. There are exceptions and one or two of the best nuts on the market have their ends drawn out to a point.

The nuts which produce 60 per cent kernel have from 60 to 80 nuts to the pound. These statistics have been gathered by the U. S. Department of Agriculture. Very few of the large varieties running about 40 to 50 to the pound yield over 50 per cent kernel.

Another distinguishing feature is the cracking quality. The ideal nut of some growers is one having as thin a shell as the San Saba, an excellent pecan grown in Texas. The term Papershell or Eggshell pecan is given to most any nut which can readily be cracked in the palm of the hand. Where the variety cannot be determined this term is often given and causes considerable confusion to those interested in proper nomenclature. From the statistics gathered by the U. S. Department of Agriculture on the pecan in Alabama about 18,000 trees were classed by the growers under the general term "Papershell." Without personal inspection of the products of these trees we are little better off than had the owner placed in the list "Variety Unknown." The following list of varieties is noted in the various counties of Alabama. The numbers after the varieties represent the counties in which they are growing, the list of which is given below the variety column.

Varieties.

Admiral Dewey, (2 and 19).
Alley, (2).
Bolton, (2).
Delmas, (19, 27 and 23).
Centennial, (2,21).
Capitol, (23).
Columbian, (3, 31, 33, 40 and 53).
Crawford, (2).
"Eggshell," (33).
Frotscher, (2, 19, 27, 31, 33, 40 and 52).
Georgia, (2, 27, 31 and 33).
Mammoth, (2).
Mobile, (23 and 53).
Money-maker, (2 and 33).
Pabst, (2, 3, 21, 31 and 33).
"Papershell," (1, 2, 4, 10, 11, 12, 14, 15, 16, 18, 19, 21, 26, 31, 37, 37, 40, 42, 48, 52, 53).
Roosevelt, (31).
Russell, (3, 21).
Schley, (2, 3, 19, 27, 31, 33, 48, 50 and 52).
Senator, (2).
"Soft Shell," (35 and 41).
Stuart, (1, 2, 3, 15, 19, 21, 27, 31, 33, 50 and 53).
Success, (33).
Taylor, (21).
Van Deman, (3, 21, 31, 33, 50 and 53).

Counties.—1, Autauga; 2, Baldwin; 3, Bullock; 4, Butler; 5, Calhoun; 6, Chambers; 7, Cherokee; 8, Chilton; 9, Choctaw; 10, Clark; 11, Clay; 12, Coffee; 13, Conecuh; 14, Coosa; 15, Covington; 16, Crenshaw; 17, Cullman; 18, Dale; 19, Dallas; 20, DeKalb; 21,Elmore; 22, Escambia; 23, LaFayette; 24, Franklin; 25,Greene; 26,Henry; 27, Houston; 28, Jackson; 29, Lamar; 30, Lauderdale; 31, Lee; 32, Limestone; 33, Lowndes; 34, Macon; 35, Marengo; 36, Mobile; 37, Monroe; 38, Montgomery; 39, Morgan; 40, Perry; 41, Pickens; 42, Pike; 43, Randolph; 44, Russell; 45, St. Clair; 46, Shelby; 47, Sumter, 48, Talladega; 49, Tallapoosa; 50, Tuscaloosa; 51, Walker; 52, Washington; 53, Wilcox.

The six leading counties in pecan plantings up to the present are Baldwin, Mobile, Lowndes, Autauga, Bullock and Butler. These counties with their respective varieties and number of trees follow:

BALDWIN COUNTY.

Varieties: Alley, Admiral Dewey, Bolton, Delmar, Frotscher, Georgia, Mammoth, Pabst, "Papershell," Pride of the Coast, Schley, Senator, Stuart.

Total number of trees, 41,525; of these 25,077 are grafted trees.

MOBILE COUNTY.

Varieties: Aurora, Delmas, Pabst, Russell, Schley, Stuart, Success and VanDeman. Total number of trees, 23,900; of these 22,300 are budded or grafted.

LOWNDES COUNTY.

Varieties: Columbian, Delmas, "Eggshell," Frotscher, Moneymaker, Schley, Stuart, Success, Twentieth Century, Mobile, Georgia and Van Deman. Total number of trees, 16,170; of these 13,821 are grafted.

Autauga County.

Varieties: "Papershell," grafted 1,050; Stuart and Pride of the Coast, grafted, 1,500. Unknown, 11,130. only 873 of the latter grafted. The total number of trees is 14,680.

Bullock County.

Varieties: Columbian, Stuart, Pabst, VanDeman, and Moneymaker. Total number of trees, 9,524; of these 305 are grafted.

Butler County.

Varieties: "Papershell," Total number 6,630; of these 780 are grafted. Unnamed, 1,200. Total number of trees, 7,830.

The next sixteen counties are:

Wilcox	Total No. trees,	4,675;	grafted,	1,225
Washington,	Total No. trees,	3,675;	grafted,	1,242
Macon,	Total No. trees,	2,537;	grafted,	75
Houston,	Total No. trees,	2,500;	grafted,	1,025
Montgomery,	Total No. trees,	2,200;	grafted,	150
Talladega,	Total No. trees,	1,625;	grafted,	1,268
Clark	Total No. trees,	1,600;	grafted,	1,115
Dale,	Total No. trees,	1,590;	grafted,	959
Tallapoosa,	Total No. trees,	1,340;	grafted,	12
Monroe,	Total No. trees,	1,300;	grafted,	430
Pike,	Total No. trees,	1,270;	grafted,	120
Dallas,	Total No. trees,	1,262;	grafted,	935
Covington,	Total No. trees,	1,035;	grafted,	176
Henry,	Total No. trees,	1,000;	grafted,	750
Russell,	Total No. trees,	1,000;	grafted,	223
Sumter,	Total No. trees,	1,000;	grafted,	
Total for the above 16 Counties,		29,609;	grafted,	9,705

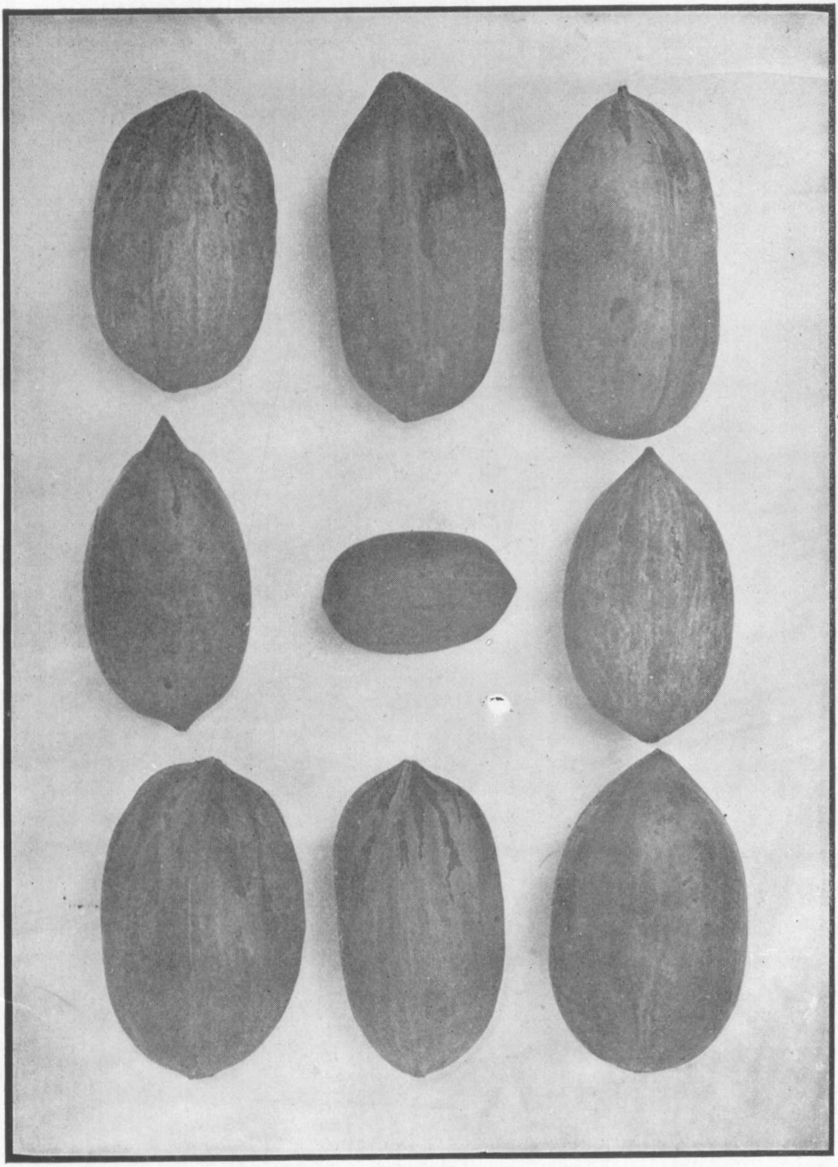

Plate VII. The varieties shown above are as follows Rows reading left to right. Top, Stuart*, VanDeman*, Columbian*, Middle row, Schley, Seedling, Russell*. Bottom row, Success, Pabst*, Frotscher. Natural size. *From Experiment Station trees. **(Photo by the author.)**

From the figures given for the six leading counties we find that about 50 per cent of the trees are standard or grafted. From these trees then we will expect to determine their adaption to their respective counties.

Taking the figures of the next 16 counties about 30 per cent of the trees are grafted or standard trees. These figures are approximate in a number of cases and the returns from the inquiry are not complete. There is a greater amount of work to be done in all the counties in gathering accurate knowledge of the habits of the various varieties. The farmer is generally too busy with other things to notice the blooming dates of pecans, age of tree when first nuts mature, etc., but these records must be obtained before recommendations can be given concerning the selection of varieties of each section of the state. A Frotscher which will bear abundantly, is free from scab, vigorous, etc., in Baldwin County may show up poorly in Jefferson County and vice versa. In choosing varieties individual tastes are to be duly considered. There is a great difference in market value and quality. As a rule a nut having the following qualities will meet a ready market: tree vigorous and prolific; nut medium and thin shelled, of good keeping quality and of delicious flavor. Note in the following tables used in scoring nuts by the National Nut Growers' Association, especially the points on which emphasis is placed.

Tree.

Vigor, 10 points; Habit, 10 points; Toughness, 10 points; Resistance to disease and insects, 10 points; Precosity, 10 points; Uniformity in Spring, 10 points; Productiveness, 40 points. Total, 100 points.

Nut.

External Characteristics: Size, 20 points; Form, 5 points; Color, 5 points.

Shell Characteristics: Thinness, 10 points; Cracking qualities, 20 points.

Kernel Characteristics: Plumpness, 20 points; Color, 5 points; Quality, 15 points.

Total, 100 points.

The nuts from seedling trees in many instances planted from the tree of a known variety under some circumstances are difficult to distinguish from the parent nut. These same trees in another locality generally appear much different and in nearly all cases inferior. With the older standard varieties many of them are found far out of the section where the first tree was found and as no records of the parent tree, in many cases, are found, it is very essential that these varieties be kept true to name in recording the locality habits. Trueness to name is of vital importance to large growers as trees failing in this may have to be top-worked which means expense and trouble later.

MARKET VARIETIES.

Characteristics. Some of these are covered with a grimy, sooty appearance which is objectionable. A shell which has a clear, clean, reddish rather than grey shell is preferable. Often dark colored streaks appear in varying lengths about the apex on many varieties and serve to distinguish them. With the present market, pecan polishing is practiced but should be discouraged. It is entirely unnatural and the pigments used are apt to cause the kernels to become rancid.

An experienced pecan grower can recognize many of the varieties by the habit of the trees and especially by the color of the bark on the twigs. For instance the VanDeman has characteristic dark wood. The disposition and appearance of the spots on the bark also distinguishes many varieties.

The Centennial was undoubtedly the first pecan to be propagated by grafting. According to Prof. Wm. A. Taylor, Dr. A. E. Colcomb took cions from the original tree in Louisiana and grafted them into 16 trees during the winter of 1846 or 1847. This was the beginning of modern pecan culture.

From the tables of varieties and counties on page 24 it will be seen that the following are prevalent: Stuart, Pabst, Frotscher, VanDeman and Schley. There are of course many fine trees in the State of the other varieties but the five mentioned prevail at present. The Stuart seems to be successfully grown over a wider territory than any of the others.

The frontispiece shows a view of eleven year old budded trees on the Experiment Station grounds at Auburn. These were set too close together and hardly give a fair test of the merits of each variety. The five varieties, VanDeman, Pabst, Russell, Columbian and Stuart are all bearing good crops but it is of course impossible to secure accurate yield records with students to keep away from the trees. Last year about 5 pounds of a complete fertilizer was applied to each tree previous to blooming time and it made a marked increase in the yield and quality of the nuts.

Cost of Trees

It pays to start with good trees if they do cost a little more. These should be secured from reliable nurserymen whose prices are generally reasonable. The cost per tree ranges from 50 cents to $2.00 according to size. The advantage in securing the higher priced budded or grafted tree over the seedling lies in the fact that with the former they will come into bearing at least within 5 years (often in 3) from the time of planting, whereas the tree from the seed will generally require from 12 to 14 years, and may never bear. Again, there is always uncertainty as to the size of the nut the seedling will produce.

The man with limited capital should begin in a small way with the best trees. He should plant seed nuts from thrifty trees to be used as stocks into which the buds or cion wood from his few standard trees can be inserted. This is a slow method, but a sure one as the grower knows exactly what to expect. A part of each year's growth of the standard trees can be cut for bud wood or cions without detriment to the trees and this surplus can be readily sold to nurserymen where the varieties can be guaranteed. Supplying this wood from excellent trees is very remunerative."

Mr. Turnipseed, of Union Springs, Ala., has been very successful with seedling trees but it is very doubtful if seeds from these trees will do as well in other locations, as they do with him. The writer agrees with Prof. Hume when he says," Plant budded or grafted pecans but if not these -------- pecans!"

Harvesting and Marketing.

There is less trouble in harvesting pecans than with most of the horticultural crops. Whatever we place on the market should appear in the best shape possible. The equipment necessary is an extension ladder, stepladder, light long poles, sacks, twine, etc. When the nuts are ready to pick the so-called cases or "burs" will open. In a cluster where one or two do not they should be thrown out. Where possible the nuts should be picked by hand as in this way very few of the fruit buds for the next season's crops are injured. There should be but one picking. In the taller trees it will of course be necessary to shake or beat the limbs. In climbing among the branches there is danger of splitting the limbs which should be avoided. It takes about two weeks for the nuts to cure after picking. To facilitate the curing the nuts should be spread out two or three inches deep on trays in a shed.

Grading. Each variety should be packed separately. With the seedling nuts where there is a diversity in size they should be graded by the use of screens. As stated before the seedling nuts are colored and polished. This should not be practiced with the standard nut. Where the nuts are mixed and it is desirable to give them a good appearance in the market they can be placed in a barrel with dry sand, the barrel being rotated until the nuts are polished.

In any market the packs containing mixed varieties or single varieties of any fruits, vegetables, or nuts, which are not evenly graded, bring minimum prices. The apple, pear, and orange growers have learned the lesson of proper grading, and packing. The same will apply to the marketing of pecans. To the average man a pecan is a pecan, regardless of size, shape or color. This being due to the fact that hardly one man in 2,000 in the United States has ever eaten a standard Southern grown pecan. In Chicago the market recognizes certain varieties of pecans, but up to the present has not discriminated as to the standardization of the leading varieties. There is a wide variation in the size of the standard varieties in different localities. Wholesale dealers find it impossible to secure uniformity, even in single varieties, which indicates that the time will soon come when standards and regulations will be formulated as is now practiced in the Apple Growers' Association.

MARKETING. The seedling nuts from Texas are generally shipped in sacks but these are unsatisfactory as they do not thoroughly protect the nuts. The best plan is to use solid wooden boxes made to contain a definite number of pounds of nuts. A convenient size would be a box holding ten pounds. In filling the boxes with nuts care should be taken to have them shaken occasionally so that the box can be filled solid. At present the finer nuts fill a private market and these packages vary in weight from one to five pounds. Paste-board boxes can be safely sent by express when wrapped in heavy wrapping paper and tied securely.

The grower's name should be stamped on the package. With the proper package and the same standard of excellence in the variety of nuts shipped each year the grower is assured of a steady customer and generally the reputation of the grower is passed on to other prospective customers and so the grower's trade will increase.

As previously stated private orders consume the present supply of standard nuts and will continue to do so for some time. The varieties bringing from fifty cents to a dollar per pound are found on the tables of some of the first-class hotels in the East. However the time is not far distant when a portion of the larger cities will learn the value of the large nuts and keep the growers busy supplying this market. When the home market is supplied we still have the European market open. The pecan is a distinctly American product and gives us a world market.

There will always be two market classes, namely, the wealthy buyers and those of moderate means. A certain standard of excellence will always find the former market profitable. The time is not far distant when the general public will be willing to pay a fair price for the better grade of nuts.

Mr. T. W. Oliver, of Montgomery, the past season recieved thirty cents per pound, wholesale and fifty cents per pound retail. The variety of nuts that he is growing is the Stuart. Although some of the better nuts are bringing the growers as high as a dollar and a dollar and a half per pound the prices will not prevail outside of the private market. However, there will be a good profit if the nuts sell at only twenty cents a pound.

Most of the varieties can be stored for a considerable time without deteriorating. Pecans for seed purposes where the grower is experimenting to establish new varieties, generally bring fancy prices. The seedling Texas pecans bring from eight to fifteen cents a pound. The pecans grown locally generally sell at from fifteen to twenty cents a pound.

TIME OF BEARING AND YIELD.

With the seedling tree especially we find that they are often intermittent bearers, i. e., irregular bearers. In Texas the main crop is heavy about every third year. The standard varieties often have better years than others. There are several reasons for this. Frosts may occur at the blooming period, also heavy rains and high humidity may prevail at the same time. If the trees pass through a drought all the energy is necessarily directed to the maturing of the present crop. The formation of buds for the next season's crop must suffer. The pecan demands a constant, regular supply of moisture and without it we must expect irregular crops. Some years the insect pests are more troublesome than others.

Ninety per cent of the trees which fail to mature profitable and regular crops may be traced to the selection of improper varieties, to trees improperly planted, and to the trees being improperly cared for after planting.

Judge Miller, of Talladega, Ala., planted a Schley tree in his yard and the third year it bore 80 nuts. When four years old it bore 200 nuts. The tree was between 3 and 4 feet high when set out.

A Mississippi grower has found that a tree averages the following yields:

6 year old	3 lbs.
8 year old	11 lbs.
10 year old	25 lbs.
12 year old	45 lbs.
14 year old	65 lbs.
15 year old	80 lbs.
20 year old	125 lbs.
25 year old	150-300 lbs.

The pecan will come into bearing as early as the apple orchard and remain in bearing twice as long.

The question is often asked, "How long must I wait before my pecan orchard will bear a commercial crop?" It will take from 8 to 12 years. There is a Mobile tree on record which produced 20 1-2 lbs. the fifth year after planting. Much depends on the variety, the soil and its treatment and the management of the orchard.

A tree from 4 to 6 years old comes into bearing and from 8 to 10 years will be profitable and between the ages of 12 to 15 years should bring a net income of $100 per acre. Ten to twenty-five acres of pecans should produce a good living. One or two hundred trees properly cared for and planted on congenial soil will be far more profitable than ten times as many trees not properly cared for.

Mr. J. B. Wight, of Cairo, Ga., planted a Frotscher in 1892 and in its sixth year bore 10 1-2 lbs., 10th year 45 lbs. and in 1908 bore 169 lbs. There is generally considerable profit in selling the bud wood of these prolific trees. The regular crop from the above tree wholesaled at 50 cents per pound and retailed at 75 cents.

Prof. H. K. Miller of Monticello, Fla., owns a Schley which bore in its fifth year 60 nuts, the seventh 5 lbs., and practically 15 pounds in the eighth year. He states that one eight year Delmas bore eight pounds of nuts and in the ninth year bore 15 pounds.

Budded and grafted trees have made the following record of yield:

5th year	10 lbs.
6th year	15 lbs.
7th year	25 lbs.
10th year	50 to 100 lbs.

CRACKING THE PECAN.

For table use the pecan is readily cracked and the kernels extracted with the use of the common two handled cracker which can be secured at the stores for 25 and 30 cents a piece. By grasping the pecan firmly in the hand and crunching down on the ends of the pecan snip off these ends first. Then place the nut longitudinally in the cracker and just press sufficiently to crack the shell. Then turn the nut and crack it once more. When this is practiced a few times there will be little difficulty in removing the kernels either whole or in halves. For candies, cake, etc., the housewife will find this method a great time saver. In snipping off the ends care should be taken not to endeavor to remove too much shell as in a well filled nut the ends of the kernel will be broken, spoiling the appearance of them. It is better to take a little time and not try to get into the tempting kernel too quickly. Cracking the nuts in the hands or placing them in the cracker either sidewise or length-wise generally results in picking out irregular shaped pieces which taste just as good but are unfit for the candies.

A well filled nut is less apt to retain the "peel" which tastes so bitter. This clings to the sutures of the poorly filled nut and helps to score against it.

There are numerous devices for extracting the kernels of pecans, one of which is a small vice with cup shaped caps. The pressure on the nut generally splits the shell in the center and the two halves are pulled apart. With some varieties this device works very well.

THE PECAN AS AN ORNAMENTAL TREE.

The pecan tree has a habit of growth which clearly distinguishes it from other trees. It attains considerable size, lives for a number of years, is symmetrical, of clean upright habit and with a clean straight trunk. The branches are strong and grow well up from the ground. The forking is wonderfully graceful and even in winter the sharp lines of the trees are prettily silhouetted against the sky. In summer the compound leaves are so light and airy that grass can readily be grown under the trees. Even in a light breeze the leaves tremble and wave while others fail to notice the slightest air current. This movement of the leaves tends to console the person suffering from heat as he realizes that some air is moving.

The merits of the pecan tree in the home yard are unquestioned. It affords not only pleasure to the children who love to climb but furnishes an abundance of delicious and nourishing food for them in the fall. The leaves do not drop until very late in the season and make a very small quantity of litter.

As a street tree the pecan should prove very valuable. As stated before it is an erect and handsome grower and makes a more pleasing shade tree than many we now find in such a bad state of decay. For shade the seedling trees should be planted at least 50 feet apart. When these mature, there is danger of course of their being injured by boys trying to knock off the nuts. With the rapid strides now being taken to inspire "young America" with a love for the beautiful, it is doubtful if the thoughtless boy will be a great menace to even nut trees for shade, in ten to fifteen years to come.

Every school yard in Alabama should have pecans growing in it. Here again the seedling trees serve the purpose as the object in view is shade, not commercialism.

REASONS FOR PLANTING PECAN TREES.

A good plantation is a most valuable piece of property to either transfer or to hand down to posterity. The man who plants the trees may not have in consideration their commercial value, but the prospective buyer of the property is apt to and the presence of the trees add hundreds of dollars to the valuation of the farm or plantation.

Practically every Alabama farmer is planting cotton and expects to keep up the growing of cotton until the boll weevil or some other pest drives him out of it. Why should he not plant an acre or two in pecans and continue to raise cotton under the young trees until they come into bearing? Cultivating his cotton will cultivate his trees. He can well afford to cease cotton growing in that acre of pecans in eight or ten years and from then on he will have a permanent income from the pecans without the annual labor the cotton requires. This pecan orchard tends to settle the farmer who is wont to travel about. He sees in a bearing orchard some income for his declining years. The great difficulty with the farmer is to impress him with the fact that it is not necessary to wait such a long time as he generally believes is required for the pecans to come into bearing. In the majority of recent home pecan plantings it has been the seed and not the budded or grafted tree that goes into the ground. Quick results cannot be expected from seedling trees.

The crop takes care of itself as well as any. It is easy to ship and has very little risk of loss when placed with the transportation company.

PECANS AS AN INVESTMENT.

Mr. J. B. Wight, of Cairo Ga., in a paper read before the National Nut Growers' Association at Chattanooga in 1908, stated, "There is money to be made in pecan growing when judiciously conducted in a business-like manner. I do not know a more attractive field in the realm of Horticulture. The farmer or land owner living anywhere in the pecan belt who fails to grow enough nuts for his own use and also some for market, is neglecting his exceptional opportunity----the pecan proposition when properly handled is in itself attractive enough without any extra touches of rainbow coloring to set off the picture."

"Are pecan investments safe? Is gold mining a paying proposition? That depends. Thousands may be made in each and thousands lost. What will be the result in any particular case? Returning to a former figure, the man at the wheel, the personnel of the crew, and the seas traversed determine all."

The above places pecan growing fairly and squarely before the planter. It is more often the man who plants and cares for the trees that decides success than the trees, soil, etc. There is much exaggeration by speculators concerning the profits in pecan raising. Many of the recently formed companies are organized by men of integrity. At the same time there are others, as in all industries, who are after "all there is in it." The public simply invests the money and the directors fatten their pockets. Among the former companies will be found men whose faith in the business adds a great deal to its stability.

Figures taken from Mr. Wight's paper which have been estimated and stated as "prospective rather than actual, so far as the income is concerned," show that good land set in vigorous budded or grafted trees at the end of the first year is worth $100.00 an acre.

At the end of five years____$300.00 per acre.
At the end of ten years_____$550.00 per acre.
At the end of fifteen years__$800.00 per acre.

Net income per acre at end of 10th year, 8 per cent, or $44.00.

Net income per acre, end of 15th year, 8 per cent. or $64.00.

Net income per acre, end of 20th year, 8 per cent. or $85.00.

The value of the last being per acre $1,050.00.

As Mr. Wight states, the above figures are conservative and can be expected only when all conditions of orchard management are properly and carefully watched.

PECAN INSECTS.

Prof. H. A. Gossard, formerly State Entomologist of Florida, in Bulletin No. 75 issued from that Station in 1905 gives a full description of the more important insects affecting the pecan.

Another valuable work on "Insects Injurious to Pecans" has been prepared by Professor Glenn W. Herrick, Bulletin No. 86 of the Mississippi Experiment Station.

Among the more important insects mentioned and described by the above authors are the following:

PECAN BUD MOTH. (*Proteoptery deludana*, Clemens.)

According to Prof. Chittenden of the Bureau of Entomology there are more inquiries concerning this insect than any other attacking the pecan. The caterpillars are usually yellowish or pale greenish, with dark heads and are generally known as bud worms. The adult stage is not well known to Entomologists.

The insect feeds on buds, tender twigs and leaves, according to the season and there are two or three gener-

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Much of the above material has been noted by Prof. F. H. Chittenden, U. S. Department of Agriculture.

ations each season. Sometimes they roll the leaves into tubes of regular sizes.

Treatment. Spray with arsenate of lead when it first appears in May. The spray should be applied before the insect can conceal itself in the buds. The "man next door" should also be induced to co-operate in the spraying. As the larvae also attacks walnuts and other trees these should also be sprayed. With plenty of time at hand Prof. Herrick's method of daily inspection of buds and the removal of insects on a pin point is efficient. The lime-sulphur wash promises to control this insect if applied during the dormant period, from December to a few weeks before the buds start.

PECAN GIRDLER. (*Oncideres texana.*)

There are two other "girdlers" or "pruners" but this one is important especially in the South. Twigs affected by this insect appear to have been sawed, the outer portion remains hanging on the tree for some time as it is on this that the female beetle deposits her eggs and when they fall the process of pupation commences. As the hickory girdler has similar habits both can be controlled by picking up the fallen branches and pruning those which hang on the tree, from such food trees as pecan, hickory and persimmon, and burning them during the winter. There have been several inquiries sent into the Experiment Station at Auburn concerning this pest.

PECAN CASE-BEARER. (*Acrobasis nubellela,* Riley.)

There have been two species of these found on pecans. One is often called the bud-worm as it attacks the leaf and flower buds. Its larva constructs a tube about its body consisting of its excrement, bark, etc., this material being joined together by silken threads. It carries the case with it, an aperture being left through which the insect pushes its head to feed.

Treatment. Prof. Gossard recommends spraying with lime-sulphur wash to which an arsenical poison has been added, applied in March and April, when the buds are opening.

The second species constructs cigar shaped cases and no doubt have often been observed on the limbs or trunks of trees. These have been found on the trees in the orchard at Auburn. It should be treated as the preceding.

ROOT BORERS.

These various grubs feed on dead or dying wood and two bettles of the genera Malodon and Prionus have been found on the pecan roots. Care should be taken to have the pecan orchard clear of stumps.

APPLE TWIG BORER. (*Amphicerus bicaudatus*, Say.)

This insect breeds generally in dying wood and the beetles bore into the twigs, usually about a bud or leaf scar, and continue straight to the center, where they form a cylindrical burrow an inch or more in length.

Treatment. Cut the infected twig below the point of attack and burn the cut portion immediately.

PECAN TREE BORER. (*Sesia scitula*, Harris.)

This insect resembles the peach tree borer. It very seldom attacks trees less than two inches in diameter, and seldom penetrates deeper than the sapwood. The borers generally enter the trees where they have been injured or budded.

Treatment. Cover denuded portions of the bark with grafting wax and put some around the buds also, just before the moths begin their flight. They should be gouged out with a knife when possible and a stiff wire run into the hole is also effective.

FALL WEB WORM. (*Hypantria cunea,* Dru.)

The brownish webs which appear during the summer are perhaps better known than the larvae which do the damage. In one large orchard the writer has visited a man goes among the trees on horseback and clips off the webs each week or so and destroys them. A ball of cotton waste wrapped to the end of a long pole, saturated with kerosene and ignited will destroy the webs. The arsenical sprays are effective.

PECAN HUSK WORM. (Gather infested nuts and destroy them.)

WALNUT CURCULIO. (Early spray of Paris Green Hogs will destroy the fallen nuts.)

The above list of insects should not discourage the prospective planter as the pecan, relatively speaking, is much freer from pests than most of our fruits. There is no insect affecting the trees as bad as the San Jose Scale which should be very consoling to the peach grower.

PECAN DISEASES.

Scab. Some varieties are more susceptible than others and when it shows up badly in an orchard the trees should be top-worked to a more resistant variety.

Scab causes circular black spots on the leaves which fuse together. It also attacks the young twigs. It appears to attack the trees worse which are in low ground and is most injurious during very wet seasons. There has not been enough work done to determine the best dates for spraying. The difficulty arises in the irregular blooming causing several sprayings to be necessary in a mixed orchard. As there are some varieties more susceptible than others in different locations it is hoped that the occurrence of this will be noted to enable further investigation and the information sent either to the Horticultural or Botanical Departments at the Experiment Station at Auburn.

WINTER KILLING.

Trees which have a thick rough bark generally escape from this. It has been avoided by planting seedlings in bottoms and top working them when 5 inches in diameter. Four-inch trees do not winter kill. In trees in which the sap rises first there is the greater danger.

FROZEN SAP BLIGHT.

This term has been applied to the injury done by frost to one year grafts. Generally a dead spot appears in the trunk of the trees. Three and five year trees are killed by this freezing. These four to six inches in diameter generally stay dormant. In grafted trees buds have been successfully inserted about one foot above the ground which is above the spot.

ROSETTE.

This is undoubtedly the result of an unbalanced condition of the tree which is not able to properly assimilate its food. It is not a bacterial disease as plant pathologists have never been able to inoculate the germs into an uninfested tree successfully. It is found in both wild or native trees and the budded and grafted varieties. It has occurred recently in the Russell tree on the Experiment Station grounds.

In appearance it resembles a minature shrub rising from the branch of the tree. The stems and leaves in the cluster are small and delicate.

A double handful of Copper Sulphate applied about the base of a tree one inch in diameter has corrected the trouble in one instance and further trials should be given this treatment.

VARIETIES RECOMMENDED.

The following descriptions have been made by the Bureau of Plant Industry, Washington, D. C., except as noted.

ALLEY.

The original tree of this variety was grown by Mrs. C. H. Alley, of Scranton, Miss., from a pecan of unknown variety presented to her by the late Col. R. Seal, of Mississippi, in 1871. This nut she planted in a box the same fall, transplanting the young seedling that resulted therefrom to its present location in her garden in 1872. The tree began bearing at the age of about nine years and has the reputation of being a steady and prolific bearer. The variety was first propagated by Mr. F. H. Lewis, of Scranton, who set buds and grafts of it in 1896, and since that time it has been considerably disseminated by him and others under the name Alley. The original tree bore about 200 pounds of nuts in 1905, and had a fair crop when the storm of September, 1906, occurred. This destroyed a considerable portion of the crop and broke several large branches from the tree, though not enough to permanently injure it.

DESCRIPTION.

Size medium, averaging 60 to 80 nuts per pound; form, oblong to ovate conical, with moderately sharp quadrangular apex; color, bright yellowish brown, with rather long and conspicuous black markings; shell brittle, thin; partitions very thin; cracking quality excellent; kernel plump and well filled out, though deeply grooved and considerably undulated and irregularly indented; kernel bright, brownish straw color; texture firm and fine grained; flavor sweet, and free from astringence; quality very good.

The tree is moderately strong, though rather slender, grower and is reported to be productive in several localities where it has been top-worked during the past five or six years.

The nut is a little larger than the Schley and about the size of the Stuart. It appears to be prolific and an early bearer in Baldwin county. It is a good keeper.

CENTENNIAL.

So far as ascertained, the Centennial is the first variety of pecan that was successfully propagated by budding or grafting. It was also the first variety planted in commercial orchard form, with a definite view to producing nuts for sale, and one of the first three to be catalogued and offered for sale.

Two of the earliest grafted Centennial trees, above referred to, are still standing at Oak Alley, La. They were thrifty, productive, and in fine condition when inspected by the writer* in the autum of 1902. The date of their grafting by the slave Antoine (1846 or 1847), under Doctor Colcomb's direction, marks the beginning of modern pecan culture.

*Wm. A. Taylor, United States Department of Agriculture.

DESCRIPTION.

Size large, average nuts running about 45 to 50 to the pound; form long, compressed cylindrical, gradually tapering to the wedge-shaped apex; base conical; color bright grayish brown with rather scanty purplish splashes toward the apex; shell rather thick, partitions thin; cracking quality medium; kernel clear, reddish yellow, deeply and narrowly grooved, but quite smooth and separating easily from the shell; plump, solid; of delicate texture and flavor, quality very good.

The Centennial tree is a rather slender grower with grayish green young wood sprinkled with small light dots. It becomes pendulous as it attains age, and is on this account one of the handsomest varieties for parks or large lawns. It is slow to come into bearing, but appears to be a fairly regular cropper after attaining an age of above 15 years from bud or graft.

It is not being propagated to any extent at present.

COLUMBIAN.

(PRIDE OF THE COAST.)

This variety has been discarded. It is a poor bearer and has a thick shell. It is also a poor filler. However, it is a favorite specimen for the unscrupulous tree agent as its size appeals to the uninformed.

CURTIS.

(Synonym: Curtis No. 2.)

The original tree of this variety was grown by Dr. J. B. Curtis, of Orange Heights, Fla., from a nut of the "Turkey Egg" pecan obtained from Arthur Brown, of Bagdad, Fla., in 1886. It was first propagated by Dr. Curtis in 1896, and was disseminated by him somewhat later. The original tree, though heavily cut for cions, yielded 80 pounds of nuts in 1905.

DESCRIPTION.

Size medium, 60 to 70 nuts per pound; form ovate conical, compressed, with a sharp pointed base and an inclination to curve near apex; color bright, with very few black stripes, but sparsely stippled with black over most of the surface; shell very thin and brittle; partitions thin; cracking quality good; kernel very plump and thick, free from indentation other than the narrow grooves, which are of medium depth; color bright, except brownish stippling that perceptibly darkens the tint in some specimens; texture firm, crisp; flavor sweet and rich; quality very good.

The tree is reported to be slender and rather pendulous in habit of growth and regularly productive. The variety is of special promise for Florida growers, as it is one of the few sorts that have originated and been thoroughly tested in that State. It is reported to be rather hard to propagate, the wood being slender and the buds not numerous. Doctor Curtis reports it free from attack by the bud worm where such sorts as Rome and Centennial are badly damaged by it.

One of the best table nuts. It is reported free from Rosette. One of the best keepers. The variety should be tested in Alabama.

DELMAS.

The original Delmas pecan tree was grown from a nut planted by Mr. A. G. Delmas at his place at Scranton, Miss., about 1877. It was propagated in a limited way by Mr. Delmas about 1890 by grafting both in nursery and orchard. Its general dissemination, however, appears to have occurred in connection with the "Schley" about 1902, mixed cions of the two varieties received from Mr. Delmas having been grafted in the Pierson nursery, at Monticello, Fla., and disseminated under the name Schley before the admixture was discovered. The wood of the Delmas is so much stouter and more erect

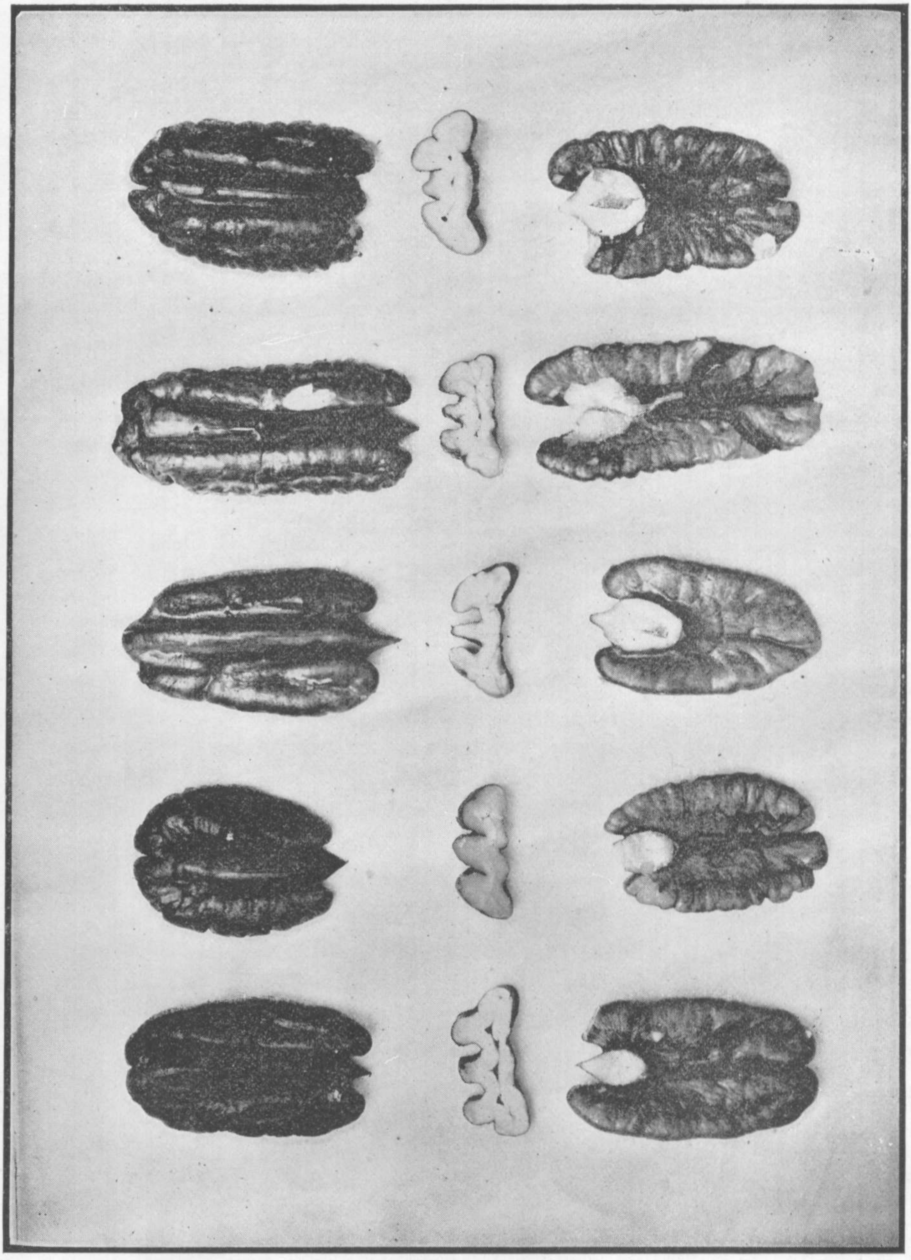

Plate VIII. This shows kernels from the following nuts: Reading from top to bottom, Stuart*, Centennial, VanDeman*, Russell* and Pabst*. Actual size. *Taken from Experiment Station nuts. (Photo by the author.)

than that of the Schley variety that little difficulty is experienced in separating them even in the nursery row.

DESCRIPTION.

Size large to very large, averaging 40 to 50 nuts per pound; form oblong ovate, rather pointed at base and rather bluntly quadrangular at apex; and distinctly marked by four conspicuous ridges extending from the apex nearly to the base of the nut; color grayish brownish, sparingly marked with black; shell rather thick, with partitions soft but corky; cracking quality good; kernel plump and well filled, grooves rather narrow, but shallow, and surface undulating; kernel bright straw color, very attractive; texture rather soft and open; flavor sweet, pleasant; quality good.

The tree is a strong grower, of erect and roundish head, very distinct from the Schley, with which it has been somewhat mixed in nurseries and orchards. It is productive and promising from the lower pecan districts, such as the Gulf Coast region, where it originated.

Tendency to scab in some localities. It is recommended for commercial orchards owing to its cracking quality and size. It is rather difficult to propagate. It is a good bearer—early and is showing up well in Baldwin county.

DEWEY.

Medium to large, ovate pointed; color dull gray and marked with slashes of purplish brown; base rounded; apex sharp; shell brittle and thin; cracking quality very good; partitions thin; kernel full, plump, smooth, light straw colored with narrow sutures of medium depth; texture firm and solid; flavor sweet, rich, good; quality very good.*

This nut originated a few miles south of Monticello, Fla. It is a very promising variety. The growth of the tree in the nursery and orchard is not entirely satisfactory.

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*Described by H. H. Hume.

FROTSCHER.

(Synonyms: Eggshell, Frotscher's Eggshell, Oliver, Majestic.)

This variety was originated by the late Oscar Oliver in his garden beside the Bayou Teche at Olivier, Iberia Parish, La. The original tree, now owned by H. J. Pharr, is still healthy, vigorous, and productive. Its exact age is not known, but the indications are that it was planted subsequent to 1860. It appears to have been first propagated about 1882 by William Nelson, and first catalogued by the late Richard Frotscher as "Frotscher's Eggshell," in 1885. Locally it is still known as the "Olivier" pecan, in honor of its originator.

DESCRIPTION.

Size large, averaging about 45 to 50 nuts per pound; form cylindrical oval with broad, rounded base and blunt quadrangular apex; suture rather indistinct; color bright yellowish brown, with scattered purplish black splashes toward apex; shell thin to very thin, with thin partitions; cracking quality excellent; kernel brownish yellow, often shrunken, showing dark veins even in the fresh nuts; texture rather dry and coarse; flavor pleasant; quality medium.

The tree of Frotscher is a strong grower, of broadly spreading and sprawling habit, the young wood bright brownish green in color and conspicuously dotted. The variety is precocious and productive, but the faulty character of many of its kernels and their stale appearance, even when perfectly fresh from the tree, materially lesson its value as a commercial variety.

The tree characters of Frotscher are quite clearly reproduced in its seedlings, and, as many of these have

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*Described by H. H. Hume.

been planted throughout the South, there is much confusion regarding the variety. It has been successfully planted in many different localities.

MOBILE.

This variety undoubtedly originated at Bayou Labatre, Ala., about 1887, and was first propagated in 1900. The tree is a very heavy bearer and clusters of eight nuts are often found. It develops faulty kernels in the vicinity of the parent tree and should not be planted too heavily without further trial. The nuts weigh in some cases as high as 24 to the pound.

Large, long, slender, slightly constricted, near the middle, pointed sharply at both base and apex, the latter rather long; color bright light brown, with dark purplish black markings; shell thin, easily cracked; partitions thin; kernel slender, under some conditions not well filled, sutures deep; color light uniform yellow; texture fine grained, crisp, flavor sweet and nutty, quality good.*

MONEY-MAKER.*

Size medium, ovate oblong; light yellowish brown with a few purplish brown marks about the apex; base rounded; apex abruptly rounded, slightly wedged; shell of medium thickness; partitions medium thick, corky; cracking quality good; kernel full, plump, broadly oval; sutures straight, broad, shallow, texture firm, solid; sweet, good; quality very good.

The principal objection to this variety is its hard shell. The size of the nut varies considerably in different localities. It is considered a good bearer.

PABST.

The Pabst is a splendid bearer and was first propagated by Mr. Charles E. Pabst, of Ocean Springs, Miss., in 1890.

The nut is of large size, averaging about 45 to 55 nuts per pound; form short, cylindrical, with a very blunt, broadly grooved apex; color dull gray, heavily splashed with purplish black; shell thick, hard; partitions rather thick, cracking quality medium; kernel plump, smooth with broad grooved, bright straw color; texture fine; flavor delicate; quality very good.

This variety is recommended not only for the pecan belt but for the more northern plantings.

The tree is very sturdy, upright, with stocky gray green young wood, sparsely sprinkled with large dots.

The Pabst has been quite generally planted in Alabama and adapts itself to a wide range of territory. Its rather thick shell is its only fault.

Recommended by the author.

RUSSELL.

The Russell pecan tree, like all others at Ocean Springs, Miss., was grown from planted nuts, that locality being below the native range of the species in that section. This tree was one of a lot of seedlings grown by the late Col. W. R. Stuart, of Ocean Springs, Miss. Mr. Charles E. Pabst first propagated it in 1894. The tree is a fairly regular bearer, averaging about 150 pounds of nuts per annum, and, though receiving little care or attention, is a healthy, vigorous tree at present writing. It has attained a high local reputation on account of its exceptionally thin shell and regularity of bearing. Rather late in maturing its crop in many places.

DESCRIPTION.

Size medium to large, 55 to 60 nuts per pound; form compressed, oval, tapering to a long, sharp apex and a rather pointed base; color grayish brown, with narrow splashes and spatters of purplish black; shell very thin, partitions very thin and fragile, cracking quality excellent; kernel broadly grooved, rather dark straw color, often lacking in plumpness and defective at tip, texture rather dry, flavor pleasant, quality good.

The tree is rather pendulous in habit, with slender, dark, conspicuously dotted young wood, bearing regularly and well, so far as tested.

SCHLEY.

This variety is a seedling of the Stuart. It was grown by Mr. A. G. Delmas of Scranton, Miss. The seed was planted in 1881 and the original Schley tree still stands on his grounds. Sometimes this nut is called the "Admiral Schley."

It is medium sized to large, quite variable, ranging from 45 to 69 nuts per pound; oblong conic to long obvate, with conical apex; color golden brown with a few purple splashes toward apex; shell very thin, partitions thin and brittle, cracking very easily; kernel long, slender, bright, rather deeply and narrowly grooved, but releasing so easily that the entire kernel can readily be removed without mutilation; texture fine grained; flavor delicate, sweet rich; quality very good.

The slenderness of the kernel is objectionable from the confectioner's standpoint. The crop is quite variable as to quantity and the nuts vary considerably in size and form. The original tree which is twenty-five years old bore 125 pounds of nuts in 1905. It shows great promise and should be thoroughly tested in districts bordering the Gulf of Mexico.

There is an occasional tendency for the nuts to get out of shape and in extremely dry seasons the nuts often curl. However, faulty nuts are never found.

Recommended for Alabama.

STUART.

(Synonym: Castanera.)

The original tree of this which is generally considered the most widely successful pecan variety yet introduced and tested, stood in a garden at Pascagoula, Miss., now owned by Captain E. Castanera. It is supposed to have been brought from Mobile, Ala., and planted in 1874. It was first propagated by Mr. A. G. Delmas, of Scranton, Mss., who cut cions in 1886. Out of sixty grafts inserted he secured one tree which still survives in his garden. Mr. Kellar then associated with Col. W. R. Stuart of Ocean Springs, Miss., secured cions from the tree about 1890 from which trees were propagated by them in their nursery. About 1892 Colonel Stuart offered these for sale under the name Stuart. It is undoubtedly one of the most widely disseminated varieties throughout the South.

Size large to very large, averaging about 40 to 50 nuts per pound; form cylindrical, slightly compressed, rather blunt apex and rounded base; color brownish gray, splashed and dotted with purplish black; shell moderately thin; partitions thin and fragile; cracking quality very good; kernel bright, moderately smooth, plump, rather narrowly grooved; texture firm, fine grained, solid; flavor delicate, rich; quality very good.

The Stuart is generally uniform in size and quite plump but the shell is rather thick and it is difficult to remove the kernels without mutilating them.* This fact has caused some of the nurserymen to restrict their stock of this variety.

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* The Bureau of Plant Industry at Washington treats such nuts as Stuart as follows where a number are to be cracked. Allow them to soak in water 10 to 12 hours. Dry them under an electric fan for about 15 minutes. This toughens up the kernels and about 90% of them can be removed whole.

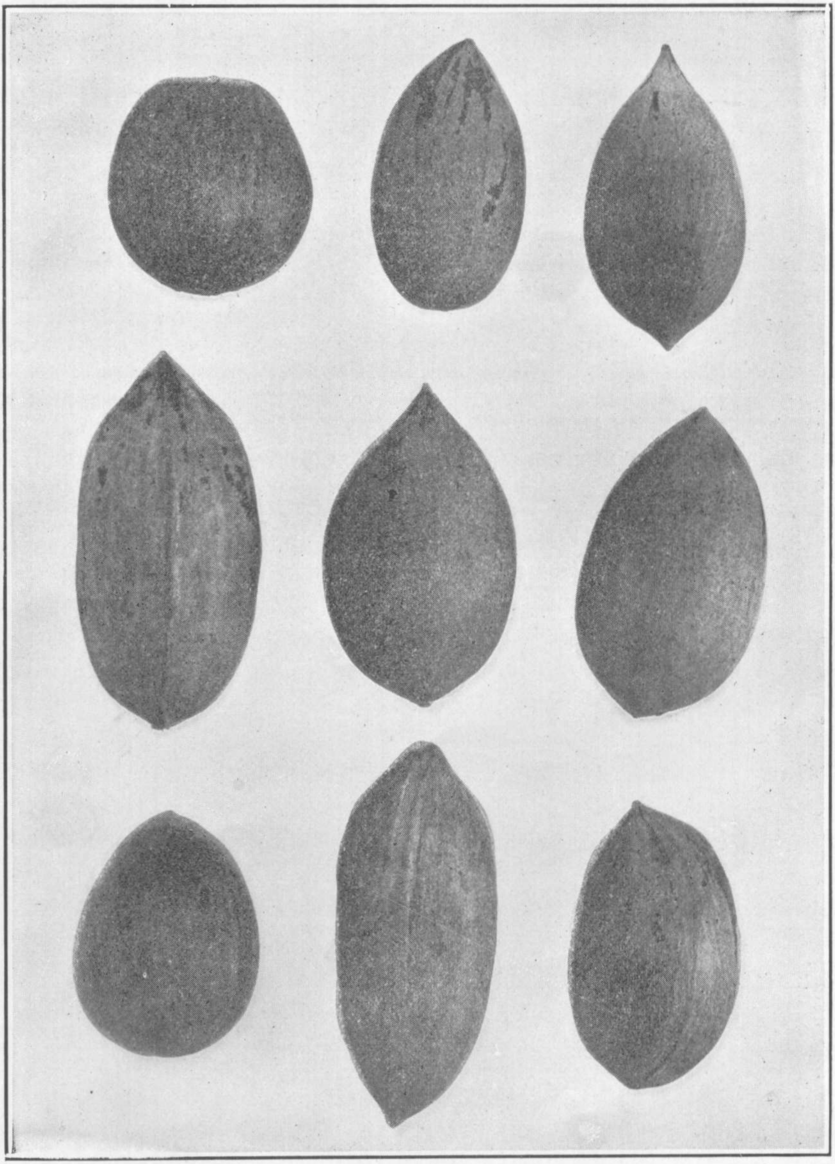

Plate IX. The varieties shown above reading from left to right are as follows: Top row, Halbert, Teche, Curtis. Middle row, Nelson, Delmas, Alley. Bottom row, Moneymaker, Mobile and Capitol. (Photo by Author.)

A strong point in favor of the Stuart is the fact that it puts out its foliage late in the spring.

The tree of Stuart is a strong, upright, spreading grower, with moderately stout young wood, grayish green in color, rather sparsely dotted with oval dots. It is proving regularly and abundantly productive in most localities where it has been fruited and is apparently succeeding over a wider climatic range than any other sort thus far tested.

Recommended for planting in Alabama.

SUCCESS.

The original tree of this variety is standing at Ocean Springs, Mississippi. Mr. Theo. Bechtel was the propagator of the variety which was introduced by him in 1903.

DESCRIPTION.

Size large, running 45 to 50 nuts per pound; form oblong, with rather sharply conical base and blunt apex; color grayish brown, with rather heavy purplish stripes, especially toward the apex; shell of medium thickness, with moderately thick partitions and fair cracking quality; kernel roundish oval, plump, bright, somewhat flaky in texture, but of pleasant flavor and very good quality.

It resembles Pabst especially in habit of growth and at the apex of nuts.

Recommended for planting in the lower portion of the State. It bears at an early age and is a vigorous strong grower. Its tendency to put out its foliage a little late in the spring is a strong point in its favor.

TAYLOR.

The original tree of this variety is supposed to have been grown from a nut planted by the brother of the present owner, Miss Lula Taylor, of Handsboro, Miss., about 1885. The variety was first propagated by W. F. Heikes, of Huntsville, Ala., at his Biloxi, Miss., nursery, about 1901, and, having been named in honor of its owner, was introduced by him in 1902. Nuts of it were examined and passed upon by the committee of nomenclature and standards of the National Nut Growers' Association at Scranton, Miss., in November, 1906, at which time it received a grade of 86.06 out of a possible 100.

The original tree of the Taylor is now about 60 feet tall, with a spread of 45 to 50 feet, and a trunk diameter of about 18 inches.

DESCRIPTION.

Form long, rather slender, constricted near middle, slightly curved, with pointed base and long, sharp apex; color bright yellowish brown, with few and narrow black markings irregularly placed; size rather large, 60 to 65 per pound; shell thin, with thin and soft partitions, cracking very easily; kernel long, slender, rather deeply grooved, but plump, smooth, and releasing the shell easily; color bright yellowish; texture very fine grained and crisp; flavor sweet, nutty, free from astringence; quality very good.

Though not yet fruited, so far as known, outside of the locality of its origin in southern Mississippi, its numerous desirable qualities indicate that it is worthy of testing where other Gulf coast varieties succeed.

TECHE.

(Synonyms: "Frotscher No. 2;" "Duplicate Frotscher;" "Fake Frotscher;" "Spurious Frotscher.")

Among the budded trees of the Frotscher pecan, it has recently been discovered that there were trees of at least one other variety quite closely resembling it in wood and habit growth, but yielding a smaller and more conical nut. This sort, which reached a number of growers, including Mr. J. B. Wight, of Cairo, Ga., and Dr. J. B. Curtis, of Orange Heights, Fla., in this way has proved to be of sufficient merit to entitle it to a distinctive name. The place of its origin is not known. Acting on this supposition, the committee on nomenclature and standards of the National Nut Growers' Association, at its annual meeting at Scranton, Miss., in November, 1906, named the variety "Teche" to distinguish it from the Frotscher. As there appears to be good reason to suppose that several other varieties closely resembling Frotscher have been and still are mixed with that variety in many orchards and nurseries, the name Teche should not be indiscriminately applied to all the "spurious" Frotschers, but should be restricted in its application to the one which is here described from specimens grown by Mr. Wight on tree obtained from the Nelson nursery in 1895.

DESCRIPTION.

Size medium to large, averaging 55 to 65 nuts per pound; form long oval, compressed, tapering gradually, with the smaller specimens slightly curved near apex; color bright, light, with few broken black stripes; shell comparatively thin, but thicker than Frotscher, with which it was disseminated through error; partitions thin and soft; cracking quality excellent; kernel bright and free from the objectionable brownish veining of the Frotscher, plump and uniformly well filled, with shallow grooves; texture of meat firm, fine grained, solid, creamy in color; flavor delicate, rich; quality very good.

The tree is of more slender and upright habit of growth than Frotscher, and is reported to be fully as productive as that variety in Georgia and Florida. It is worthy of trial wherever that variety succeeds.

This variety should be given a fair trial in Alabama. It is prolific and comes into bearing early.

VAN DEMAN.

(Synonyms: Bourgeois, Dumminie Mire, Mire; Mere and Meyer erroneously; Paragon in part, Southern Beauty.)

The original tree of this variety was grown from a nut planted by the late Dumminie Mire, of Union, St. James Parish, La., in 1836. About 1877 Emil Bourgeois cut cions from it for propagation. Eleven out of twenty-two he set as top grafts succeeded. When these grafts began bearing he commenced propagating young trees for planting in orchard form and for sale to nearby planters, among whom it is known as the "Dumminie Mire" pecan to this date. A number of nuts and some cions from these grafted trees having passed into the hands of Col. W. R. Stuart, of Ocean Springs, Miss., about 1890 he renamed the variety VanDeman in honor of Prof. H. E. Van Deman, then Pomologist of the Department of Agriculture. Since 1892 it has been widely advertised and distributed under this name.

Mr. W. A. Taylor, now of the Department of Agriculture, personally inspected the original trees at Union Post Office, La., in 1902 and states that it was a beautiful, thrifty tree, measuring seven feet six inches in circumference and bearing from 200 to 300 pounds of nuts per annum.

Size large to very large, averaging from 45 to 55 nuts per pound; form long, compressed, with a rather sharp base and a long, sharp apex, often slightly curved; color rather dark, reddish brown; slightly splashed with purplish black, especially toward apex; shell moderately thin, partitions thick but brittle; cracking quality fair; kernel long, narrowly grooved, generally plump, except at tip; color bright, clean, attractive, rich; quality very good.

The tree is of a strong moderately erect habit, with grayish-green young wood showing in conspicuous dots, and is a regular and abundant bearer in the locality of its origin. It does not thus far appear to be as productive elsewhere nor to fill out its kernels as well.

The above descriptions cover most of the nuts known to be growing in Alabama. With further tests perhaps some will be thrown out but for a number of years the grower must determine for himself the varieties which seem to readily adapt themselves and produce the finest and greatest quantity of nuts on his soils.

Pecans can be grown in every county in Alabama and it is hoped that this Bulletin will create more interest in this profitable industry. Plant pecan trees either for their shade or their profits. The best nut for every county has been found and every farmer should try out new varieties and keep records of them, then in a few years we can safely say which is the best nut for each particular county.

Co-operative work along these lines is strongly urged and specimens of nuts with the form filled in under Appendix and their names should be sent into the State Horticulturist at Auburn, Ala., for recording.

APPENDIX

GENERAL FORM FOR PECAN RECORDS.

All persons owning budded or grafted trees or exceptionally fine seedling trees should keep records of them in the following way. This outline was prepared by the Secretary of the National Nut Growers' Association and where possible this blank should be properly filled in, torn out and mailed to the State Horticulturist at Auburn, Alabama, as these records will be invaluable to the State at large.

GENERAL.

1. Name of variety.
2. Place of observation.
3. Origin and parentage of tree.
4 Date of Planting.
5 General character of growth.
6. Height.
7. Circumference, 3 feet from the ground.
8. Form of top-upright, spreading or dropping.

LEAF.

1. Date of first appearance.
2. Date of full leaf.
3. Date of first falling of leaf.
4. Date of tree bare.

FLOWER.

1. Date of appearance of first male flowers.
2. Date of full blooming of male flowers.
3. Date of disappearance of male blossom.
4. Date of formation of first nuts.

1. Date of first mature nuts.
2. Date of average ripening of crop.
3. Date of last ripening.
4. Date of gathering crop.
5. Yield.

INSECT INJURIES.

1. What insects affect the limbs, trunks, leaves?
2. What is the extent and character of the damage?
3. What fungus diseases affect the tree?
4. What is the character and extent of the damage?

CLIMATIC CONDITIONS.

1. Frosts—date of occurrence at or after blooming.
2. Frosts—date of occurrence before ripening of fruit.
3. Rainfall, by months.
4. Temperature, maximum and minimum, each month. This can be supplied from nearest Weather Bureau station.

SOIL AND DRAINAGE.

1. Character of surface soil.
2. Character of the subsoil.
3. Lay of the land, flat, sloping or hilly.
4. Exposure.

5. Proximity to streams or ponds.

6. Depth to ground water, as indicated by average water of near by wells.

OTHER CHARACTERISTICS.

1. Date after permanent planting that tree bore first nuts.

2. Is the tree a regular or irregular bearer?

3. Is the tree solitary? If not, how near to other trees?

4. Does the nut part easily from the husk?

5. Fertilizers—kind, amount, when applied?

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

PEACH GROWING IN ALABAMA

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AND

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PEACH GROWING IN ALABAMA

Peaches can be grown with success in practically all parts of Alabama, certain sections being particularly well adapted to their culture. The average fruit grown in this State has fine flavor and a good appearance, and is of exceptionally good shipping quality; the latter point being most important, as it is a difficult fruit to handle.

Few fruit bearing plants are less particular about the soil in which they grow, and few will yield so much fruit in proportion to the land they occupy. Peaches will grow and bear heavy crops with very little attention, and yet without intelligent care, they are sure to prove disappointing. The work of caring for the trees is comparatively simple and easily learned. The development of new varieties has made the crop much more certain and the introduction of new methods of spraying has made the control of insects and fungi successful.

The outlook for peach growing in Alabama, has never been better than it is at present. The soils and weather conditions are as favorable as they were years ago, except some of the land has been neglected and is in need of fertilization. Several through lines of railroads give an outlet to the best Northern markets. The old markets are consuming more fruit each year, and new markets are being developed in the rapidly growing towns and cities. For the past few years first class peaches have brought fancy prices. The number of trees in some sections have greatly decreased because of poor shipping facilities, fungous diseases, and insect pests. With proper culture, spraying, etc., no other State offers a better opportunity for the peach growing industry.

Location.

For home use, one can have fair success on soils of diverse character, but for commercial use, careful attention must be given to the selection of a site favorable to the crop, and having the best advantages in shipping, marketing, etc. In choosing a location one must have in mind the ultimate development of the orchard. If only a limited amount is to be grown, for local markets or express shipments, it is best to locate convenient to a good market, or preferably, near several small ones.

Site.

After the locality has been determined, a proper site for the orchard must be selected, and to do this, a number of things must be considered. The higher land should be selected rather than the low bottom, and some parts of the farm may be better suited than others. Good air drainage is a most important factor to be considered, as the fruit is not as likely to be injured by frost when such is secured. By selecting a site elevated above the surrounding land, good air drainage is secured, with free circulation of air in the summer, keeping the brown rot reduced and producing fruit of high color.

Never select a site exposed to strong winds, as the trees are blown about until they become loosened in the soil; spraying is difficult, trees loaded with fruit are apt to be broken and the fruit shaken from the trees before it has matured.

The soil is also an important factor in selecting the site. The soil best suited for the peach is a well drained sandy loam with a good porous sub-soil. Any of the loams may be used. Soils containing stiff clay or coarse sand for any depth should be avoided.

Preparation of the Land.

The preparation of the land for planting should be thoroughly done, as without this trees will start off poorly. The preparation of the land should be made as thorough for peaches as for the cotton or truck crop. If the trees are to be planted in the spring, the ground should be plowed as early as possible, so as to conserve moisture. Late plowing tends to dry out the soil. For fall planting, the land may be sown in cowpeas the summer previous. All large stones should be picked up and carted off. All stumps should be pulled out of the ground and burned. Any other litter that would hinder the growth of the orchard, should be removed.

Selection of Trees.

Nurserymen grade trees according to their caliper (diameter) and height. It is best to select trees graded by caliper, as in many cases they may be simply a long whip, and of very small caliper. Where the tree is to be cut back to the proper height, there is less waste of growth. In selecting the trees, those of medium size, either one year "dormant" or first class "June buds" are preferable. June buds may be secured from four to five feet in height, or from 7/16 to 9/16 inches caliper, which are excellent for setting.

Trees are graded as follows:

Peach — Height in ft.
One year: 6-8, 5-6, 4-5, 3-4, 2-3, 1-2.
Caliper in inches
¾ and up, ⅝-¾, 9/16-⅝, ½-9/16,, 7/16-½
⅜-7/16.

Peach — Height in ft.
June Buds: 5-6, 4-5, 3-4, 2-3, 1½-2, 1-1½, ½-1.
Caliper in inches
⅝-¾, 9/16-⅝, ½-9/16, 7/16-½, ⅜-7/16.

It is usually best to patronize the local nurserymen, as they generally handle the varieties that are best adapted to local conditions. In case the local dealer does not handle th varieties desired, it is best to order from a distance, rath than accept undesirable stock. It is an advantage, in purchasing trees from the local nursery, to be able to inspect them before purchasing. Again, one is less apt to introduce injurious insects and diseases that are uncommon to the neighborhood. The home nurseryman in order to continue his business must supply trees as represented.

Planting.

There are two seasons for planting orchards, namely, in the fall and spring. Both have their advantages and disadvantages. The trees planted in the fall have a better chance to become established in the soil, ready for growth in the spring; the roots that have been broken having calloused. The greatest disadvantage of planting in the fall is that such trees are apt to be blown and rocked by the winter winds until they become loosened in the ground. This can be remedied however, by going through the orchard in the early spring, and pressing the soil about the trees.

Trees planted in the spring, have less chance to become established, and if the season is dry, there is a greater risk of losing them.

In planting the trees, the hole should be dug large enough to allow the trees to be planted without crowding any of the roots. The sub-soil should be well loosened and the tree placed in the hole about one inch deeper than it was in the nursery. All broken and bruised roots should be carefully removed and a search should be made for borers. This may save much trouble later. The bottom of the hole should be filled with good soil; then set in the trees, and fill the hole with soil, and pack it firmly with the heel. On soils that are poor, manure should be used. A splendid method is to dig the hole for the trees and then fill them with manure, leaving them until two or three good rains have fallen. The fertilizing material is thus leached out and carried into the soil. When ready to plant, the manure is forked out, and the trees put in place, and the manure mixed with the soil about the trees. When manure is not obtainable, the trees are planted, placing good soil in the bottom of the holes, and applying commercial fertilizers in ly spring, about the time when the trees are budding out.

Laying Off the Orchard.

There are several ways of laying off an orchard, viz.: in squares, triangles, and in rows running parallel with the terraces. In most cases squares 18x18 feet are the best, as cultivation and spraying operations are carried on much easier. The most satisfactory way is to have the orchard in as regular form as it can be made, on the site selected. The outside rows should not be crowded against the fence, making it impossible to get around the trees in these rows to cultivate and spray them. Mixed planting is generally unsuccessful. In such cases, the culture for one fruit is radically different from that required by the other, for example, the apple planted with the peach. Peaches and plums are in the same class, but plums rot so much quicker than peaches, they are apt to be a disadvantage to the peaches when planted with them.

It is rather a difficult problem to make the orchard rows straight on rolling ground. An orchard with straight rows is much more attractive and satisfactory than one irregularly planted. The time devoted to lining up the rows will be repaid during the life of the orchard.

The first step is to establish a base line along one side of the proposed orchard, preferably on the longer side. If the field is to be set in squares, another line should be run at right angles to this base line, starting at the corner of the field where the first tree is to stand. The direction of this line may be established by the use of a carpenter's square on three stakes, one at the corner, another along the base line, and another along the side line. Good, strong stakes should be driven in the ground where the trees are to be planted on the base and side lines. A wire or cord may be stretched across the field parallel to the base line, and this will indicate the position of the second row, and this process is continued until the entire field has been laid off. Conspicuous tags should be tied to the wire at intervals equal to the distances apart which the trees are to be planted in the row.

Distance between the trees:—The proper distance between the trees, depends upon their ultimate size, variety, soil, location, and kind of treatment they are to be given. With good treatment and rich soils, some of the larger growing varieties should be planted twenty to twenty-four feet apart, while on the poorer land sixteen feet apart will be sufficient. Commercial orchards require a greater distance between the trees than for those in a home orchard, as more space is required in the former for the use of machinery in spraying and cultivating. It is best in all cases to give the trees plenty of room, as a higher grade of fruit, and larger crops are borne on the individual trees if they are not crowded. The best distance is 18 ft x 18 ft. or 18 ft. x 20 ft. apart. The first distance will give 134 trees per acre, and the latter 121 trees per acre.

FERTILIZERS.

Peach trees will generally make a satisfactory growth the first year, if the soil has been well prepared, the trees planted early, and given good culture. If the land is poorly prepared and the weeds are allowed to grow between the young trees, very little growth is to be expected. It is a bad practice to plant trees on poor land, and then try to build that land up. It is far more satisfactory to turn under a few crops of cow peas or other organic material before planting the peach trees. However, with a moderately poor soil, a successful orchard may be produced, with proper management and fertilization. For soils that will produce a fair crop of corn ,the following formulae are recommended at the rate of 3 lbs. for one year old trees, and increased 1 lb. for each year until the seventh year, which will give a full grown tree eight to ten pounds:

Acid Phosphate 14%	1060 lbs.
C. S. M.	580 lbs.
Muriate of Potash	360 lbs.
Total	2000 lbs.

Or the following:

Acid Phosphate 16%	925 lbs.
C. S. M.	580 lbs.
Muriate of Potash	360 lbs.
	1865 lbs.
Soil or sand	135 lbs.
Total	2000 lbs.

The materials for the above formulae can be secured and mixed at home, thus saving the cost of having them mixed or paying freight on sand or soil. The mixing can be done by spreading out the different materials on the barn floor. All lumps should be broken up with a shovel, and the pile should be turned several times. With a little care, the pile can be evenly mixed, and this work can be done on rainy days when the farm hands have spare time.

The method of applying the fertilizer consists of putting the desired amounts about the trees out as far as the branches extend, and care being taken not to spread any of the fertilizer in a zone of two feet immediately around the trunk. Where cowpeas or clover are grown between the trees, these will maintain the fertility of the soil on that space. With the above fertilization of the trees, and with the cultivation of the legumes mentioned, the trees will get the full benefit of the fertilizers applied.

A cover crop of rye, vetch, or clover should be used to hold the soil during the winter rains.

Liming the Soil.

A large proportion of the soils of the State are acid, and require an application of lime. The blue litmus test is generally sufficient to determine whether or not soils are acid. Either the air slaked or the ground lime rock, may be used. Soils that are not apt to leach badly may have a liberal application, and may not require to be limed again for several years. Soils of a sandy nature, and which leach easily should be limed frequently. Two or three tons per acre is considered a liberal application. It is a good practice to use 20 to 30 bushels per acre each spring, especially when green crops are being turned under. Lime corrects acidity and aids the soil in decomposing organic material in it.

Pruning.

Of all our orchard trees, the peach stands in greatest need of careful and regular pruning. The pruning of the peach should be practiced every winter, and it should be cut back more severely than any other fruit tree. A study of the habit of growth of the peach, makes this statement more emphatic. The fruit buds of the apple or pear are mostly borne on old, short spurs, attached to the older limbs. The fruit spurs of the apple and pear lengthen but little each year and the fruit is found for the most part on the body of the tree instead of on the new growth at the extremities of the branches. On the contrary, the fruit buds of the peach, are borne chiefly on the long whips of new growth, which is most abundant at the extremity of the branches. In order to secure an abundant crop of peaches, it is necessary to so treat the trees, as to secure abundant new wood growth, the year before the peach crop is expected.

PLATE I. A one-year-old tree showing normal growth and result of heading low. Photo taken August 1st, 1911.

Forming the Head.—The main thing in view is to secure a tree that is well shaped, one having a good open head, so as to allow plenty of air and sunlight about the branches and facilitate the operations of spraying and harvesting. Much of the success in pruning, depends on getting the trees started right the first year. When the young tree is planted in the orchard it should be stripped of all its limbs, and cut back 18 to 24 inches above the ground, depending upon the size of the tree. Large trees should not be cut back as far as small ones. If the trees are large and well branched, the branches should be cut to three inch stubs, as the buds on the branches are usually better developed than on the trunk, and they make a better growth. Disbudding is necessary if the best shaped trees are desired. Frequently more shoots are formed than are necessary, and if rubbed off at the proper time, will throw the growth to the rest of the tree where it is needed. For an ideal tree three shoots should be allowed to grow from 3 to 6 inches from each other, and in such a way that they will form equal triangles about the trunk if viewed from above. A crotched head should be avoided in the peach tree as with all other trees. The three shoots should be shortened back at the close of the first season to about one foot in length, and during the next season, they should be allowed to divide into three or four branches. The same heading-back and multiplication of branches should take place the third season. Thus where such a framework of branches has developed from the main branches of the tree, which are not more than 18 to 24 inches from the ground, it can be readily seen what an advantage has been taken for the spraying and gathering of the fruit.

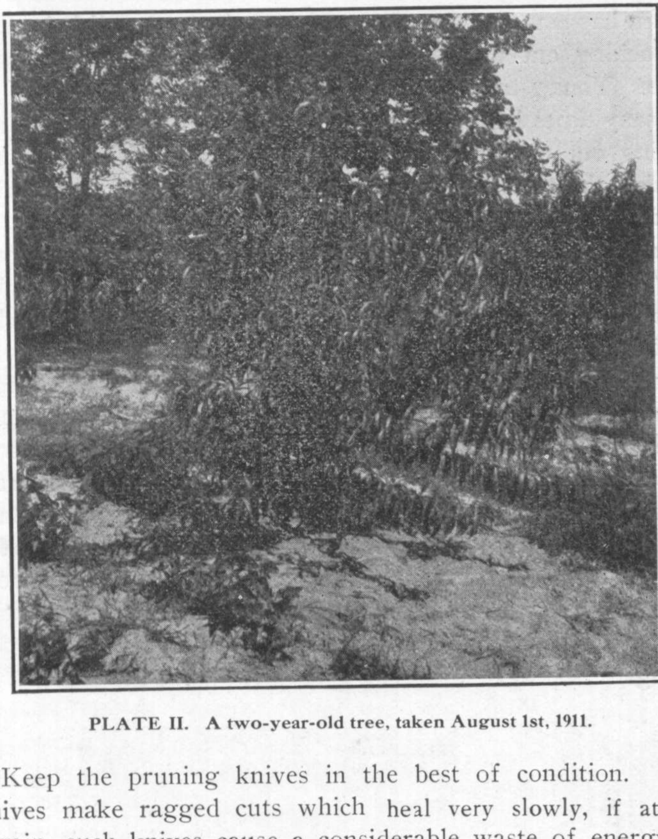


PLATE II. A two-year-old tree, taken August 1st, 1911.

Keep the pruning knives in the best of condition. Dull knives make ragged cuts which heal very slowly, if at all. Again, such knives cause a considerable waste of energy on the part of the operator. All cut surfaces over one-half inch in diameter should be painted over with white lead to protect the wound from the action of the weather and injury from insects.

Much of the labor required in pruning during the winter can be avoided by judicious summer pruning. The soft young suckers which tend to fill up the centers of the trees can be easily rubbed off if done at the right time. Remember that surplus wood requires just so much more time to spray properly and extra spray material.

Young trees can be more uniformly shaped if disbudding is practiced. After the trees have been set and growth begins in the spring, they should be gone over and all shoots not needed in forming the head of the tree should be rubbed off. It often happens that the young tree can be kept well balanced by pinching out the terminal buds of the rapidly growing shoots. Young trees on rich soils often grow very rapidly, and many times become top heavy. This can be prevented by pinching out the terminal buds during the growing season. Pinching the terminal buds induces branching and there will be less waste of wood at the time of dormant pruning.

During the third and fourth years, the pruning does not differ materially from that already described, and care should be taken not to allow the latteral branches to become too thick, nor should they be allowed to fill up the center of the tree, bearing in mind that a low, open, spreading tree is the ideal desired. This subsequent pruning should consist of heading in the main branches and vigorous shoots from a half to two-thirds of their length. Always head back to a good latteral whenever possible, and so prevent the growth of surplus shoots. In any case short branches should be encouraged to grow low down on the trunk, and also branches to provide protection from the sun. Nothing aids more in growing well matured, well developed and highly colored fruits than good pruning.

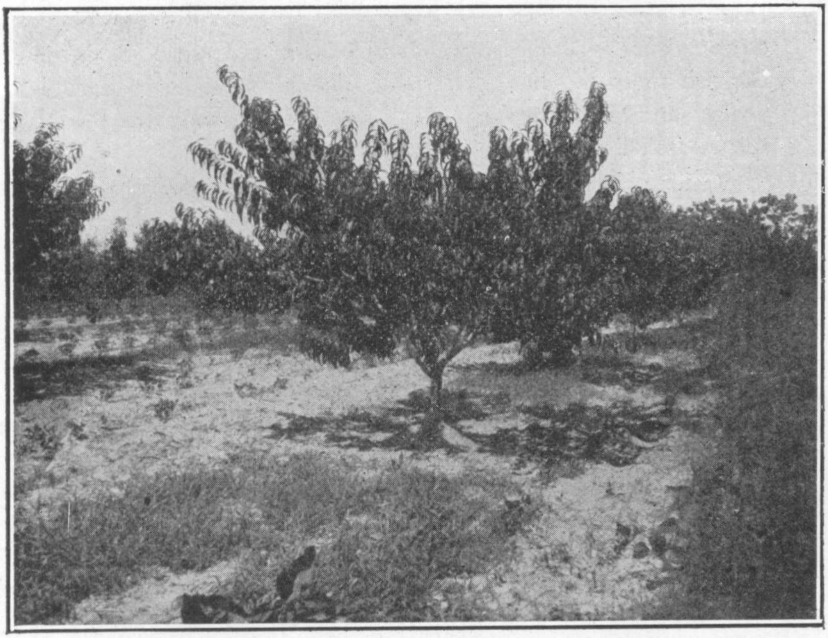


PLATE III. **A four-year-old Carman tree, well shaped and vigorous. Note the mound of soil at base of tree for treating borers. Photo taken August 1st, 1911, in Experiment Station Orchard.**

After-care of the Orchard.

It is very essential to take the very best possible care of the young trees. They should be kept thrifty and healthy, and all necessary care given them to conserve the moisture and plant food in the soil. The latter can only be accomplished through systematic cultivation. Different soils and environment will necessarily change the methods practiced. Early in the spring, as soon as the soil will permit, it should be stirred six to eight inches deep, thus, if the trees have been planted as deeply as they should, plowing this depth will cause them to produce a deep root system which will not be injured so quickly by freezing or drought. After this plowing the fertilizer should be applied and worked in with a disc harrow or cultivator. Frequent cultivations should be given with the cultivator or disc harrow, running deep enough to form a good soil mulch, and prevent subsequent baking or crusting of the surface, and prevent loss of soil moisture by evaporation. Thorough culture kills all the weeds which are a constant drain on the soil moisture and plant food, and also assists in decomposing and liberating any plant food which may have been turned under.

Cultivation should cease after August 1st, in order that the trees will have an opportunity to mature and harden the season's growth and buds for winter. Buds are often severely injured by cold by the growing continuing too long in the season. At the last cultivation, a cover crop may be sown. Cowpeas may be sown in July, which will greatly aid in supplying the soil with nitrogen and humus. The cover crop will absorb and maintain much plant food that is likely to be washed out of the soil, and in the spring, when turned under, greatly improves the mechanical condition of the soil. Clovers and vetches may be used also, as they are nitrogen-producing plants. If the soil is not in need of nitrogen, oats, rye, etc., may be used, but should never be allowed to mature, as this will occur too late to begin proper cultivation. Any crop that requires hoe and plow culture, may be planted in the orchard, and reduce the cost of caring for it. Crops should not be planted closer to the trees than three to four feet from the end of the branches, and when the orchard is inter-cropped, more care must be taken to maintain the fertility of the soil. It is not advisable to grow grain crops in the orchard, as they draw heavy on the moisture and plant food. If the soil is liable to wash, clover sod may be grown between the rows, with a space left along the line of the row, to allow space for cultivation. Hills too steep to cultivate, may be mulched with straw, but such lands should be avoided if possible. Straw mulch is not to be recommended, as it encourages a surface root system, which will cause injury to the trees by drought.

In cultivating the orchard, care should be taken to protect the trees from injury by putting pieces of leather on the ends of the single-trees, and by using low hames, also by placing a muzzle on the horses to prevent their nipping the young shoots.

All weeds, grass and other litter that might harbor mice, should be removed. Where rabbits bother by chewing the bark, the trees should be wrapped with tar paper or wire netting.

PROFITS.

The Department has received numerous inquiries concerning the cost of producing a crate of peaches in Alabama orchards. Data has not been received from many of the larger growers but the following figures are based on actual records of expense as recorded at Auburn:

One winter spraying and four summer sprayings per tree.	$ .10
Fertilizers, per tree	.10
Pruning	.04
Interest on tools, wagons, etc., 8 per cent.	.12
Interest on land	.23
Picking and grading one crate	.10
Total	.69
Average price per crate	$2.00
Average yield per tree, one crate—cost	.69
Net return	$1.31

With 134 thrifty trees to the acre in bearing this would give a total income from that acre of $175.54. This figure, however, is quite relative as the same varieties on different soils and managed by different men will vary considerably. However, with the best of care this figure is conservative.

INSECTS.

The principal insects attacking the peach are the plum curculio, San Jose scale, peach borer, lesser peach borer, West Indian peach scale, black peach aphis, fruit tree bark beetle and nematode root gall.

The plum curculio is the insect which causes "wormy peaches" and is recognized as a small grub in the matured peach. This insect can be controlled by the use of the following spray formula, which is further described in Alabama Bulletin No. 152.

2 lbs. arsenate of lead.
3 lbs. pure rock lime.
50 gallons water.

Mix the arsenate of lead into paste in a bucket before adding to the solution. Slowly slake three pounds of rock lime in water, and strain both the mixtures into fifty gallons of water. Apply this mixture just as the "shucks" are falling.

The fact that over 90 per cent. of the injury by brown rot is directly responsible to the punctures of the plum curculio, makes it imperative for the peach grower to give his trees a thorough application of this mixture.

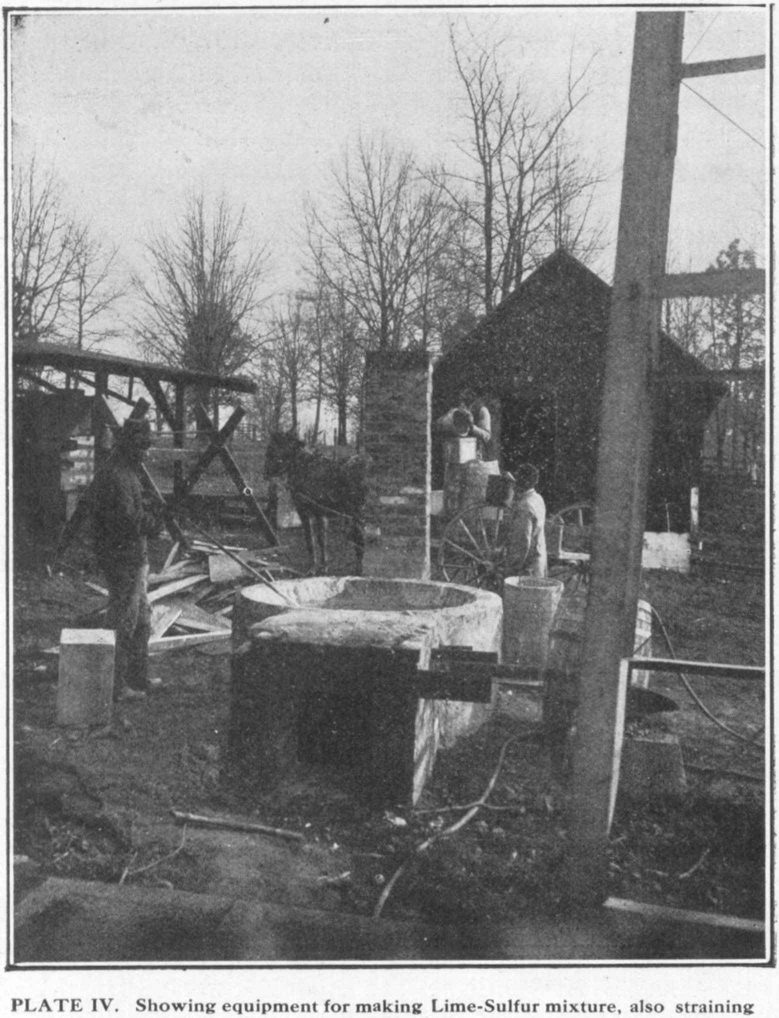


PLATE IV. Showing equipment for making Lime-Sulfur mixture, also straining the mixture into spray barrel.

The second spraying should consist of self-boiled lime-sulfur described below, with two pounds of arsenate of lead added to it. This gives us a combined insecticide and fungicide, protecting the peaches against the attack of the curculio, not entirely controlled by the first spraying.

San Jose scale and West Indian peach scale can be controlled by the use of lime and sulfur wash, as described in Alabama bulletin No. 144. The formula and a brief description of its preparation follows:

15 lbs. pure rock lime.

15 lbs. flour or flowers of sulfur.

50 gallons water.

In case 90 per cent. pure lime cannot be secured, as much as twenty pounds should be used to make up for the impurities. In preparing this wash the lime and sulfur is boiled in a kettle over a fire from 30 to 40 minutes, forming a chemical combination which is very caustic, and can only be applied to the trees when in a dormant condition. If only one spraying through the winter is to be given this should be applied about a week or two before the buds open in the spring.

Black peach aphis can be controlled by the use of tobacco decoctions. Fruit tree bark beetles, and nematodes are only controlled by digging up and burning the infested trees.

The peach tree borer can be controlled by banking the trees with soil the first of July to the height of eight or ten inches, about the trunks. [See Plate III., Page 121.] The soil should be packed thoroughly to hold it in place, and in this manner the moths find it impossible to make their way to the trunk or roots. The moths lay their eggs from July to October, and by having the mounds, many moths are prevented from coming out, and those that get out, are compelled to lay their eggs above the mound. In this way the small borers are easily found. The orchard should be gone over in November, the mounds leveled, and all the borers dug out with a knife. It is essential that this operation be thoroughly done. In the Experiment Station orchard last year, trees not mounded contained from two to ten borers, while scarcely a borer could be found in the trees that were mounded. All the borers on the mounded trees were so high up the trunks that they were easy to detect and destroy.

Diseases.

The principal diseases of the peach are: *Brown rot, leaf curl, milldew, shot hole fungus* and *scab.* These diseases can be controlled by the use of self-boiled lime-sulfur wash, which is described in Alabama bulletin No. 152, and is briefly given below. The formula consists of the following:

8 lbs. pure rock lime.

8 lbs. flour or flowers of sulfur.

50 gallons water.

It will be noted that the ingredients of this wash are the same as used for the winter wash, but only one-half the quantities of lime and sulfur are required. Another point which should be noted, is the fact that in preparing the self-boiled lime-sulfur, no fire is used under the kettle in which the mixture is being prepared. In allowing the lime to furnish the heat, and in reducing the time of boiling to ten minutes, a chemical combination is formed much less caustic than the winter wash, and one which can be applied with safety to the trees in foliage.

To prepare the mixture place eight pounds of lime in four to six gallons of water, the latter brought up to a temperature of 190 to 200 degrees. As soon as the lime begins to slake, pour in the sulfur, which has been freed from all lumps and cover the barrel or kettle with a piece of heavy matting or burlap. Watch the mixture at intervals to see that it does not become too dry. If this happens add a little water. Allow the boiling to continue ten minutes. Add cold water to stop boiling and strain the mixture through a wire gauze, having twenty meshes to the inch, into the spray barrel. Remember that no heat is used other than that generated by the slaking of the lime.

The first application of the above mixture should have two pounds of arsenate of lead mixed with it, to form a combined fungicide and insecticide, and this wash should be sprayed on the trees two to three weeks later than the application of arsenate of lead, or three weeks later than the shucks have fallen.

The third application should consist of self-boiled lime-sulfur alone, and should follow about three to four weeks later than the second application.

The trees in the Station orchard have been very thoroughly sprayed the past few years, and there has been little trouble with either "wormy" or "rotten fruit." Again the fruit has been exceptionally large, well formed, highly colored, and of the very best quality. Fifty gallons of the summer wash will cover about thirty-five to forty, six-year-old trees. In a wet season it may be necessary to spray four times while the crop is maturing. It is absolutely a waste of time to apply the self-boiled lime-sulfur unless the applications are made as soon as the fruit begins to form, with arsenate of lead, followed by the self-boiled lime-sulfur, at intervals of two or three weeks.

Thinning.

Some varieties tend to overbear every season in spite of the large number of fruits which drop in May. The average peach grower never practices thinning and many times secures a crop of undersized fruit poor both in flavor and color when with judicious thinning, fruit of much superior quality could be obtained. It requires considerable nerve to pull the peaches from the tree but where they are distributed thicker than 4 to 6 inches on the branch the intermediate fruits should be pulled. Where the trees are thinned there seems to be a tendency for them to form more fruit buds than where not thinned. Judicious pruning in the winter will correct the tendency of trees to overbear.

Harvesting and Marketing.

The gathering and marketing of peaches is undoubtedly the most neglected and at the same time the most important phase of the industry. There is more complaint among Alabama peach growers concerning their inability to place their fruit on the market at paying prices than upon any other feature of the business. Gathering the fruit at the right time and experience in grading and packing are essential features of success. Again it requires tact and considerable business ability to place the fruit in the right market. Many failures have been due to the fact that the shipments from certain points have been too small to attract "big" buyers. When a grower advertises the fact that he will have 50 or 100 cars of a certain variety a certain week he will not pass unnoticed. Growers owning from 10 to 50 acres should organize and advertise in the name of that organization. Such an organization to be effective should have its officers and set of by-laws. Its members should be instructed to grow certain varieties that the combined output of those varieties will be sufficient to attract the larger buyers.

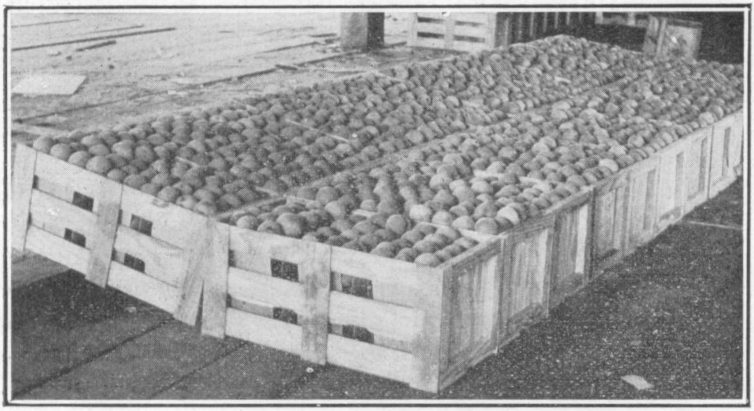


PLATE V. An Alabama Product.

There is just one stage in the development of the peach when it should be picked for shipment and with many commercial varieties this stage is limited to 24 hours. The greater portion of the southern peaches reach the northern market in mediocre condition resulting from their being gathered when immature. Such fruit is undersized, poorly colored and without its characteristic flavor or keeping qualities. Again there is danger of pulling the fruit when over ripe. The under side of the peach or that portion away from the sun is indicative of the fruits' actual condition. When the green color of the under side has changed to a creamy white the peach is ready for gathering. The few days preceding the maturing of the peach are very important ones to the grower. At this time the peach increases in size between 15 and 20 per cent. This increase in size, in addition to the increase in net returns for mature peaches, is a factor not to be slighted. All ripe fruit should be gathered at a picking and only an expert foreman can judge the efficiency of a gang of six pickers. The weather conditions often cause anxiety at the time of harvesting. Wet weather tends to soften the fruits and consequently they must be picked earlier at such a time. Careless picking ruins many a grower. The fruits must be handled carefully. Do not allow them to be dropped into the baskets or allow them to be poured from one basket to another.

Packing.

At the packing house the fruit should be culled, grading it according to size at the same time. Imperfect fruit means those which are even slightly bruised, curculio stung, showing slightest signs of decay, and deformed or split slightly along the suture. It requires much experience and skill to grade the fruit properly. The packers should also be required to cull the fruit as the graders often allow inferior fruit to remain unnoticed. Much of the culled fruit can be regraded and shipped as culls, canned, or evaporated.

Peaches are generally packed in the Georgia six-carrier crate which holds 7-8 of a bushel. Each carrier or "cup" should be packed uniformly. The colored side of each peach should show to the best advantage. The crate should be full enough to require slight pressure on the top to fasten it. A competent inspector should watch every layer placed in the cups.

All crates should be labelled according to the grade of fruit they contain. Trouble may result from careless work here. It is rather difficult for all growers to decide on standards for grades. Each grower, or each organization, as the case may be, attempts some such standardization. Mr. Jones may put his Carmans out as "Extra Fancies" and Mr. Smith may do likewise yet the actual grade of the former's may be far superior to that of the latter. If both shipments reach the same market the commission men spend little time in deciding the merits of the case and Mr. Jones gets the order the next season. However, Mr. Smith may have been very conscientious in his grading. The best fruit one year may not reach that standard the next year and where a standard has been set, maintain it, even if it should be necessary to send out crates labelled "seconds" one or two seasons. Honesty counts here as elewhere.

Serious losses are often caused by the shipment reaching a so-called "glutted" market. The majority of the large growers seem to think that New York, Philadelphia and Chicago need all the peaches. As a result prices in those cities very often hardly pay the freight, while smaller cities are hungry for peaches and willing to pay good prices for them.

By-Products.

Some of the largest growers in Alabama have installed large canning factories in their orchards and find them very profitable investments. Canning the peaches prevents loss from poor shipping facilities at the time the crop is moving and furnishes employment for experts and laborers should the market "go wrong." Every farmer who owns peach trees should have a home canning outfit. These can be purchased from $5.00 up and one season's trial with one will prove their value. Having a goodly supply of canned peaches in mid-winter sounds better than feeding surplus peaches to the hogs. Farmers' Bulletin No. 426 gives instruction concerning the operation of canning and demonstrations have been conducted by the Horticultural Department at Auburn during the farmer's institutes and also in co-operation with the Extension Department. There are a number of reliable firms handling home canning outfits and the names of these can easily be secured by referring to the advertisements in the various horticultural journals. Some of the oufits familiar to the writers and which give very good satisfaction are as follows:

Tharpe Hardware Mfg. Co., Elkin, N. C.
Slemmer & Son, Goldsboro, Md.
Home Canner Co., Chattanooga, Tenn.
The Raney Canner Co., Chapel Hill, N. C.
Reeves and Son, Collinsville, Ala.
Dixie Hardware Mfg Co., Elkin, N. C.
F. S. Stahl Mfg. Co., Quincy, Illinois.

Cans are supplied by many companies, a few given below:

E. F. Kirwin & Co., Baltimore, Md.
American Can Co., Atlanta, Ga.
Modern Canner Co., Chattanooga, Tenn.
F. S. Stahl Mfg. Co., Quincy, Illinois.

A Few Dont's.

Don't purchase trees from tree agents unless they and the companies they represent are well known.

Don't turn stock in the orchard.

Don't sow oats in the orchard.

Don't plant too many varieties in commercial orcharding.

Don't wait until the last minute to order crate material.

Don't allow the trees to suffer from insects and diseases as attention to spraying will control both.

Don't ship immature fruit.

Don't attempt pruning with cheap and dull knives.

Selection of Varieties.

The question of varieties is a most important one with the large grower. He can ill afford to plant varieties other than those given a fair trial in the vicinity of his proposed orchard. The description of varieties which follows is based entirely on notes taken at this Station for the past eight years and the dates of blooming, ripening, quality, etc., will only be relative in other portions of the State. There is generally a difference of two weeks between the ripening period of trees in the southern section of the State and those at the Station. In the northern section of the State the fruit will ripen about two weeks later than at Auburn.

The home orchard should contain varieties which will give a succession of fruit from May 15th to August 15th. Only those varieties should be selected which have either been tried in your particular vicinity or reported upon by Experiment Stations of the southern States.

The local market generally prefers freestone varieties, which can be used for home canning. Shipping varieties require durability to withstand long rail trips and they should have firm flesh and rather thick skin.

Notes on varieties tested at Auburn follow:

DESCRIPTION OF VARIETIES.

ALEXANDER.—Low spreading tree, vigorous grower; fruit small to medium; color pink on yellow ground; flesh white; quality rather poor; fair for home use; ripens May 30th to June 5th.

AMELIA.—An upright grower but shy bearer; fruit medium to small; apex prominent and distinct; color yellow with splashes and dots of crimson; flesh yellow, red at pit, firm and rather coarse; quality fairly good; freestone; ripens August 2nd.

ANGEL.—Tree prolific; fruit medium size, round and slightly pointed; skin yellow washed with red; flesh white, sweet; freestone; ripens July 10th to 14th; for home use.

BEAUTY BLUSH.—Large upright tree, light foliage; heavy bearer; fruit medium to large; freestone; ripens June 30th to July 6th; recommended for home use.

BELLE—(Georgia Belle).—Tree of low spreading habit, vigorous grower, and very productive; foliage heavy; fruit very large; skin greenish white with splashes of carmine; flesh white, firm, flavor sweet; quality good; freestone; ripens July 1st to 10th; good shipper; highly recommended for home and market.

CARMAN.—Tree round and well shaped, vigorous and medium size; foliage heavy; fruit large, round and flattened at cavity; skin light yellow with crimson patches deepening to magenta in sun; flesh white, quality fine, freestone when fully ripe; the best for its season; excellent shipper; ripens June 1st to 10th; highly recommended for home and market.

CHAMPION.—Tree has spreading top, a heavy bearer; fruit round, large; skin greenish yellow—rose in sun; flesh greenish white, solid, sub-acid; fair quality; good for commercial or home use; ripens June 26th to July 6th.

CHINESE CLING.—Open, spreading and fairly vigorous tree; fruit slightly oblong, very large; skin straw colored, with deep red blush, striped and splashed; skin thin showing slight bruises; flesh white, reddish at pit, soft and tender; mild sub-acid, quality excellent; prolific; a good shipper, and also good for home use; ripens July 4th to 11th.

COBLERS INDIAN.—A fair peach of medium size, ripening July 15th to the 20th, but not recommended for this section.

DAWSON.—Tree slow growing, unproductive; fruit round, medium large; skin, upper half rich magenta in irregular splotches on crimson; lower half rich yellow; flesh yellow, flavor excellent, quality good; a poor shipper and not recommended for this section. Ripens June 15th.

ADMIRAL DEWEY.—Tree an upright grower; winter kills badly; prolific; fruit medium to large, conical in shape; skin rough, red to yellow, flavor very good; quality fine; rots badly and a poor shipper; ripens June 10th to 15th.

EARLY CRAWFORD.—Tree vigorous with open top; fruit medium to large, round; skin yellow, reddish in sun, flesh yellow, reddish at pit, firm; freestone, quality good, shy bearer; ripens July 10th to 14th. Not recommended.

ELBERTA.—Tree vigorous, spreading, with heavy foliage; a good bearer; fruit large, skin yellow, rose tinted in sun; flesh yellow, firm and juicy, sub-acid; good quality, excellent for shipping and home use; a standard variety; ripens July 8th to 20th.

EMMA.—Tree of large upright form, very productive, but fruit rots and drops badly; fruit round, small; skin has tinge of pink on yellow ground; flesh yellow, sweet to sub-acid; quality fair; ripens July 15th to 25th, freestone, for home use.

EVERBEARING.—Not promising so far; ripens July 18th to 22nd.

FAMILY FAVORITE.—Tree vigorous, fruit ripens a day later than Champion, and resembles that fruit, being a little smaller, and not as heavy a bearer; flavor sub-acid; fair quality; ships fairly well; recommended for home use; ripens July 2nd to the 8th.

FAME.—An upright growing tree; fruit medium size, freestone; yellow flesh; good quality; rots badly; for home use only; ripens July 18th.

FRANCES.—A large upright growing tree; fruit of medium size; skin magenta on yellow; flesh yellow, sweet; freestone; quality good; ripens July 15th to 19th.

GLOBE.—A well shaped, vigorous tree of medium size, not prolific; fruit medium to large, round; skin a yellowish green with pink blush; flesh yellow, firm; sub-acid; fair quality, ships well, but being unproductive is not recommended; ripens July 14th to 17th.

GOV. HOGG.—A large upright growing tree, fairly productive; foliage medium to heavy; fruit large, round; skin cream yellow with light crimson blush in sun; flesh cream yellow, pinkish near pit; slightly sub-acid; good quality; ripens June 22nd to 26th; too soft for shipment; recommended for home use.

GRAY.—Tree spreading, fairly productive; fruit large, flesh yellow; freestone; acid; ripens June 26th to July 8th; not recommended.

GREENSBORO.—Vigorous low spreading tree, with heavy foliage, and fairly productive; buds and wood hardy; fruit large, oblong, compressed; skin velvety, light yellow, pinkish about apex and along suture; flesh white, sweet and juicy; quality good; cracks badly; ripens at apex first, highly recommended for home use; ripens May 25th to June 1st.

HILEY (Early Belle).—A low spreading, fairly vigorous tree; a rather irregular bearer; fruit conical, medium to large; skin very light yellow, with crimson blush; flesh white, tinged with red near tip, fairly firm and juicy; sub-acid; quality very good, a good shipper; ripens June 21st to 30th; recommended for home or market.

HONEY (De Montigny).—Fruit medium size, oval compressed, suture deep, apex sharp recurved; skin whitish yellow; flesh creamy white, juicy and very sweet; freestone; ripens July 1st to 10th; recommended for South Alabama.

IMPERIAL (White Imperial).—Fruit medium to large, skin greenish yellow, washed with red; flesh white, sweet and juicy, flavor excellent; quality good; freestone; ripens July 10th to 14th.

INGOLD (Lady Ingold), (Stark).—Wood and buds tender; fruited in 1906, ripening July 2nd to July 5th; fruits were well colored, seventy-five per cent dropped from brown rot; color deep yellow with red cheek, showy; flesh yellow, red at pit, juicy and good; freestone.

LATE CRAWFORD (Crawford's Late).—Fruit of medium size, round; skin yellow with red cheek; flesh yellow, red at stone; tender, free; quality good; buds rather tender; only suitable to certain localities; a good shipper; ripens July 10th to 15th.

LEMON CLING (Kennedy's Carolina).—An upright growing tree with medium sized foliage; fruit medium, conical; apex very prominent; skin lemon yellow with pink blush; flesh yellowish white, juicy, sweet; quality excellent; ships fairly well; fairly productive; ripens July 17th to 26th.

MAMIE ROSS.—A low spreading tree of medium size, with heavy foliage and of medium productiveness; fruit large, round; skin thick, tenacious, light yellow, pinkish near apex; flesh yellow, sub-acid; quality good; home use, promising for some localities, particularly South Alabama; freestone; ripens May 28th to June 10th.

MATTHEWS (Matthews' Beauty).—Tree with large spreading top; vigorous; medium sized foliage and very productive; fruit medium to large, oval; skin greenish yellow with pink splash; flesh yellow, firm, sub-acid; recommended for home use; a fair shipper; ripens July 6th to 14th.

MAYFLOWER.—A low spreading tree; productive, fruit medium sized, oval; apex pointed; surface velvety, dark red and evenly colored; flesh greenish white, juicy and soft, sub-acid; quality fair; clingstone; a good bearer and good shipper; valuable for its earliness; ripens May 15th to 20th.

McKINNEL.—An upright, rank growing tree with heavy foliage, very productive but very susceptible to rot; trees must be thoroughly sprayed to secure a crop; fruit conical, medium to large; apex small and sharp pointed; surface smooth, red to greenish yellow; flesh yellowish white, fine grained; flavor very good, juicy; quality very good; ripens May 25th to June 5th.

MOUNTAIN ROSE.—Tree vigorous with a spreading top and medium foliage; fruit medium sized, roundish; color white with red in sun; flesh white, slightly red at pit, juicy and sweet; freestone; productive; good for home use; ripens July 1st to the 9th.

OLDMIXON FREE.—Fruit small to medium sized; color white with red cheek; flesh white and red at pit; fair quality; good for home use only; ripens September 10th to 25th.

ONDERDONK (Onderdonk's Favorite).—Fruit medium sized; skin and flesh yellow; productive; freestone; ripens July 15th to 21st.

OVIEDA.—A spreading slender branched tree; fruit oval and small; color yellow, blushed with red—attractive; prolific; ripens July 3rd to the 15th. Home use; particularly the southern portion of the state.

PALLAS (Honeydew).—A medium sized peach; red tipped at base and apex with light yellow; flesh white, fine grained; freestone; ripens July 6th to 10th. A variety adapted to the southern portion of the state.

PEENTO (Chinese Flat).—Fruit medium sized, flattened at both ends; skin pale greenish white with mottling of red in sun; flesh light yellow, sweet and juicy; clingstone. This, like the other varieties of the Peento group, should only be planted in the extreme southern sections of the state, as they bloom so early; ripens June 30th to July 5th.

PICQUET (Picquet's Late).—A medium to large peach; color yellow with a red cheek; flesh yellow, rich, sweet and of good flavor; ripens July 28th to August 4th.

REEVES (Reeve's Favorite).—A round, medium sized peach; apex elongated—pointed; color yellow green with magneta in sun; flesh yellow, firm, sub-acid; quality rather poor; ripens July 12th to the 15th; prolific.

RIVERS (Early Rivers).—A very hardy spreading, vigorous tree; fruit medium to large, conical; surface smooth, white with dark crimson blush in sun; flesh white, firm, fine grained, juicy; very good quality. Too soft to ship; fairly productive and good for home use; ripens June 10th to the 20th.

SALWAY.—Fruit large, not attractive yet it ships well and ripens so late that it is very desirable; color yellow, mottled with brownish red; flesh yellow, firm, sub-acid; ripens July 30th to August 6th.

SIMMS.—An upright vigorous tree with heavy foliage; not prolific and rots badly; fruit of medium size, round; color yellow splashed with red stripes; bloom abundant; skin tough and thick; flesh yellow slightly juicy, sub-acid; quality good; freestone; ripens July 20th to 27th.

SLAPPEY.—Upright growing tree, foliage heavy, fairly productive; fruit medium to large, conical; apex elongated, slightly rounded; color bright orange yellow with red cheek; flesh yellow, mealy; quality very good; ripens June 19th to the 27th; recommended for commercial or home use.

SMOCK (Smock's Free).—An upright growing tree, not hardy, leaves, medium to large; rather productive; fruit medium in size, roundish; color yellow with red cheek; flesh yellow, dry; quality fair; rots badly; recommended for home use only; ripens July 2nd to 6th.

SNEED (Peeble's May Cling).—A large spreading tree bearing well when young; fruit medium in size, oval; color creamy white with red blush in sun; flesh white, juicy; semi-cling; quality poor; not recommended; ripens May 15th to June 2nd.

STINSON (Stinson's October).—Fruit large, oval; color creamy white; flesh white with pink veins; scabs badly in Station orchard; ripens October 4th to 8th.

SUSQUEHANNAH (Griffith Mammoth).—An upright medium sized hardy tree; not prolific; fruit large, oval; apex prominent point; surface smooth; color lemon yellow tinted in sun with magenta blush; skin thick, tenacious; flesh yellow, rather stringy, very good, sub-acid; freestone; ripens July 15th to the 20th.

TABER.—A large tree, upright, hardy, prolific, with medium sized leaves; fruit medium to large, round; surface yellow, crimson blush in places; flesh whitish yellow, juicy, sub-acid, quality fairly good; excellent for canning; ripens July 1st to the 15th.

THURBER.—A medium sized tree, low spreading; productive; fruit large; color creamy white, light crimson in sun; ots small red and numerous; flesh white, red at pit, juicy; freestone; quality very good; a good shipper; ripens July 15th to the 24th; recommended for home use.

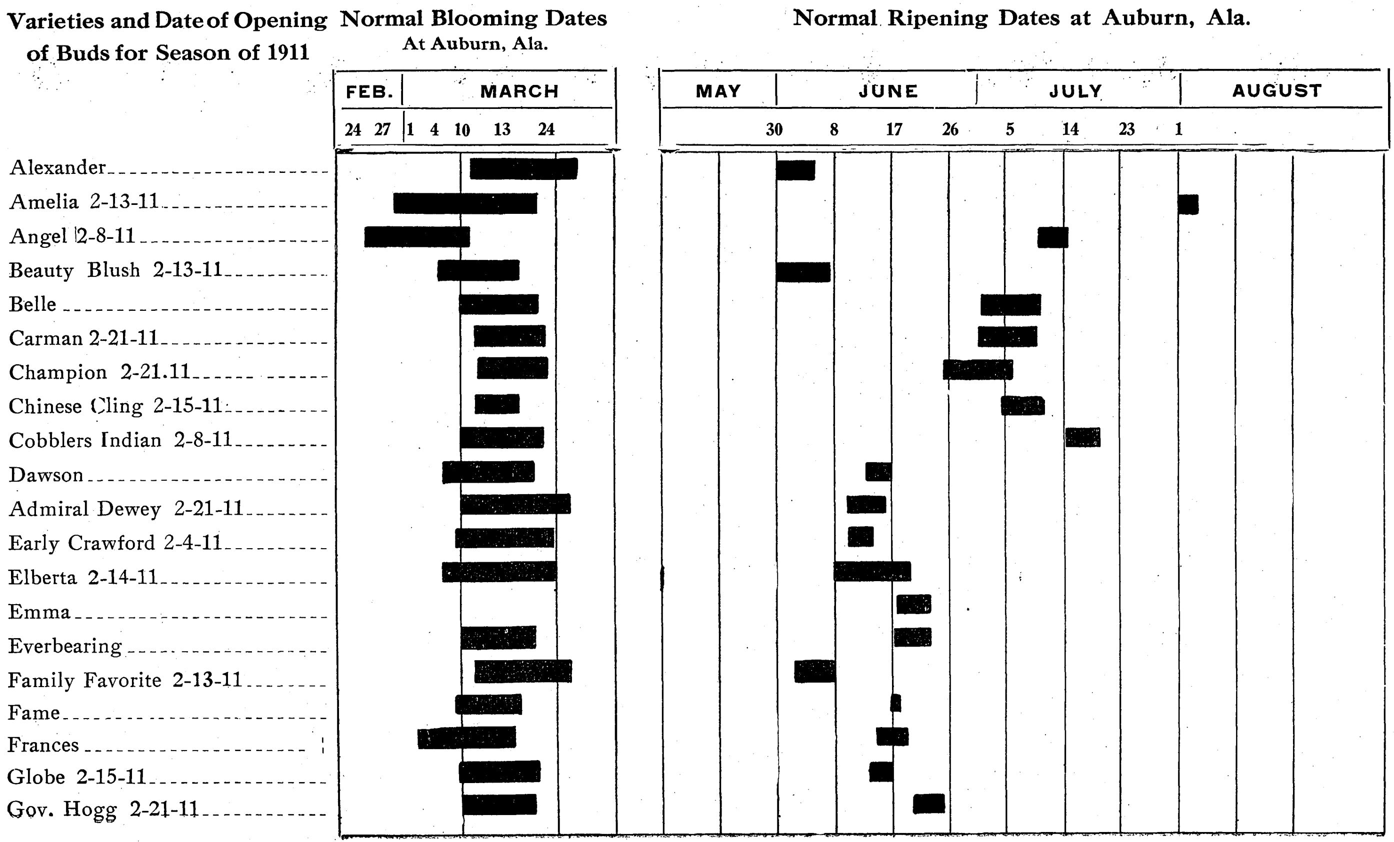
TILLOTSON (Early Tillotson).—Fruit medium sized, white, practically covered with red; not prolific; ripens June 27th to July 6th.

TRIUMPH.—A strong tall growing tree, hardy, very prolific; fruit medium to large, conical; color yellow splashed with maroon; larger portion being covered with red; flesh bright yellow, red at pit; semi-cling but free when ripe; ripens June 3rd to the 10th; variety for home use or shipping.

VICTORIA.—A large, round fruit; color yellow; flesh yellow, juicy; freestone; fairly productive; suitable for south sections of the state; ripens June 23rd.

WADDELL.—A low open spreading tree, hardy but not vigorous; leaves medium to large; fruit medium to large; color yellow with pink patches; flesh white, firm and juicy; very productive; an excellent shipper; recommended for general planting; ripe June 28th to July 2nd.

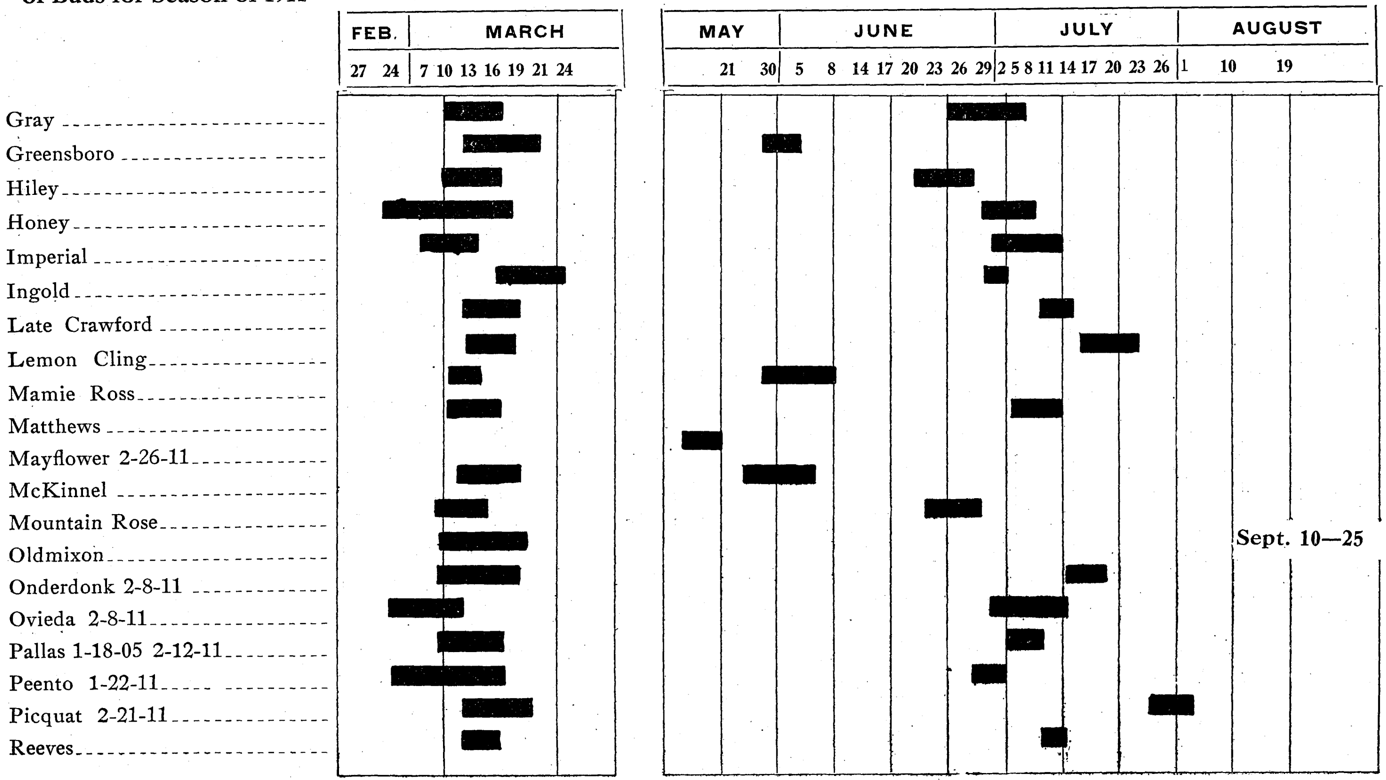
WALDO.—Fruit medium sized; roundish oblong; color light yellow, dark red in sunlight; flesh yellowish white, red at pit; sweet and of good quality; freestone; suitable for planting in south portion of state with the others of the Peento group; ripens June 16th to 24th.


Varieties and Date of Opening of Buds for Season of 1911
Normal Blooming Dates
At Auburn, Ala.
Normal Ripening Dates at Auburn, Ala.
FEB.
MARCH
24 27 1 4 10 13 24
MAY
JUNE
JULY
AUGUST
30 8 17 26 5 14 23 1
Alexander
Amelia 2-13-11
Angel 2-8-11
Beauty Blush 2-13-11
Belle
Carman 2-21-11
Champion 2-21.11
Chinese Cling 2-15-11
Cobblers Indian 2-8-11
Dawson
Admiral Dewey 2-21-11
Early Crawford 2-4-11
Elberta 2-14-11
Emma
Everbearing
Family Favorite 2-13-11
Fame
Frances
Globe 2-15-11
Gov. Hogg 2-21-11

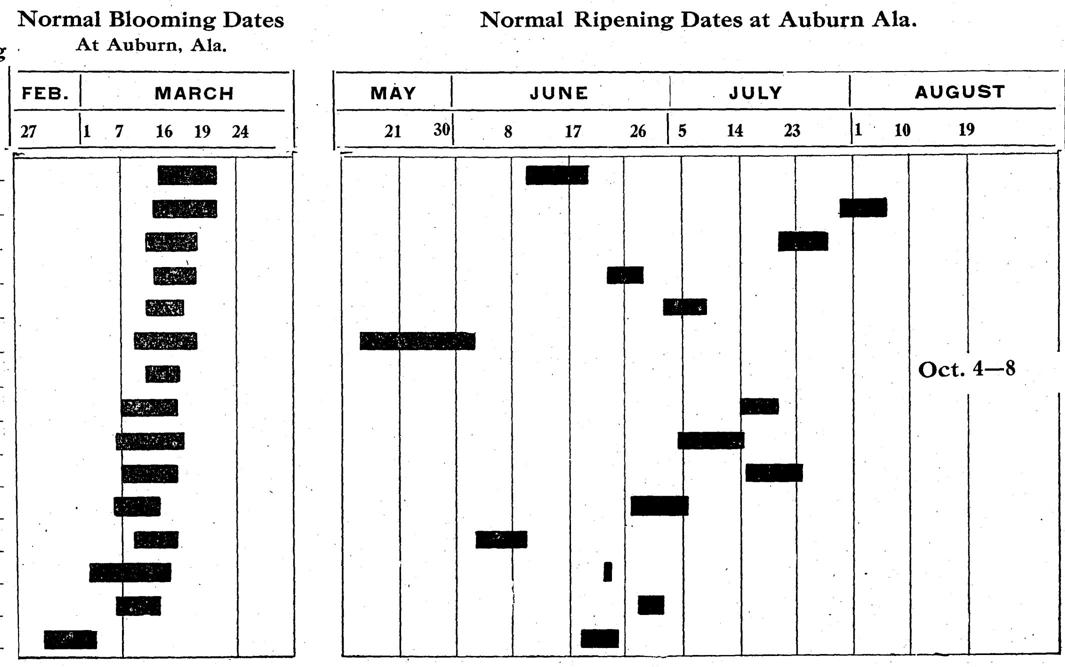
Varieties and Date of Opening of Buds for Season of 1911

Normal Blooming Dates At Auburn, Ala.

Normal Ripening Dates at Auburn, Ala.



Varieties and Date of Opening of Buds for Season of 1911



Rivers 2-27-11

Salway 2-15-11

Simms

Slappey 2-15-11

Smock 3-21-11

Sneed 2-21-11

Stinson 2-21-11

Susquehannah 2-19-11

Taber 2-11-11

Thurber 2-12-11

Tillotson

Triumph

Victoria

Waddell

Waldo 2-2-11

Charts Showing Maximum and Minimum Temperatures Recorded by the Horticultural Department at Auburn, Ala., for the Years 1904-1911, Inclusive, During the Peach Blooming Period.

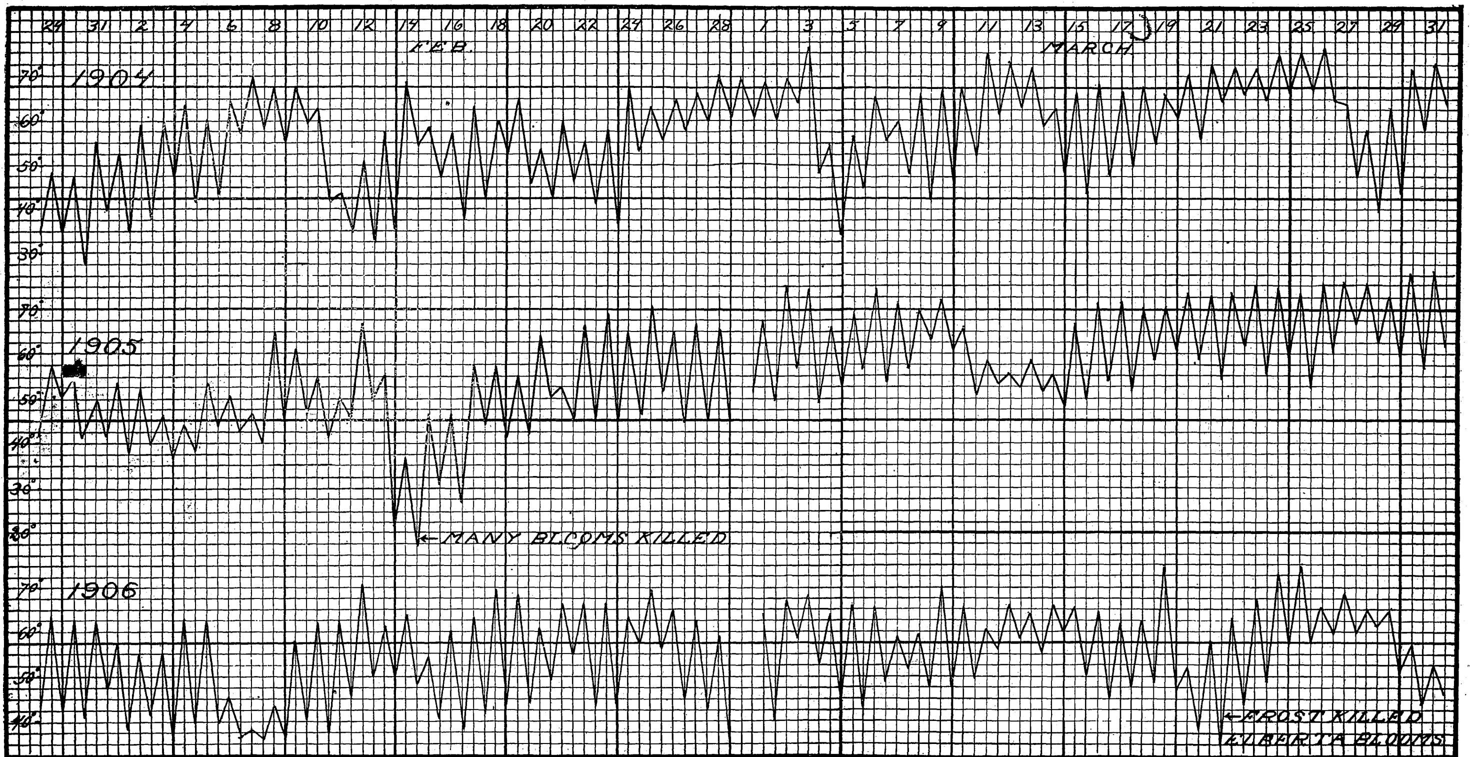
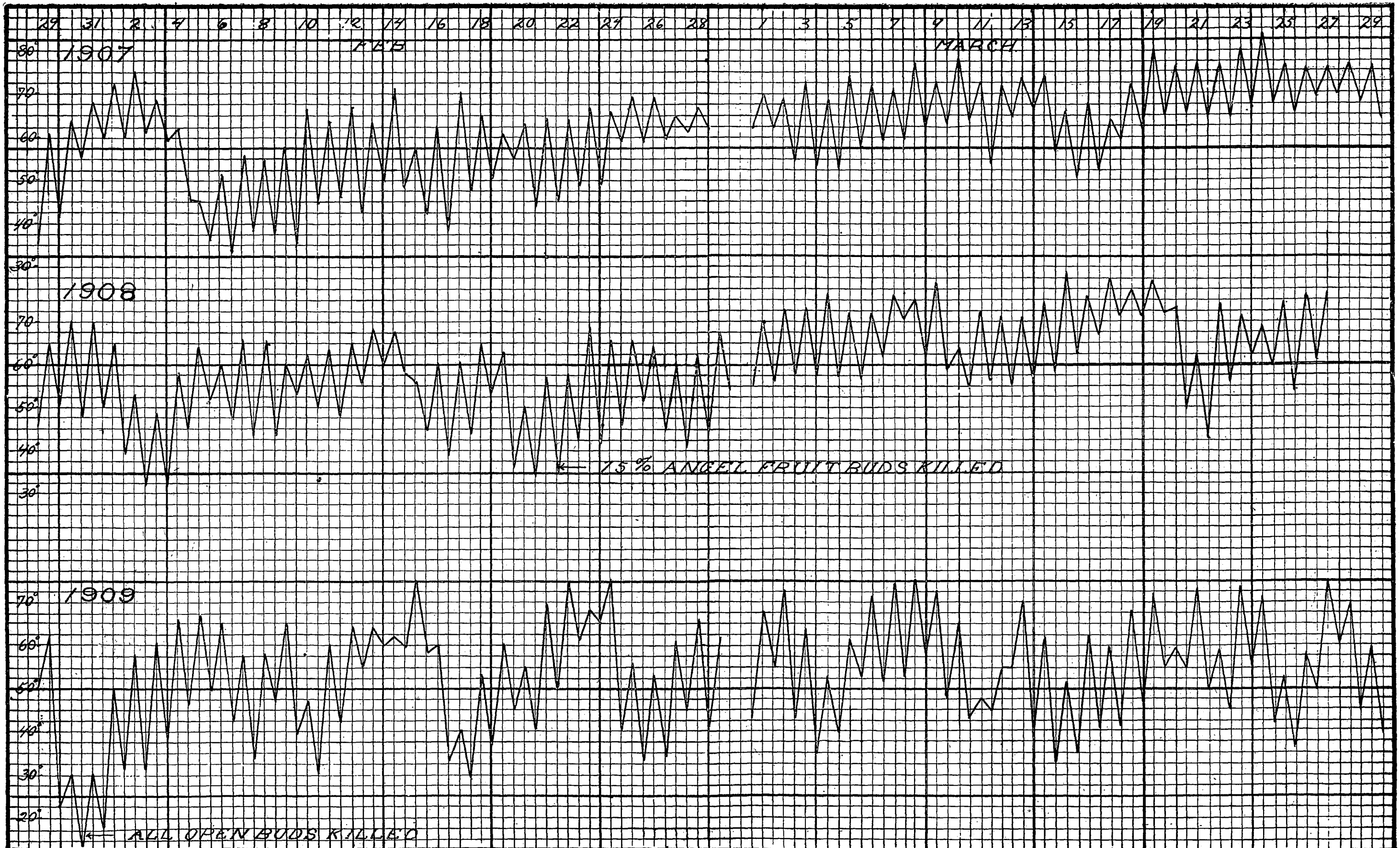
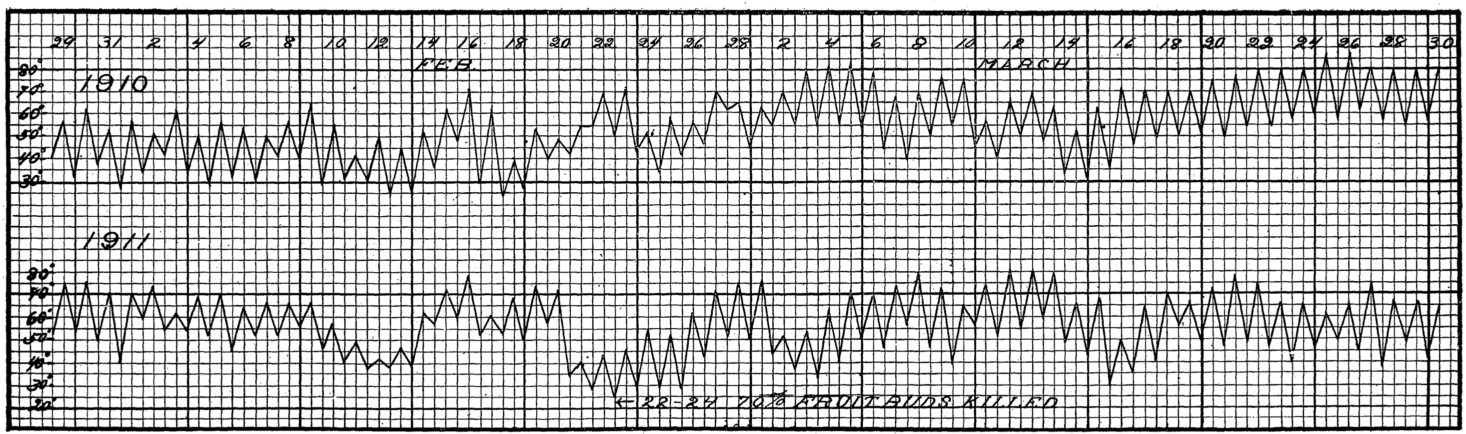


Fig. 4.



29 31 2 4 6 8 10 12 14 16 18 20 22 24 26 28 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
FEB
MARCH
1907
1908
1909
80° 70° 60° 50° 40° 30° 20°
← 15 % ANGEL FRUIT BUDS KILLED
← ALL OPEN BUDS KILLED


29
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30
FEB.
MARCH
1910
1911
80°
70°
60°
50°
40°
30°
20°
←22-24 70% FRUIT BUDS KILLED

Fig. 6.

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BULLETIN NO. 157 SEPTEMBER, 1911

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

THE SATSUMA ORANGE

BY

P. F. WILLIAMS, Horticulturist

Opelika, Ala.
Post Publishing Company
1911

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*In Co-operation with U. S. Department of Agriculture.

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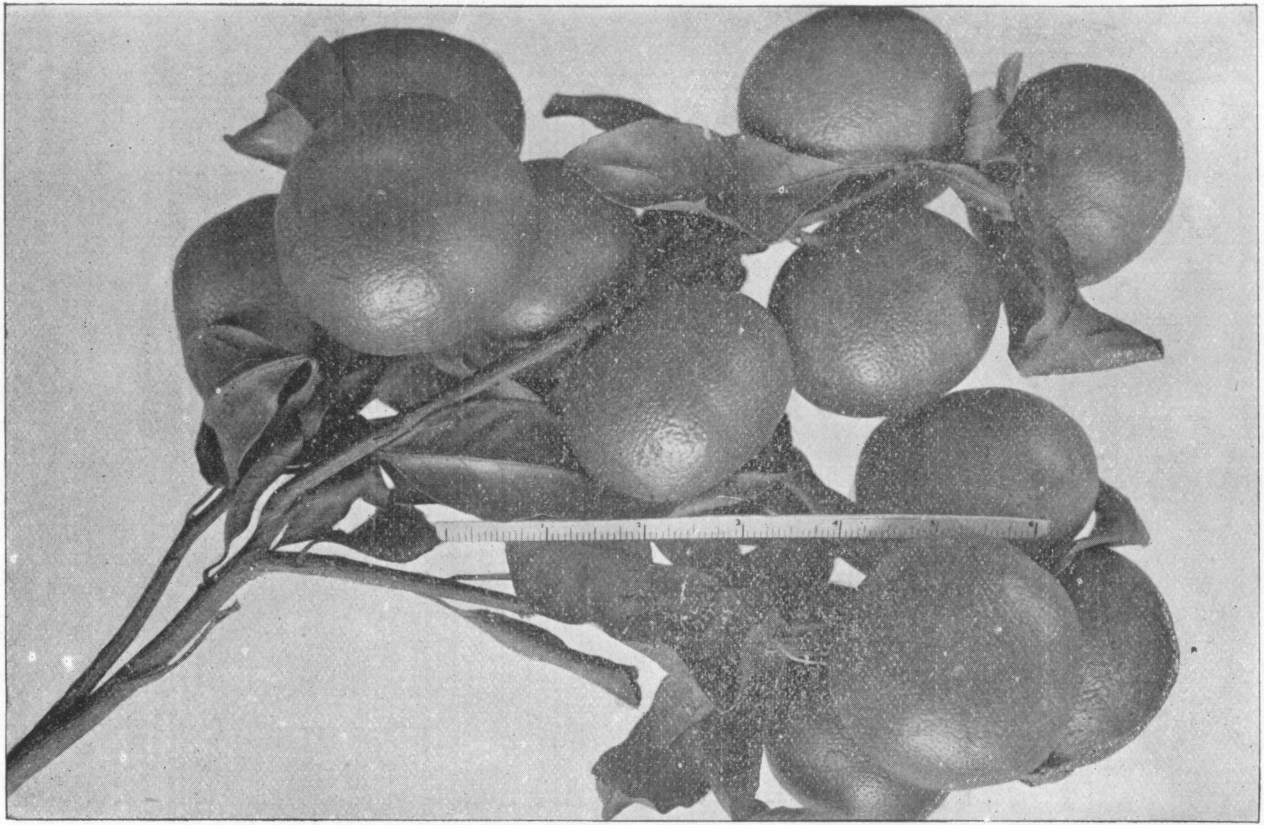

PLATE I, A cluster of Alabama Satsumas, showing their shape and relative size. (Photo by author.)

THE SATSUMA ORANGE

There has been such a demand for information relating to the culture and adaptability of the Satsuma orange to Baldwin and Mobile counties in Alabama that the following bulletin has been prepared not only to tell of the work already done but to encourage an industry that promises to bring considerable wealth to the lower section of the State.

As the boll weevil advances in Alabama more attention must be given to the cultivation of crops other than cotton and there is no fruit or vegetable which yields or even promises to yield higher net returns per acre than Satsuma oranges.

Although this orange is the hardiest edible orange in cultivation there is always a possibility of an unusual freeze killing the trees back and for this reason the writer does not advise anyone to invest in Satsuma oranges and nothing else. As explained later, banking the trees above the bud wood, during the winter, insures the orchardist against total loss as trees killed back to the mound will throw out sprouts which will bear again in two seasons. However, the earning capacity of the orchard is practically nil for several years and should such a disaster occur some other crop should be depended upon to tide over such an occasion. Most of the large groves now being planted have the Satsumas interspaced with pecans and this makes an excellent combination. The pecans will eventually overshadow the Satsumas but a considerable income will be realized on the latter before it becomes necessary to remove them.

There are many so-called "native" citrus trees in the lower counties of the State and these would indicate that there is reason to believe that Satsuma orange culture in that section could be made profitable. But aside from this there is evidence on every hand that the orange business has come to stay in Alabama as the writer has visited several bearing orchards which have not only produced profitable crops but their owners are increasing the planting every year.

Note.—The author is indebted to Prof H. Harold Hume for criticisms and suggestions kindly offered during the preparation of this bulletin.

The Satsuma orange belongs to the Mandarian group of oranges and undoubtedly came originally from China. Some three centuries ago the Satsuma was introduced into Japan and it is from this latter country that China now gets its supply. Some of the Japanese Satsumas enter our American markets.

The Japanese name for the Satsuma is *Oonshiu* and was introduced into Florida by Dr. Geo. Hall in 1876, and later by Mrs. Van Valkenburg in 1878.

There are several bearing Satsuma orange orchards in Baldwin and Mobile counties and one that the writer is particularly familiar with is that of Dr. Scott at Battles Wharf on the eastern shore of Mobile Bay. The trees in this grove range between 2 and 12 years of age and are in a very thrifty condition. A two and one-third acre grove netted Dr. Scott $1,400.00 in 1909.

The South Orchards Company, which is developing a 2400 acre tract a few miles south of Mobile, has planted approximately 48,000 Satsuma trees among a grove of 16,000 pecan trees. When this tract is completely planted it will be one of the largest combination orchards in the South.

Mr. A. H. Daves, of Irvington, has a grove in bearing in connection with his nursery. The trees are in a strong and vigorous condition.

Dr. A. B. Farnham, of Citronelle, has a small orchard which has proved successful.

Mr. A. B. Gaston, of Springhill; E. T. Molyneux, of Fairhope; Dr. Gaylord, of Barnwell, and J. M. Kroner, of Theodore, all have bearing trees which give every evidence that the Satsuma orange is particularly adapted to the lower section of the State.

Mr. Chas. Schultz, of Marlow, sold $50.00 worth from 12 trees, besides all the family could pick up for themselves and friends.

Mr. Thomas Brigden, a pioneer horticulturist residing at Prospect in Walker county, recently informed the writer that he experimented with Satsumas some years ago, a friend in Japan having sent him several specimens. One of his trees was given no protection and was killed by frosts the first season. The second tree was sheltered with pine boughs during the winter. The second season this was killed when the temperature went to 15 degrees below zero. The third tree was planted in a box and placed in a shed during the winter from November 1 to March 1. This third tree produced 8 or 10 crops consisting of 20 to 30 of the most delicious fruit. He stated further, "that with the same care given a tea rose, Satsumas could be handled in a small way even as far north in the State as Prospect." This would indicate that those who take pleasure in handling any sort of plants that need this protection through the winter could grow a few Satsuma oranges which would not only add much interest to their endeavors but would at the same time supply a considerable number of delicious fruits. Should the effort fail a few times the expense and loss of time would be very slight.

POMOLOGICAL DESCRIPTION OF FRUIT.

Form oblate; sections frequently showing through the rind; size variable, $1\frac{7}{8}$x$2\frac{5}{8}$ inches and $2\frac{5}{8}$x3 7-16 inches representing the variation in size; color, orange yellow; base usually slightly creased; calyx, small; apex, scarred with a round brownish spot situated in a broad shallow depression; rind, $\frac{1}{8}$-inch thick, inclined to be rough; oil cells, large, conspicuous, frequently depressed, though sometimes flush with the surface; flesh coarse grained, deep orange in color; juice sacks short, broad; juice abundant, yellowish orange in color; pulp melting; acidity and sweetness well balanced; flavor sprightly, agreeable; quality excellent; pith open with the sections, frequently separated at the inner edges; generally seedless, though occasionally from one to four seeds are found, top-shaped, broad, plump, not distinctly beaked as in others of the group; season October-November.

Tree thornless, evergreen, and of spreading dwarf habit, branches reclinate, branchlets angled; leaves broad, tapering abruptly toward the apex, petioles scarcely margined. The leaves generally point upward and thus either follow the direction of the branches or are at right angels to them. The smaller fruits ripen first while the larger ones are later in maturing. In extreme southern climates it does not color well, but remains green or greenish for a considerable time after the juice has acquired its best flavor.*

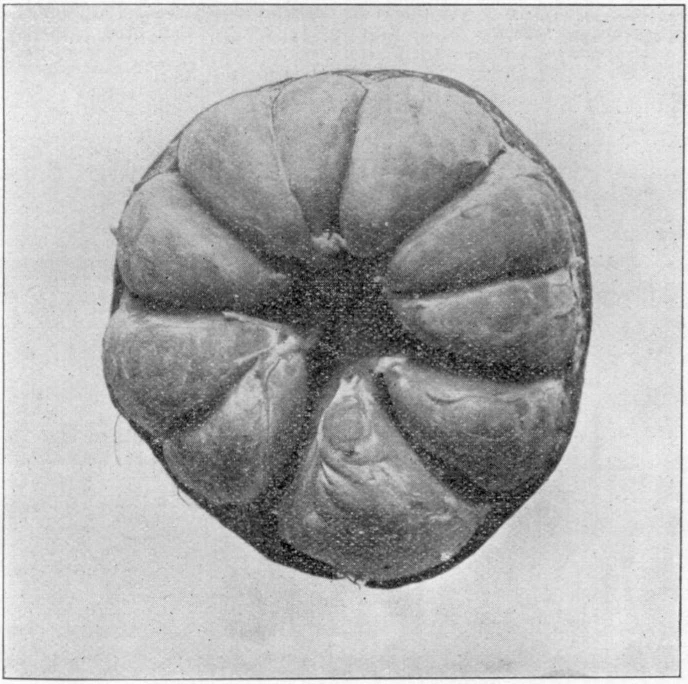

PLATE II. A Satsuma fruit, actual size, showing how readily the sections part. (Photo by author.)

As the trees are thornless the danger of the fruits being punctured during windy weather is eliminated. The plates on pages 163 and 165 show the characteristic form of the trees.

The Satsuma orange is very prolific and comes into bearing when two years old . The writer has counted the fruits on a number of two-year-old trees in Mobile and Baldwin counties which had from 50 to 125 fruits to the tree. The four-year-old trees had from 200 to 400 fruits and 8 to 12 year trees from 1,000 to 1,500 fruits. In Baldwin and Mobile counties the fruits begin to ripen the latter part of September, the main har-

*Description by Prof. H. H. Hume.

vest being made October 8th or 9th. The fruits remaining on the tree even into January retain their excellent flavor but it is not advisable to leave large quantities of the fruit on the trees as late as this as freezing weather will cause serious damage to the fruit. However, this shows that the market season easily ranges from October 1st to January 1st.

The larger Satsumas seem to lack the quality and flavor of the medium sized fruits. Many of these larger fruits are coarse rinded and often warted and contain a large percentage of "rag," indicating that the tree has been supplied with an excess of nitrogen supplied from vegetable sources or that the crop on the tree or sometimes on a single branch of an otherwise well laden tree was scattered which would produce the same effect, the fruits in such cases having an excess food supply.

The more oblate fruits seem to have the best flavor. Variations in the fruit as well as the different stages of ripening will be found upon the same tree. To the person picking Satsumas for the first time, it seems peculiar in removing the rind of a green fruit to find the pulp ripe. Of course, it takes a golden color to sell the fruit and these green fruits are allowed to color up before picking. In extreme southern sections of the gulf coast the coloring comes very late. This is objectionable as the fruits on the trees are apt to be injured by subsequent freezing temperatures and shipments are delayed.

SITE.

There are many factors which make Baldwin and Mobile counties adaptable for the production of Satsuma oranges. Both have the advantage of accessibility to a central shipping point, namely, Mobile, which has direct through railroad lines to the north and east. The principal advantage of the region is the climate. There are no locations in the orange growing regions which are positively safe from the danger of frosts. There are sometimes, numerous locations within a radius of a mile where frosts seldom cause any serious damage while within that same radius might be found spots which are affected by even the slightest frosts. Such factors as elevation, proximity to bodies of water, direction of the wind, wind breaks, cold air drainage, etc., determine the susceptibility to frost injury even more than latitude. A location either on the side of an elevation or upon its top is preferable to the lower situations.

The prevailing winds in different sections of Mobile and Baldwin counties are variable for the most part. At Daphne, on the eastern shore of Mobile bay, the wind generally comes from the southwest. In determining the position of windbreaks the older residents of the locality where the orchard is to be planted should be consulted.

The fact that there are many thrifty twelve-year-old trees about Mobile is sufficient proof that the lowest temperatures of the winters during the life of those trees has not been detrimental to them. There is more danger from freezes which follow wind and rain storms than the frosts. Under the subject "methods of protection" the elimination of this danger is discussed. Although Satsumas have not been killed back in the past 12 years there is always a possibility that this may occur and should it, provided the trees have been banked above the bud wood, sprouts will throw out forming new heads which will bear in two or three years. Of course, this may mean a serious, although a temporary loss and the grower of limited means should not be dependent entirely upon his citrus grove but should cultivate other crops in conjunction with it to tide over any period of misfortune. If Satsumas are killed to the ground every twelve years, which is very unlikely to happen, they will still pay splendid dividends on the money invested, where they are cultivated and fertilized properly.

The minimum temperatures from 1897 to 1911 as recorded by the weather bureau station at Mobile follow:

Jan.	28th,	1897	18
Jan.	2nd,	1908	20
Feb.	13th,	1899	1
Feb.	18th,	1900	19
Dec.	21st,	1901	16
Dec.	27th,	1902	23
Feb.	17th,	1903	24
Jan,	27th,	1904	27
Feb.	14th,	1905	15
Dec.	24th,	1906	27

Dec.	5th,	1907	32
Jan.	24th,	1908	28
Dec.	20th,	1909	22
Jan.	7th,	1910	26
Jan,	5th,	1911	18

SOILS.

In Mobile and Baldwin counties the coastal plain rises in gentle swells to about 300 feet above tidewater. There are several types of soil in both these counties and for the most part the surface soil is generally adapted to Satsuma orange culture. More depends upon the nature and proximity of the sub-soil to the surface. Citrus fruits grow on a great diversity of soils although it is noted that a soil containing too much vegetable nitrogen produces abundant wood growth and very poor fruit. This condition may be counteracted by using fertilizers rich in potash. A sandy hammock soil is preferred by the older growers. This soil is found where the timber growth consists or consisted of such trees as magnolia, hickories and oaks. The clay should be within at least 12 to 18 inches of the surface. Bloom will drop if the clay is down too far below the surface. It is impossible to grow Satsumas on alkali soils. High lands are preferable. The soils in Mobile county, for the most part, are a little heavier than those in Baldwin county.

Above every consideration drainage should be thought of. Either the underlying sub-soil should be sufficiently porous to allow moisture to pass down through it or ditches should be made to carry off the excess water.

STOCK FOR SATSUMAS.

Satsuma trees should be budded on *Citrus trifoliata* roots. These are conceded to be the hardiest roots known, and adapt themselves to a wide variation of soils. Prof. Hume has noted an instance where this plant has withstood a temperature of 22 degrees F. below zero without injury. *Citrus trifoliata* is deciduous and this is the only instance we find of the kind among the citrus fruits. As a fruit itself, it is worthless, except for propagating and breeding purposes. There are other stocks used to a considerable extent in the orange industry, but the *Citrus trifoliata* is the only stock that should be used for propagating

Satsuma oranges. Grown on other stock, the Satsuma does not attain such excellent flavor and the trees on other stocks are usually either shy croppers or poor growers. Again, trees grown on *Citrus trifoliata* ripen the fruit several days earlier than other stocks.

Purchasers of Satsuma trees should assure themselves that their trees are budded on *Citrus trifoliata* stock. Mr. Walter T. Swingle, of the Bureau of Plant Industry, has explained the differences between the pith cells of the trifoliata and sour orange. This requires a microscopical examination and where there is any question in the matter specimens of the pith from the main root may be sent either to the Department of Horticulture at Auburn or the Bureau of Plant Industry, Department of Agriculture at Washington, D. C. Groups of the pith cells of the trifoliata orange have thick walls which readily distinguish them from the even and thin walled cells of the sour orange pith. Small portions of the pith can be taken from the root without serious injury to the tree.

The best trees to plant are those with a one or two year top on three or four year old roots. A vigorous, well shaped nursery tree appears below.

PLATE III. An ideal Satsuma tree from the nursery. One-year top on three-year roots.

The Chinese and Japanese have used *Citrus trifoliata* as a stock for citrus trees for centuries, but it is only recently that the stock has been used for this purpose in this country, and there are yet many points to determine, concerning its adaptability for certain soils and elevations, also its influence in dwarfing trees worked upon it.

San Jose scale attacks *Citrus trifoliata,* but as it does not attack other species of citrus fruits, this is not serious. The stock generally outgrows the top worked upon it, and the more vigorous the top, the more vigorous the stock.

The fact that this stock is not responsive to sudden changes in temperature, especially to those warm spells which generally start activity in other trees during January and February, adds greatly to its value. There is no question but that the stock has a very marked influence on the top growing upon it, and as the Satsuma is the hardiest sweet orange grown, the combination adds, of course, materially to its hardiness.

Satsuma oranges are budded to *Citrus trifoliata* stocks. Buds are inserted in March and April, this being known as *Spring Budding.* When budding is performed in June or July, the term .*Summer Budding* is given, and *Dormant Budding* is practiced during September and October. In the latter case the buds remain dormant until the following spring. To protect the dormant buds or the point of union where the budded top has already grown out, soil is banked up on either side of the nursery rows.

The common method of budding is known as T budding but in this case the reversed T is used. The stocks selected are often those resulting from seed planted in the spring, during February, and worked the following spring if of sufficient size. Generally the trifoliata seed is sown in the fall. They sprout in the spring and the following spring they are transplanted and budded in September. The older stocks are better and those two or three years old are most commonly selected. The greatest danger from excessive cold is at the point of union of bud and stock and for this reason care should be taken to bank the soil up above this. Where the point of union is well down toward the crown of the stock this is more easily accomplished.

All leaves and limbs should be removed from the stock near the ground to facilitate wrapping the inserted bud. A little wood removed with the shield containing the bud does no harm. The bud is pushed gently up under the raised ends of the bark of the stock until all its cut surface has come in contact with the opened surface of the stock. Budding cannot be practiced, unless the bark slips readily.

The buds should be wrapped with a strip of waxed cloth, or raffia beginning slightly below the lower cut, wrapping it tightly around the stock in a spiral manner, so that each new edge overlaps the previous one, and as soon as the vertical cut has been covered, draw the cloth down across this, as it will stick readily to the cloth, and there will be no necessity for tying. The bud is covered with cloth, which is contrary to the method practiced with other fruits.

Considerable attention should be paid to bud selection, as there is great variation in the character of fruits produced on different branches, and where possible, buds from branches bearing the finest fruit should be selected. The demand for Satsuma trees has been so great the past few years, that many nurserymen have been forced to utilize all available bud wood, and in some cases they have not given as close attention to the selection of buds, as is desirable. Trees grown from selected buds will cost more than those not selected but growers will gladly pay the difference in price.

The buds may be unwrapped in from ten to twelve days if the weather has been warm, otherwise they should not be unwrapped for from fifteen to twenty days. Experience will teach the propagator just when the buds should be unwrapped, and an examination of two or three buds will generally indicate the proper time for unwrapping.

Practically all orange trees are dormant budded, banked in the autumn and as soon as danger from frost is past the banks are removed and the tops are cut entirely off close down to the buds. Lopping is not often practiced the tops being entirely removed. If the stocks are of good size the cut surfaces are painted immediately with white lead. If they are small in size painting is not necessary.

PLATE IV. Showing a row of one-year-old Satsumas in the nursery.

The ideal Satsuma tree is one that is well branched, and in order to produce this sort of tree, it is necessary to cut the tops back when they are two feet high, to induce them to put out more branches. All buds developing below the bud on the stock, should be removed, as they take the strength from the bud wood.

Cost of Trees.

The prices quoted for Satsumas budded on Citrus trifoliata stock in a 1911 catalog published by one of the largest southern nurseries growing citrus trees are as follows:

	Each	Per Ten	100	1,000
1 to 2 feet	.35	$3.00	$27.00	$240.00
2 to 3 feet	.45	4.00	35.00	320.00
3 to 4 feet	.55	5.00	45.00	420.00
4 to 5 feet	.65	6.00	55.00	520.00
5 to 7 feet	.75	7.00		

Many beginners in orange culture are over-anxious to secure bearing trees and consequently neglect to lay the foundation for the orchard properly. As stated above, a crop should have been grown on the land previous to the setting of the trees. Velvet beans, or cow peas are excellent crops to be turned under to supply humus and add nitrogen to the soil. Such a crop saves on the fertilizer bill considerably and at the same time puts the soil in the proper condition for tree planting.

Preparation of the Land.

Complete clearing is far more preferable than partial clearing. All standing timber except portions which may be utilized for wind-breaks should be cut and the stumps removed. A stump puller, the use of dynamite or burning out the stumps are methods generally practiced. All this work should be done the winter previous to the planting. One method commonly practiced is to plow the land 4 inches deep during the winter before planting and later plowing again about 10 inches deep. This method allows the humus to remain near enough to the surface to promote nitrification and the deep plowing mixes the decomposed vegetable matter thoroughly with the soil.

If the first plowing is deep a disc plow should be used, as this turns the soil on edge allowing the vegetable matter to decompose without souring. This method also prevents a deep layer of clay being thrown up to cover the humus. Shallow plowing can then follow in the spring when such crops as cabbage, Irish and sweet potatoes, peas or beans can be planted followed by late Irish potatoes. Good clean culture the first year should be practiced on new land to put it in shape for the orange grove.

Where the sub-soil consists of rather stiff clay a sub-soil plow should be used along the proposed tree rows to allow the roots to easily push their way into the moisture retentive soil. After plowing the harrow should be used and this followed by a drag consisting of overlapping planks which will put the surface in excellent condition. This thorough preparation aids the stakers and hole diggers.

Systems of Planting.

There are several different methods of laying off a grove consisting of the square, triangular, hexagonal and quincux systems. The hexagonal (six sided) system, or the square system, should be used unless the Satsumas are planted between pecans. In the latter case the square or rectilinear method should be used.

Double plantings may be made such as placing a peach tree in each square of orange trees. The peach tree serving its usefulness in 5 or 6 years is cut out.

Inter-cropping.

Many crops can be grown between the tree rows until they seriously interfere with the best development of the Satsumas. Some growers have been raising vegetables between the rows the first few years with much profit.

Laying out. A stout wire is often used, which is long enough to reach along one side of the field. This wire should have rings at 16-foot intervals or pieces of wire soldered to it at these intervals. Two sixteen-foot wires with rings attached to either end are also used. Having placed stakes at the intervals along the wire establishing the locations of the first tree row, take the sixteen-foot wires placing one end of one on stake No. 1 and the end of the other on stake No. 2, then bring the other ends together and at the place they meet place a stake for the beginning of row No. 2. This is repeated, next placing the first 16-foot wire on stake No. 3, bringing it to meet the wire on No. 2, etc., continuing until row 2 has been staked off. Row 3 is similarly determined.

Time for Planting.

There are many planters who advocate November planting of Satsumas, while others contend that the trees should be planted in February. If the soil is moist in February or March, providing the trees are freshly dug, planting at this time may be successful. In fact, there have been successful plantings of the Satsumas at various times throughout the winter but all things considered, November or December planting is preferable. There is, of course, the danger of frosts injuring young trees, but this is obviated by banking clean earth, free from pieces of weeds or trash up several inches about the bud wood, this earth to be pulled away in the spring, after danger from frosts has passed.

Transplanting can be done in July or August if the trees have been selected and there is plenty of moisture in the ground, but there is little necessity for moving trees at this season.

Planting.

The roots of the *Citrus trifoliata,* upon which the Satsumas have been budded are very fibrous and delicate, and great care must be exercised in the handling of the trees after they have been removed from the nursery. These delicate roots should not be exposed to wind or sunlight, and even when the trees are taken to the field, the roots should be kept covered, and a sufficient number of holes should be prepared, so that there will be no delay in getting the unpacked trees into the ground.

The different States which have nursery inspection laws, require trees to be entirely defoliated, and fumigated before they are shipped, and this so-called "goose-picking" prevents the distribution of the insect known as White Fly, which is a menace to the citrus industry.

Most of the nurserymen have been pruning the roots before sending the trees out, but the business has grown so rapidly that they have been giving up this practice. It would be much better for the nurserymen to attend to this, as the planters are very apt to pay little attention to either top or root pruning.

Satsuma trees are packed in bales by the nurseryman in lots of 100 to 500, depending on their size. Boxes are used for lots of 2,000 or over. It generally pays to have the trees shipped from the grower by express as delays in transit are often disastrous. As the roots dry out very rapidly the nurserymen should be required to "puddle" them before packing and when the trees are ready for planting the "caked" earth should be washed off.

The holes should not be prepared until everything is ready for planting, to conserve the moisture; they should be commodious, and in planting the trees the fibrous roots should be spread out very carefully, as wherever they are allowed to become matted, they are apt to ferment and rot. Mr. E. T.

Molyneux, of Fairhope, Ala., has had considerable experience in planting Satsumas, and he has one man throw the dirt in about the roots, while another uses a watering pot to settle the dirt as it is thrown in, until the hole is nearly full, and then the remaining portion of the hole is simply filled with loose soil, which gradually settles. In planting trees, particularly oranges, the planter is generally too hasty, and with the exception of poorly prepared land, this is the cause of the frequent losses in new plantings.

Practically all the root system for Satsumas should remain intact and the pruning should consist of the removal of broken and bruised portions, making smooth cuts above these, as these smooth cuts will callous rapidly, and from these callouses, new roots will be rapidly produced. Wherever the roots become dry, the dry portions should be removed. The trees should be planted at the same depth that they were in the nursery rows, and to protect the newly planted trees from the hot rays of the sun, the trunks are often wrapped in paper or straw, or covered with whitewash. The top, if consisting of a single stem, should be cut back about two feet above the ground, and if there are any branches leading from this, these should be cut back to spurs, having two or three buds on them.

The top soil should always be saved to place down around the roots and where this is very poor use about one pound of a commercial fertilizer rich in nitrogen well mixed with it placing this in the hole at least six inches below and six inches further out than the roots reach. Some growers have used a dressing of rotted stable manure as the only source of fertilizer until the trees come into bearing, care being taken not to have this come in contact with the roots or body of the tree. This practice is dangerous, however, as manure is not apt to be well rotted when it appears to be. Some nurserymen have lost many trees by using supposedly rotted manure. A pound of bone meal added to the manure is still more beneficial. When the trees have come into bearing fertilization with stable manure or sources of vegetable nitrogen should cease as this tends to produce excessive wood growth at the expense of fruit. Again the fruit resulting from such fertilization tends to be oversized and "warty" and the flavor is very poor.

Fertilization.

No fertilizer should be used at the time of planting unless the soil is very poor. The fall after planting use stable manure or scrapings from the barnyard and dig it in about the trees, not working too close to the trunk. When the trees are bearing well and growing vigorously, fertilize well, with about five pounds per tree of the following formula on land with a moderately heavy clay sub-soil, applying it about the latter part of March:

100 lbs.	sulphate or muriate of potash.
950 lbs.	cotton seed meal.
950 lbs.	14% acid phosphate.
2,000 lbs.	Total.

The above is an 8-3-3 goods.

For land with sandy clay sub-soil use an 8-2-9 formula consisting of the following:

1,000 lbs.	acid phosphate.
200 lbs.	cotton seed meal.
36 lbs.	nitrate of soda.
360 lbs.	muriate of potash.
404 lbs.	soil.
2,000 lbs.	total.

When the sub-soil is light it will require an 8-4-12 formula.

Mr. A. H. Daves at Irvington, Ala., who is growing Satsuma oranges successfully, has been applying 400 pounds of bone meal and 200 pounds of potash for his half acre orchard, making the application the latter part of April or first of May after the bloom has set.

Cultivation.

In most sections of Mobile and Baldwin counties it is advisable to bank the trees with clear earth up several inches above the bud to protect the trees from possible freezes. Cultivation should not commence until danger of such freezes are past when the banks can be removed.

For the first two years cultivation should consist of using a two-mule plow and harrow, several shovelfuls of stable manure having been scattered close enough to the trees to benefit them but not too close to the trunk of the tree. Two weeks after plowing, cow peas may be planted in rows between the tree rows. In the middle of the tree rows next the water furrow a row of velvet beans can be planted. The cow pea vines will be dried up in July and at this time the velvet beans will have reached the tree rows. There is seldom trouble from the beans climbing the trees as they have attained their maximum growth by the time they have covered the tree rows. This system of planting cover crops will conserve moisture and time spent in cultivation. After frosts have killed the beans they may be turned under.

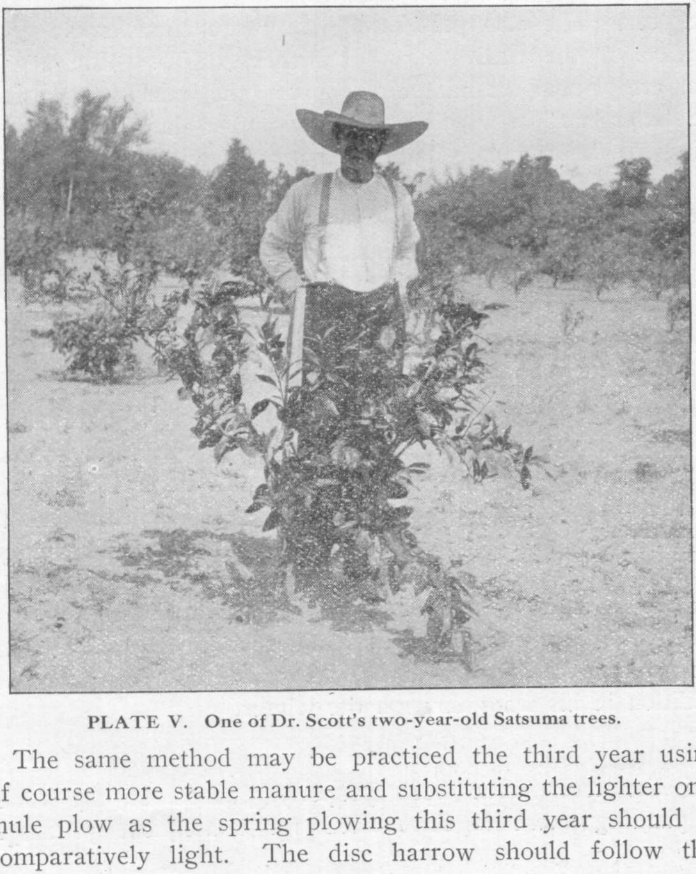

PLATE V. One of Dr. Scott's two-year-old Satsuma trees.

The same method may be practiced the third year using of course more stable manure and substituting the lighter one-mule plow as the spring plowing this third year should be comparatively light. The disc harrow should follow this light plowing to level the ground.

From the third year on light cultivation should be practiced. Provided there is still much vegetable material scattered over the surface of the grove which has remained from the previous fall it will be necessary to use a cut-away harrow for the first cultivation. This first harrowing can be rather deep provided the new roots have not come too close to the surface. After this first harrowing it is merely necessary to maintain a mulch of pulverized soil over the orchard to a depth of not over an inch or two. This can be accomplished by using a light weeder if the preliminary cultivation has been sufficient.

Where cow peas are planted between the trees in the grove they should receive a liberal application of fertilizer using 200 pounds of acid phosphate in the drill before planting the peas. The cow peas often pay for a considerable proportion of the cultivating and fertilizer bills. Where the peas are planted the middle of January they can be harvested the latter part of April and at this time they bring good prices in the market. The pea rows should not be planted closer than six feet from the spread of the tree branches and their cultivation should be discontinued at any time when they interfere with the growth of the trees.

It will require a light cultivation about every ten days mucn of course depending upon the rains, to keep the grove in perfect tilth. This should be continued until about the first of September. Later cultivation than this may prove disastrous owing to the fact that the trees respond readily to cultivation and it is the object at this season to allow the wood to harden and mature in preparation for winter. All vegetable growth on the ground should be turned under by December first. From observations made the past winter it has been clearly shown that trees should not be forced in view of their susceptibility to frost injury. When the trees are in a thoroughly dormant condition there is little danger from excessive cold weather and the grower should aim to maintain that dormant condition in his trees through the winter.

Pruning.

If the trees have been properly pruned at the time of planting there is little need for subsequent pruning.

A low headed tree is preferable and by this is meant one which does not branch more than 12 to 18 inches above the ground. Whenever cuts are made they should be made smooth and when branches are removed which are one-half inch or more in diameter the cut faces should be painted with white lead.

PLATE VI. A six-year-old Satsuma tree.

Since the big freeze of '98 practically every grower has headed his trees much lower than previous to the freeze. The foliage being nearer the ground serves as a considerable protection to the trunks of the trees. It is much easier to gather the fruit from the low headed trees. Such trees are also better able to withstand high winds. In case it should become necessary to use orchard heaters or build fires to protect the trees during a freeze it will be found an advantage to have the trees headed low as there is less air circulation in such a grove. Staking the heavily laden branches is not always necessary. The lower branches lying upon the ground will support those above them and there is practically little damage done to the fruit resting upon the ground. Staking or "propping" is rather expensive. Where the owner has but a few trees it might be well to prop the branches.

Protection Against Cold.

It is advisable to bank the trees through the winter as before mentioned. This had best be done from the middle of November to the middle of December. Most of the coldest weather occurs through January and February but there has been one instance when the temperature has fallen to 16 degrees F. as early as December 21st. Care should be taken not to bank the trees too high as this may injure them. It is only essential that a sufficient amount of bud-wood be protected. The soil used in banking the trees should not contain decaying vegetable matter as this may injure the bark where it comes in contact with it and it may foster the work of wood-lice. Winter rains will cause the banks about the trees to settle and it may be necessary to go over the trees a second time in the course of a few weeks.

When the temperature reaches 27 degrees and there is fruit on the trees wood fires or the orchard heaters should be started. There is also danger with the temperature at 30 degrees when the trees are opening their fruit buds. The older trees withstand low temperatures much better than the younger trees.

There are a number of good orchard heaters on the market the average price being $30.00 per hundred. Much depends on their capacity. The heaters should hold not less than two gallons of fuel oil. The greatest damage is apt to be done between 2 a. m. and 6 a. m. but the trouble may start even before this. Fuel oil should be used and this can be secured in carload lots at 2 1-2 cents per gallon. This oil should be purchased on a co-operative basis, that is, several growers should combine in ordering and thus materially reduce the price they would necessarily pay on small quantities of oil. This oil can be stored in galvanized iron tanks or in cemented cisterns provided the walls of the latter have been coated with a layer of asphalt paint to prevent leakage.

Although the orchard heater may never be called upon to save an orange orchard or crop it is always prudent to be prepared. The heaters have lately come into prominence among the vegetable growers and where the latter are grown in large quantities for the northern markets in addition to the culture of oranges, the value of the heaters is much more augmented.

Marketing.

The earlier the period of ripening of the Satsuma the more important, from a commercial standpoint as at that time there is practically no competition from either the California or Florida oranges. Where the Satsuma is known, even with this competition, there would hardly be a chance of crowding out the Satsuma, as among a great many people it is preferred even to the Florida and California orange. The Texas growers are somewhat concerned regarding a future market for the Satsumas coming from the large groves which have been planted there recently, but the writer believes that first-class Satsumas, well graded and well packed and placed in the right markets will always bring profitable returns for the growers. The fruit packs and ships well and will not deteriorate in two or three weeks from the time of picking.

As the production of Satsuma oranges increases it will be necessary for the fruits to be cured as the Florida and California oranges are treated before shipping them. In Texas they are curing their Satsumas in large curing houses. The fruits are gathered in half bushel boxes which are 22 inches wide, 40 inches long and 12 inches high. These have a partition in them and as they are brought into the curing house they are placed in tiers. At the duration of 4 to 6 days early in the season or 2 to 5 days later in the season the fruits are graded and packed. Treated in this way the fruits will keep a considerable time in the open market.

The "special" market uses up the present supply very rapidly, and as more people learn the value of the orange and with constant shipments from the growers there is little doubt that the question of keeping quality will not concern the grow-

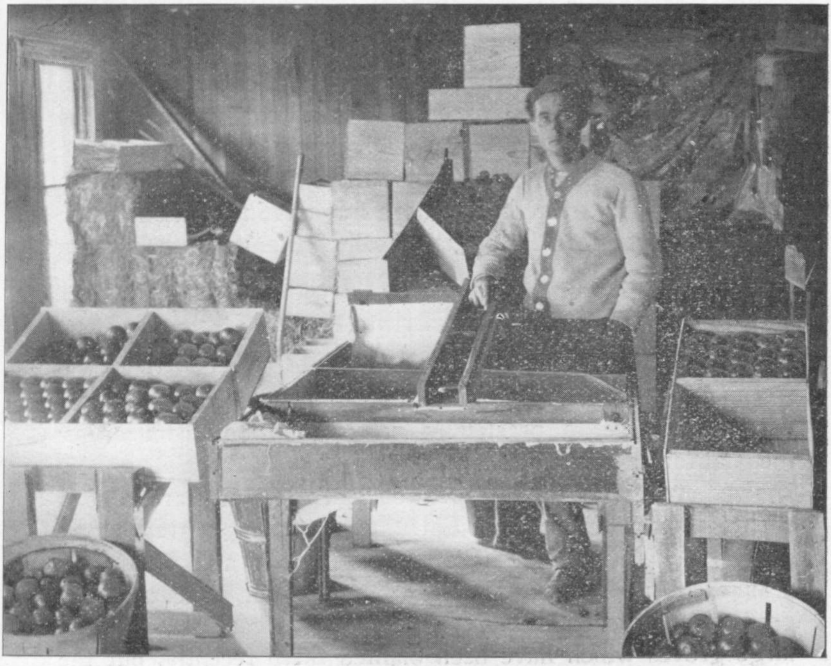

PLATE VII. Interior of a small grading and packing shed.

ers for some time. Chicago people have become very fond of the Satsuma and many of the southern growers are shipping their oranges into that market. At present the cities of Mobile and New Orleans consume most of the oranges grown along the gulf counties of Alabama, Mississippi and Louisiana. Most of the fruit is packed in barrels which contain from 700 to 900 fruits bringing from \$16 to \$18 per barrel. Shipping by the barrel is much cheaper for the grower, and will do very well at present for the local trade, but for northern shipments the half-crate or strap is used. Some of the growers are paying considerable attention to proper packing and grading, and this, of course, is to be commended and will be necessary as the industry increases. These straps contain on the average about 240 fruits and bring from \$4.25 to \$4.50 in the wholesale market. Dr. Scott, of Battles Wharf, has been selling his fruit by the hundred at from \$1.75 to \$2.00, the fruits bring from 10 cents a dozen up to 35 cents a dozen retail, depending on their size and quality. The fruit runs from 1½ to 3½ inches in diameter.

DISEASES AND INSECTS.

Although there have been very few reports from Satsuma growers in Alabama concerning fungus or insect troubles the trees have been attacked by both in other sections and there is the probability that with the increase in plantings more instances will be noted of these troubles. Prof. Harold Hume in his book entitled "Citrus Fruits and Their Culture" has given much valuable information concerning the diseases and insects attacking citrus fruits and abstracts from portions of his descriptions follow:

Citrus stock is resistant to a large degree to the disease known as Foot Rot. This trouble is confined to the crown and main roots of trees extending about a foot above the ground and to some distance down along the roots. An exudation of gum indicates the trouble. When the tree is attacked the leaves turn yellow.

Scab.—This trouble has been found on Satsumas and when they are attacked by it the fruits become distorted and warty, corky elevations cover the surface and give it a roughened appearance. Often the leaves are drawn out of shape. The disease is caused by a species of *Cladosporium citri.**

The disease can be controlled by spraying the trees with ammoniacal solution of copper carbonate. This solution is not apt to injure the foliage. The formula is as follows:

Copper carbonate, 5 ounces.

Strong ammonia (26 per cent.) 3 pints.

Water, 50 gallons.

Reduce the copper carbonate to a thin paste with water; slowly add the ammonia. Finally add the fifty gallons of water.

Sooty mold.—Practically all citrus growers are familiar with this trouble. Where present the leaves, fruits and twigs are covered with a black sooty coating. Wherever scale and associated insects which exude honey-dew are present this sooty mold will be found. This fungus lives on the honey dew and when it follows the attacks of the White Fly (*Aleyrodes citri*) which attack the under sides of the leaves the damage is considerable.

The leaf surfaces being covered with the fungus are unable

*Recently determined by Fawcett.

to perform their functions and create an unhealthy condition of the trees. The stem end of the fruits are generally covered with the fungus and necessitate brushing of such fruit before placing it upon the market. This treatment is apt to be detrimental to the fruit and adds considerably to the cost of harvesting and marketing.

To eradicate the trouble the insects must be destroyed which secrete the honey-dew and this matter is treated under the subject of Insects.

INSECTS

White Fly (*Aleyrodes citri* Riley and Howard.)

During warm weather egg laying commences within thirty hours after the adults appear. The eggs are deposited upon the under surface of the leaves, generally on new shoots. Hume has noted 20,000 eggs deposited upon a single leaf. The eggs hatch in from three to twenty days much depending upon the weather. The young larvae being whitish green and transluscent are rather difficult to discern. There are four larval stages before the pupal stage is reached.

The adult female is a little over 1.4 mm. in length and her wing expanse is about twice the length of the body (1-10 of an inch). These wings are colorless when the female is first hatched but become covered with a white wax within a few hours. The male resembles the female.

Treatment.—All nursery stock should be completely defoliated before being planted. Trees affected should be either fumigated or sprayed with hydrocyanic acid gas with Good's Potash Whale Oil Soap or Schnarr's Insecticide during the pupal stage of the insect. The spray mixtures mentioned are recommended for small growers.

Fumigation methods have been discussed at length in several Department of Agriculture Bulletins, the latest contribution to the subject being Bureau of Entomology Bulletin No. 76 which can be obtained by writing Secretary Wilson or addressing the Department of Entomology at Washington, D. C.

In a recent article in the Florida Grower, Mr. W. W. Yothers and Mr. S. S. Crossman have discussed some results of their work with miscible oils for controlling the White

Fly. Four formulas are given and a summary of their results follow:

FORMULA No. I.

Caustic potash whale oil sop....................	1½ gals.
Crude oil (not distallate oil) 24 degrees Baume..	3 gals.
Water to emulsify about........................	1½ gals.

This will make about 200 gallons of the spray material containing 1½% of oil. Cost about 63 cents.

FORMULA No. II.

Caustic potash whale oil soap....................	2 gals.
Distallate oil (gas oil) 30 degrees Baume...........	4 gals.
Water to emulsify about	2 gals.

This will make 200 gallons of spray material containing 25% of oil. Cost about 84 cents.

FORMULA No. III.

Caustic potash whale oil soap....................	2 gals.
Paraffine oil (Diamond paraffine oil) 28 degrees Baume	3 gals.
Water	1 gal.

This will make 200 gallons of spray material containing 1½% of miscible oil. Cost about $1.00.

FORMULA No. IV.

Caustic Potash whale oil soap....................	2 gals.
Paraffine oil (Junior Red Engine oil) 2 degrees Baume	3 gals.
Water	1 gal.

This will make 200 gallons of spray material, containing ½% of oil. Cost about $1.05.

Preparation.—Care should be taken to add the oil to the soap gradually while it is being stirred. Satisfactory results cannot be obtained by adding the oil to the soap or the soap to the oil too suddenly. This stirring should continue for about a minute, when the water may be added. To determine whether a perfect emulsion is being obtained, put a little of the mixture in a glass of water. The presence of free oil on the surface will indicate that more stirring is necessary. Where a pump is used in mixing, one-half the amount of soap is necessary.

Formula Nos. I. and II. do not loosen the sooty mold to any great extent and neither have they the stable qualities which, according to our ideas, will make them valuable to withstand the summer rains. We recommend them for use in winter and where the immediate loosening of the sooty mold is not desired. Formula Nos. III. and IV. loosened the sooty mold perfectly and have the stable qualities which we hope will make them valuable for summer use.
Whale oil soap No. 3 ....12 to 15 Lbs.

According to the authors and Dr. E. A. Back, April is perhaps the best time to spray. For summer use formulas III and IV should be diluted to make 300 gallons.

"Diamond Paraffine and Junior Engine Oil" are trade names. The former is used for slow moving bearings and costs 13 cents per gallon in barrel lots. The latter is used for fast moving bearings and costs about 14 cents per gallon.

"At present we are unable to see any difference in the insecticidal qualities of the two oils, so the other uses to which they may be put will assist each grower to decide for himself which to buy."

"Schnarr's Insecticide" sold by J. Schnarr & Co., of Orlando, Fla., has given good results for the control of White Fly. This sells for 40 cents per gallon in 50 gallon lots. The manufacturers recommend 50 gallons of the insecticide for 2,000 gallons of spray.

Soft Scale (*Lecanium hesperidum.* Linn.)

This scale is known also as the turtle-back scale or brown scale, has been reported by many growers in Alabama this fall (1911). In some cases the apprehension of danger from the soft scale has let to some growers cutting down many of their trees. The older growers have learned that natural enemies, such as parasites and lady bugs have controlled the insect sufficiently to cause no serious alarm. In fact, as Hume has written the author "it is probably the least noxious of all citrus scales." One thorough spraying with whale oil soap will destroy the insects.

This insect changes its color as it develops from a transparent yellow in the young, changing to a brown in the adult. The latter is 3 or 4 mms. long (.12 to .16 inches), is turtle shaped, broadly oval, and swollen, and has a flattened rim encircling the scale. The female insect during its last stages becomes merely a cap filled with young. The young are thin and flat and scarcely discernible on the leaves or twigs. The insects starve unless they can reach the young tender bark or leaves of the new growth. As they have no true scales but rather a toughened skin they are soon exterminated by the attacks of natural enemies or by spraying.

The Purple Scale (*Lepidosaphes beckii.*)

This scale attacks Satsumas and resembles the "Oyster Shell Bark Louse" which has given the apple growers so much trouble. The eggs are very small and white. The young larvae are about one-tenth of an inch long. They soon settle on the bark or along the mid rib of the leaves. When the female scale insect is nine weeks old it deposits eggs of the second brood, the young from these eggs emerging from beneath the scale in about a week. The greatest activity among the young is about the latter part of March; in June or July; and in September or October according to Hume.

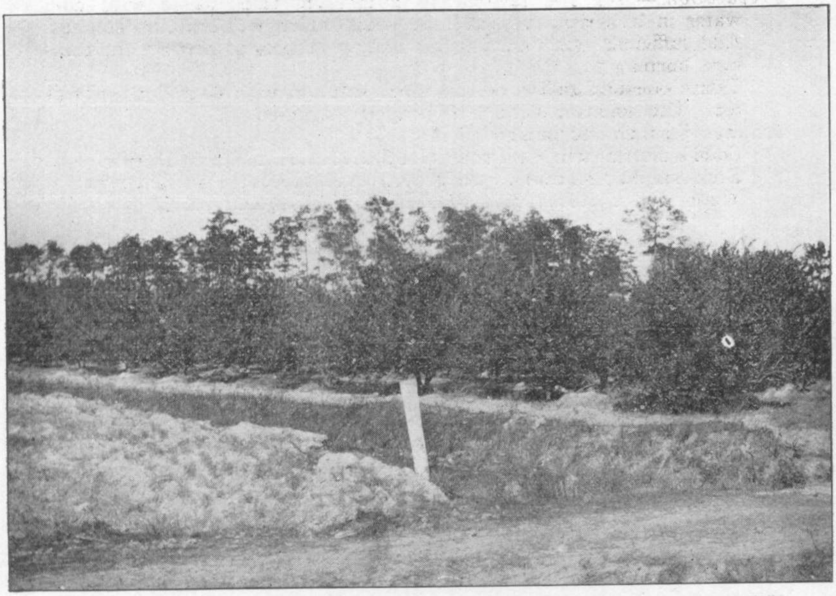

PLATE VIII. A portion of the Glen St. Mary Nursery Company's Satsuma orchard, one of the oldest in the South.

Treatment.—Good's Caustic Potash:

Whale oil soap No. 3	12 to 15	lbs.
Water	50	gals.

or

Kerosene oil	2	gals.
Soft whale oil soap	1	quart.

or

Chipped hard soap	½	lb.
Water	1	gal.

Preparation.—Dissolve the soap in the gallon of water which has been brought to the boiling point and while still boiling pour it out into another vessel away from the fire. The kerosene may now be added and the best way to emulsify the materials is to pour it all into a force pump and force it back into itself for several minutes. The lost water should be added so that there will be 4¼ gallons.

To Use in the Winter Months—Add 10 gallons of water to each gallon of the solution. For use during the summer add 15 gallons of water to each gallon of the solution. Do not use kerosene emulsion on the trees when defoliated.

Orange Rust Mites—The Six Spotted Mite and the Purple Mite or Red Spider will undoubtably be a source of trouble as the Satsuma plantings increase. Prof. Hume recommends the following formulas for these pests:

SODA-SULPHUR SOLUTION

Sulphur	20 lbs.
Caustic soda (98%)	10 lbs.
Water	20 gals.

Preparation.—Mix the sulphur to a medium thick paste with cold water in a barrel, then add the soda, which will boil the sulphur. Add sufficient water during this boiling process to prevent the mixture burning.

Dilute one-half gallon of this stock solution with 40 gallons of water. The solution should be properly strained.

Another formula recommended is:

Good's potash whale oil soap No. 3	12 to 15 gals.
Soda sulphur solution (see above)	1 to 2 quarts
Water	50 gals.

As the Satsuma orange groves increase there will undoubtably be more attention given to the various fungii and insects which attack the trees and fruit. Growers should report any such troubles to the Department of Horticulture or Department of Entomology at Auburn that they may be identified and remedies suggested. The writer will be glad to learn the names of all growers, also the number of trees in their respective orchards, and any other data which will help to increase our knowledge of a very promising industry.

Co-operative experiments have already been undertaken by the Department of Horticulture at Auburn with Satsuma growing in Alabama and it is the desire of the Department to extend this work.

The author suggests that the Satsuma growers organize so that larger quantities of fruit may be shipped than is now the case with individual growers. Again it will be necessary to standardize the grading and packing, a problem to be handled by an organization. Such an organization will do much to disseminate knowledge concerning the culture of the Satsuma. Again a more concerted action can be taken when it becomes necessary to fight insect or fungus pests. Small growers co-operating can afford to buy better spray pumps and in purchasing chemicals for a number of growers the prices are less than where expressed to individuals.

Sample boxes of graded Satsumas should be expressed to the larger cities where they should be exhibited to acquaint the public with them. If a growers' organization would handle this matter it would be a very short time before an appreciative market would be developed.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

Fattening Beef Calves in Alabama

Investigations in Cooperation With the Bureau of Animal Industry, Washington, D. C.

BY

DAN T. GRAY
Professor of Animal Industry

AND

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Opelika, Ala.
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*In cooperation with U. S. Department of Agriculture.

Fattening Calves in Alabama

BY

DAN T. GRAY AND W. F. WARD.

INTRODUCTION.

The beef cattle business can be, and usually is, divided into two parts—breeding and fattening. As a rule, the man who raises the calf does not finish it on his own farm for the market; he usually sells it to a neighboring farmer who makes a business of fattening and preparing the calf or steer for the market. Thus the feeder often times has no interest at all in raising the calves. Probably the ideal condition, at least for Alabama and adjacent states, is for the calf to be raised and finished on the same farm. But this ideal condition can seldom be realized because the man who raises the calf has, as a rule, only a few cows and can seldom afford to take the time and trouble to fatten the few calves which these cows bring each year. Even if the small farmer were to fatten these few calves each year he could seldom afford to ship them to the large markets, so he is at the mercy of the local buyers. As a result of this condition of affairs the professional feeder has developed. His business is to collect calves and steers into carload lots and prepare them for the open market.

The farmer, who has as many as 30 breeding cows on his farm should make it a rule to fatten their offspring himself; he can seldom afford to sell the calves to the professional feeder. The feeder usually makes money on the process of fattening, and the man who raises calves in sufficient numbers should keep this extra profit at home. Furthermore, the farmer who has from 8 to 12 calves or steers ready for the feed lot, will usually find it profitable to buy a sufficient number of feeders to complete the load, and he can then finish all of them on his own farm.

There are many ways of disposing of beef calves or cattle, and the farmer should be watchful to avoid methods by which money might be lost. It is possible to raise beef cattle properly and by selling them improperly to lose money on the business in just the same way that it is possible to raise good apples, potatoes, and peaches and lose money on them when the marketing part of the business is not studied and given proper attention. When beef cattle are bred, fed, and marketed in a scientific and businesslike manner satisfactory profits should be realized. This is proved by the experience of good cattle men, and by the cooperative experimental work between this Station and the Bureau of Animal Industry.

OBJECTS OF THE WORK.

The farmer who raises calves is often at a loss to know at what age they should be disposed of. The spring calf may be sold the subsequent fall; it may be fattened during the winter months and sold as a fat yearling calf; it may be kept on the farm until it is from 2 to 4 years of age and then sold to a professional feeder; or, the mature steer may be fattened on the farm where it was raised instead of being sold to a feeder. On account of the various methods which it is possible to adopt for disposing of beef animals, the owner is often in doubt as to the most profitable manner of handling and disposing of his crop of calves.

This Station, working in cooperation with the Bureau of Animal Industry, has done several years' experimental work in fattening mature steers for the market.* The steers used in this experimental work were not raised on the farm where they were fattened; they were purchased from small farmers who sold them for from 2 1-4 to 3 1-2 cents a pound, the price paid depending upon the quality, age, size, and condition of the animals. Excellent profits were realized on all of the cattle with the exception of one lot, but it is probable that some of the farmers who raised the steers lost money on their part of the transaction, as cattle cannot be raised and sold at a profit for 2 1-4 cents a pound.**

Since the publication of the results of the work above mentioned, many farmers in the South have raised the question, "Why not fatten the animals while they are young?" In the past our farmers and planters insisted on keeping the offspring of their beef cows until they were from three to four years old.

*Note—See Bureau of Animal Industry bulletins Nos. 103 and 131, and Alabama Station bulletins Nos. 150 and 151.

**See Alabama Station bulletin No. 150, or Bureau of Animal Industry bulletin No. 103.


LOT 1. A close view of some individuals in this lot to show the general quality of the calves.

but many inquiries are now made as to the advisability of fattening the calves so as to dispose of them by the time they are a year old.

Two or three points can be urged in favor of this system. First, more breeding animals can be kept upon a farm when the offspring are disposed of at an early age, than when they are held and sold as steers. Second, the younger the animal, the cheaper each pound of beef is made. Third, the money invested is turned more rapidly when the calves are sold at a young age.

In order that they might be in a position to assist in answering such inquiries, the authorities of the Alabama Experiment Station and the Bureau of Animal Industry undertook three experiments in fattening calves which are hereinafter described. The details in this bulletin are accordingly divided into three parts. In Part I the calves were fattened during their first winter on cottonseed meal and hulls, corn-and-cob meal, and alfalfa hay; in Part II similar winter fattening was carried on with cottonseed meal and hulls and peavine hay; and in Part III the calves were fed in the winter and fattened during the following pasture season.

Part I.

Winter Fattening of Calves on Cottonseed Meal and Hulls, Corn-and-Cob Meal and Alfalfa Hay.

The main object in doing this calf-feeding work was to determine whether the farmer can afford to raise a good grade of calves and finish them for the market while they are yet less than a year old. Secondary considerations were, of course, involved as well.

In this part of the test the calves were divided into three lots, so that a comparison of certain feeds could be made. The following problems were studied:

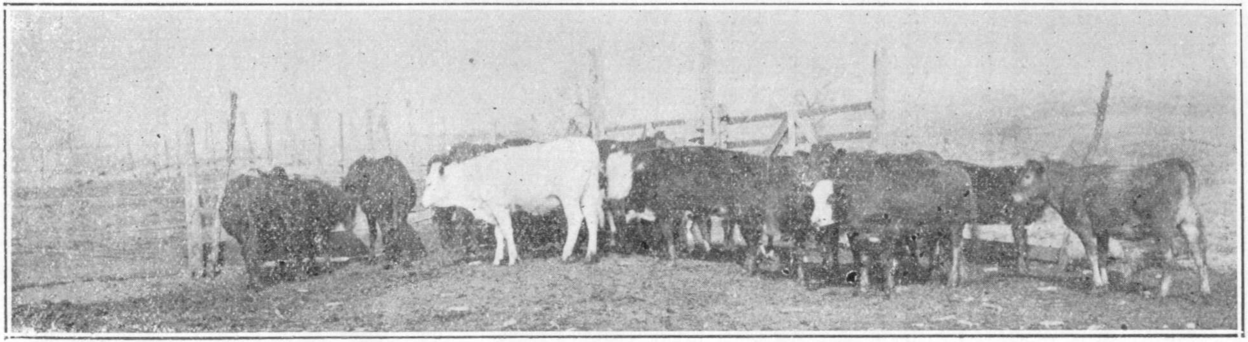
1. To learn whether a farmer can profitably raise and fatten calves and finish them for the market by the time they are a year old.
2. To make comparisons of southern feeds and combinations of feeds which can be used for fattening calves during the winter months.

Owing to the fact that a high grade of calves cannot be obtained near the Experiment Station at Auburn, Alabama, the work was carried on upon the farm of Cobb and McMillian, of Sumterville, Alabama, with whom the Station and the Bureau have been in cooperation for a number of years. Cobb and McMillian furnished the calves and the feed and the Alabama Experiment Station and the Bureau of Animal Industry provided a trained man to live on the farm and have personal supervision of the experimental work. Mr. H. J. Chatterton was stationed upon the farm and supervised the work.

KIND OF CALVES USED.

The calves used in this work were high grade animals. The farmer who raises beef cattle cannot afford to raise scrubs, especially the man who expects to finish them for the market while they are young. It would have been absolutely impossible to have made a profit on these calves if they had

LOT 1. Picture taken at beginning of test, November 17, 1910 They were fed a ration of cottonseed meal, cottonseed hulls and alfalfa hay until March 17, 1911. When the test began they averaged 338 pounds in weight, and were from 6 to 8 months old.



LOT 1. Picture taken at the close of the test, March 17, 1911. These calves averaged 541 pounds in weight when sold, and were from 12 to 14 months old. They were fed on the above ration 119 days, during which time they made an average daily gain of 1.71 pounds. At the beginning of the test they cost $3.50 per hundred-weight; at the close they sold for $5.01 per hundred-weight. A clear profit of $1.84 was made on each calf.

been scrubs instead of high grade beef calves. High-priced feeds can seldom be fed profitably to low-priced cattle. It may be possible for a professional feeder to make a profit on scrubs even when high-priced feeds are used, but when such is the case it means that the feeder made the profit at the expense of the man who raised the scrubs. In other words, it means that the feeder did not pay the producer as much for the scrubs as it actually cost to raise them.

The majority of the calves were raised on the farm of Cobb and McMillian, near Sumterville, Alabama, where the feeding was done; some of them were purchased from neighboring farmers in Sumter and adjoining counties. The calves were all well-bred animals although not pure bred. They were grade Shorthorns, Aberdeen-angus, Herefords, and Red Polls, the majority being from one-half to seven-eighths pure. All had been born the preceding spring, so they were from 6 to 8 months of age when the fattening experiment began. During the summer they had run with their mothers on good pasture, and during this time they demanded practically no attention from the owner, except to see that they were salted and dipped. Both the mothers and the calves were dipped regularly all through the summer months to reduce the number of ticks. Very few ticks appeared on the cattle during the summer time.

On November 17, 1910, when the preliminary feeding began, the calves averaged 338 pounds in weight.

GENERAL PLAN OF THE WORK.

When fall arrived, and the pastures were exhausted, the calves were taken from their mothers, and placed in this winter work. They were in excellent condition at this time. The original intention had been to begin the winter feeding early in the fall, to avoid losing any part of the calf-fat, but, on account of an unavoidable delay, the feeding was not begun until the above mentioned date, so no doubt the calves lost a few pounds in weight after the pastures became short.

On November 17, 1910, the calves were tagged, dehorned, and divided into three lots. Each lot of calves was fed all winter, or until March 15, 1911, on the following feeds:

Lot 1—
  Cottonseed meal,
  Cottonseed hulls,
  Mixed alfalfa hay.

Lot 2—
  Cottonseed meal 2-3*,
  Corn-and-cob meal 1-3,
  Cottonseed hulls,
  Mixed alfalfa hay.

Lot 3—
  Cottonseed meal 1-3*,
  Corn-and-cob meal 2-3,
  Cottonseed hulls,
  Mixed alfalfa hay.

SHELTER AND LOTS.

The calves were young, so each lot was provided with shelter sufficiently good to turn the cold rains and break the cold north winds. If they had been mature steers the shelter would not have been necessary, but calves will not do well, even this far South, without some protection from the cold winds and rains of the winter months. Each lot was confined in a one-half acre paddock. While the lots were not paved, still they did not become excessively muddy, even during the periods of excessive rain. The ground floors of the sheds were always dry, so the calves had a comfortable and convenient place in which to rest.

METHOD OF FEEDING AND HANDLING THE CALVES.

On November 17, 1910, all the calves were tagged and dehorned. On the following day the individual weights were secured and the 77 calves were divided into three lots as nearly equal as possible in quality, weight, and breeding. The preliminary feeding began November 18, 1910. All of the males were castrated on November 23 and 24. No doubt the results would have been more satisfactory if the calves had been castrated at an earlier age.

*As will be seen later the feeds were not fed in exactly the proportions here indicated.

The animals were fed twice each day, the morning feed being given about 7 o'clock, and the night feed at 5 o'clock. The concentrated feeds were placed in troughs each of which was about 12 feet long and 3 feed wide. The hay was fed in separate hay racks. Both the troughs and the racks were under sheds so that the feed never became wet and the calves had comfortable quarters in which to eat.

Salt was supplied regularly, also pure water in clean troughs.

At the beginning and end of the experiment individual weights were secured on two successive days. During the course of the test the total weight of each lot was secured every 28 days.

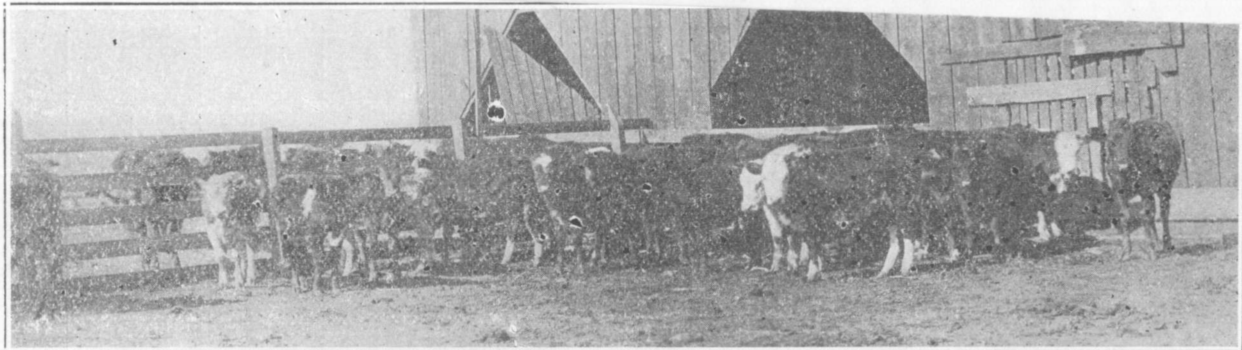
CHARACTER AND PRICE OF FEEDS.

Cottonseed meal, corn-and-cob meal, cottonseed hulls, and mixed alfalfa hay were all used in this test. The cottonseed meal and the hulls were purchased and hauled to the farm. The corn-and-cob meal and the mixed alfalfa hay were grown upon the farm. All of the feeds were of good quality. The cottonseed meal was fresh and bright; the hay consisted of a mixture of about one-half each of Johnson grass and alfalfa. The corn was grown upon the farm and before it was fed the whole ear of corn with the shuck was run through a grinder and made into corn-and-cob meal.

The feeds were valued as follows:

Cottonseed meal	$26.00	a ton
Cottonseed hulls	7.00	a ton
Corn	.70	a bushel
Mixed hay	15.00	a ton

As a matter of fact, the cottonseed meal cost only $25.00 a ton, and corn was worth only 50 cents a bushel, but the above prices were adopted for the sake of uniformity. These prices have been used in other publications from this Station, and represent fairly accurately the average prices of feeds in this State.



LOT 3. At beginning of test, November 17, 1911. These calves were given a ration of cottonseed meal 1-3, plus corn-and-cob meal 2-3, cottonseed hulls and alfalfa hay. They averaged 328 pounds in weight at beginning of test.

LOT 3. At close of test March 17, 1911. These calves averaged 546 pounds in weight at the close, or they made an average daily gain of 1.83 pounds. They gained more rapidly than the calves in Lots 1 and 2, but did not make the gains as cheaply. Too much corn-and-cob meal was used for the greatest profit, as only $1.48 was made on each calf, while $2.25 was made on each calf in Lot 2. However, the corn was sold for more by means of the calves than it would have brought on the market as corn.

DAILY RATIONS.

More care and skill must be exercised in feeding a young animal than an old one. A six-year-old ox may be cared for and fed in a careless manner and still no serious results follow; but the young calf will not grow and develop with any degree of satisfaction under a careless system of management and feeding. The younger the animal the greater the skill required to care for and feed it; one case of overfeeding will often throw the stomach and bowels out of condition for weeks. It will be noticed from the table below that at first the calves were given a very small quantity of concentrated feed, the amount being gradually increased to the end of the test. They were given, from the beginning, all of the hay they would clean up.

TABLE 1.—*Daily Ration for Each Calf.*
(Nov. 17, 1910—March 17, 1911.)

RATION	LOT 1	LOT 2	LOT 3
	Pounds	Pounds	Pounds
Preliminary Periods **Nov. 17-Dec. 7**	2.09 cottonseed meal 5.34 cottonseed hulls 5.10 mixed hay	1.91 cottonseed meal .69 corn-and-cob meal 5.77 cottonseed hulls 5.57 mixed hay	1.36 cottonseed meal 1.69 corn-and-cob mea 5.35 cottonseed hulls 4.66 mixed hay
Regular Periods **First 28 Days**	2.69 cottonseed meal 7.36 cottonseed hulls 5.05 mixed hay	1.85 cottonseed meal .92 corn-and-cob meal 7.36 cottonseed hulls 5.18 mixed hay	1.85 cottonseed meal 3.73 corn-and-cob meal 7.39 cottonseed hulls 3.70 mixed hay
Second 28 Days	3.16 cottonseed meal 7.57 cottonseed hulls 5.24 mixed hay	2.14 cottonseed meal 1.17 corn-and-cob meal 7.57 cottonseed hulls 5.51 mixed hay	2.14 cottonseed meal 4.67 corn-and-cob meal 7.57 cottonseed hulls 3.36 mixed hay
Third 28 Days	3.63 cottonseed meal 8.00 cottonseed hulls 5.86 mixed hay	2.70 cottonseed meal 1.35 corn-and-cob meal 8.00 cottonseed hulls 5.51 mixed hay	2.15 cottonseed meal 4.30 corn-and-cob meal 8.00 cottonseed hulls 8.57 mixed hay
Last 16 Days	3.67 cottonseed meal 8.88 cottonseed hulls 5.79 mixed hay.	3.42 cottonseed meal 1.71 corn-and-cob meal 8.80 cottonseed hulls 5.74 mixed hay	2.00 cottonseed meal 4.00 corn-and-cob meal 8 00 cottonseed hulls 5.60 mixed hay

During the preliminary feeding period each calf in Lot I received an average of only 2.09 pounds of cottonseed meal each day. And during the last 16 days of the feeding period the calves in this lot received an average daily feed of only 3.67 pounds of cottonseed meal. At one time the daily allowance of cottonseed meal was raised to four pounds for each calf, but some of them began to scour and the amount of meal was quickly reduced. The calves in Lots 2 and 3 received a partial feed of corn-and-cob meal; this corn-and-cob meal was mixed with the cottonseed meal, so the daily allowance of concentrated feeds for the calves of these two lots was greater than that of the calves in Lot 1. During the preliminary period each calf in Lot 2 received a daily feed of 2.6 pounds of concentrated feeds, practically one-fourth of the amount being corn-and-cob meal. Each calf in Lot 3, during the same period, received 3.05 pounds daily of the concentrated feeds, 55.4 per cent. of which was corn-and-cob meal. At the end of the test each calf in Lot 3, was eating 6 pounds daily of the mixture of one-third cottonseed meal and two-thirds corn-and-cob meal; they ate this amount readily with no ill results following. It should be noted that when the amount of feed was increased it was increased gradually. No abrupt changes were made.

WEIGHTS AND GAINS.

When the preliminary weights were secured, November 18, 1910, the calves averaged from 6 to 8 months in age. While they were not large for their age, they were larger than the average for the State. Their mothers probably averaged about 1,000 pounds in weight in usual breeding condition. The calves had not been pampered in any way during the summer months; they had simply run with their mothers upon a reasonably good pasture.

In some previous experimental work* done by this Station and the Bureau of Animal Industry, yearling grade Angus calves attained a weight of only 402 pounds, but they were heavily infested with ticks. Some ticks were permitted to get on the calves used in the present test, but they were not badly infested. Of course, this slight infestation retarded their development, but just how much it is impossible to state.

*See Alabama Station bulletin No. 150, or Bureau of Animal Industry bulletin No. 103.

LOT 2. Picture taken at beginning of test, November 17, 1910. This lot of calves was fed a ration made up of cottonseed meal 2-3, plus corn-and-cob meal 1-3, cottonseed hulls and alfalfa hay. They averaged 333 pounds in weight November 17, 1910.

LOT 2. At close of test, March 17, 1911. When these calves were sold they averaged 543 pounds in weight, and were from 12 to 14 months old. They made an average daily gain of 1.76 pounds; they gained a little more rapidly than those in Lot 1. They sold for $5.11 per hundred-weight, or 10 cents a hundred more than th[illegible]
so it paid [illegible]

The table below shows that satisfactory gains were secured during this winter test:

TABLE 2.—*Weights, Total Gains, and Average Daily Gains.*
(Nov. 17, 1910—March 17, 1911.)

Lot	Number of calves	Ration	Number of days fed	Average initial weight of each calf	Average final weight of each calf	Average total gain of each calf	Average daily gain of each calf
Preliminary Period (Nov. 17-Dec. 7)							
				Pounds	Pounds	Pounds	Pounds
1	27	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	19	338	380	42	2.21
2	24	Cottonseed meal ⅔ Corn-and-cob meal ⅓ Cottonseed hulls Mixed alfalfa hay	19	333	374	41	2.16
3	26	Cottonseed meal ⅓ Corn-and-cob meal ⅔ Cottonseed hulls Mixed alfalfa hay	19	328	367	39	2.05
Regular Feeding Period (Dec. 7, 1910-March 17, 1911)							
1	27	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	100	380	541	161	1.61
2	24	Cottonseed meal ⅔ Corn-and-cob meal ⅓ Cottonseed hulls Mixed alfalfa hay	100	374	543	169	1.69
3	26	Cottonseed meal ⅓ Corn-and-cob meal ⅔ Cottonseed hulls Mixed alfalfa hay	100	367	546	179	1.79
Preliminary and Regular Periods Combined (Nov. 17, 1910-March 17, 1911)							
1	27	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	119	338	541	203	1.71
2	24	Cottonseed meal ⅔ Corn-and-cob meal ⅓ Cottonseed hulls Mixed alfalfa hay	119	333	543	210	1.76
3	26	Cottonseed meal ⅓ Corn-and-cob meal ⅔ Cottonseed hulls Mixed alfalfa hay	119	328	546	218	1.83

During the preliminary period, from November 17 to December 7, the calves were dehorned and the males castrated, yet they made excellent gains. The lots gained a daily average of 2.21, 2.16, and 2.05 pounds, respectively, during this period. Of course, some of this increase in live weight can be attributed to "fill;" it was not all real gain in terms of meat and bone.

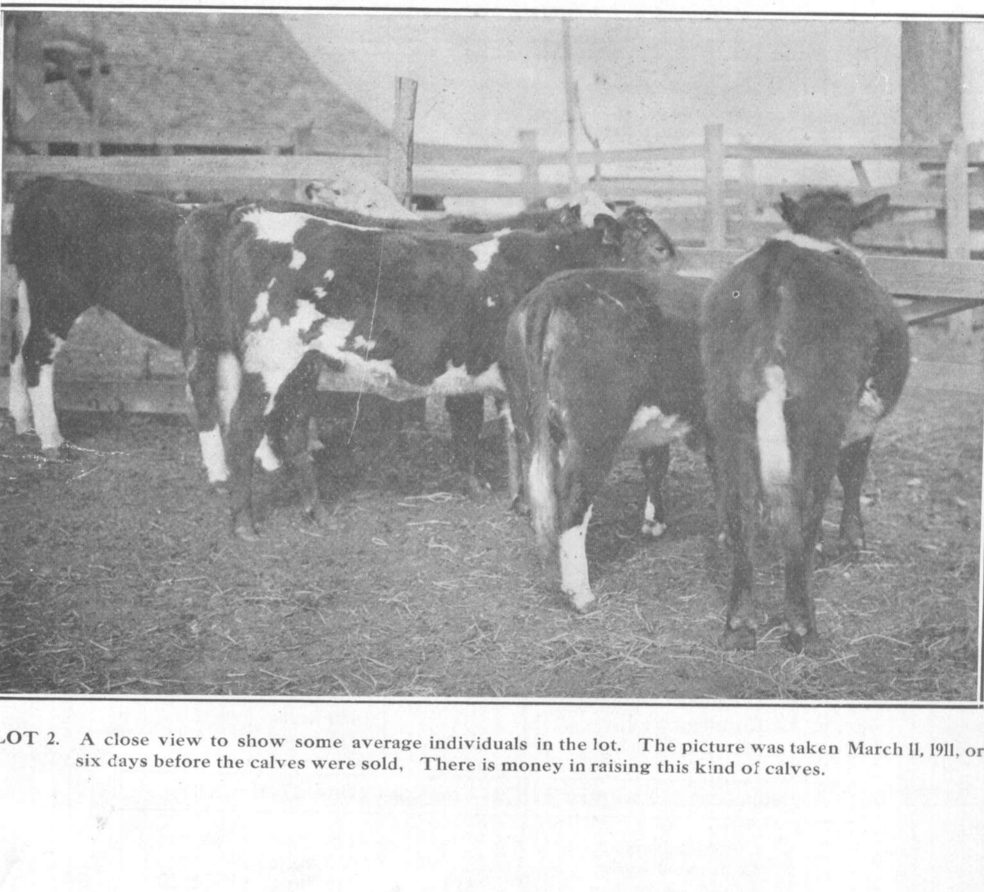
During the regular experiment, from December 7 to March 17, the gains were also entirely satisfactory. The calves in Lot 1, the lot which had no corn-and-cob meal mixed with cottonseed meal, made the smallest gains, each calf gaining 1.61 pounds each day; this, however, was a satisfactory daily gain for small and young animals. The calves in Lot 3, the lot which was given the heavy feed of corn-and-cob meal along with the cottonseed meal, made the greatest gains, each calf gaining 1.79 pounds daily. The calves in Lot 2, the lot which received the small amount of corn-and-cob meal along with the cottonseed meal, made an average daily gain of 1.69 pounds.

During the whole winter feeding period each calf gained an average of 203, 210, and 218 pounds in weight in Lots 1, 2, and 3, respectively, so when the calves were sold, March 17, the whole lot of 77 calves averaged 543 pounds in weight. They were practically 12 months old when sold.

It should not be inferred that the ration which produced the greatest gain in a given time is necessarily the best or most profitable one. While the question of rapidity of gain is an extremely important factor in final profits, there are other factors, as the cost of the gain, which must be taken into consideration.

QUANTITY AND COST OF FEED REQUIRED TO MAKE 100 POUNDS OF GAIN IN LIVE WEIGHT.

While the feeds used were all expensive ones, the cost to make 100 pounds of gain was not excessive. In fact, the gains were made cheaply. This was due to several factors. First, the calves were young and growing, and young animals of all kinds can be made to increase in weight more economically than old ones. Second, the calves were very thrifty, and so made good use of the feed that they ate. Third, all of the rations were extremely palatable, especially the two which had the corn-and-cob meal mixed with the cottonseed meal. A young animal of any kind will not make satisfactory gains on an unpalatable ration. Fourth, the calves had comfortable quarters and were fed and watered regularly.



LOT 2. A close view to show some average individuals in the lot. The picture was taken March 11, 1911, or six days before the calves were sold. There is money in raising this kind of calves.

TABLE 3.—*Quantity and Cost of Feed Required to Make One Hundred Pounds of Gain.*

Lot	Ration	Number of days fed	Pounds of feed to make 100 pounds of gain	Cost of feed to make 100 pounds of gain
	Preliminary Period (Nov. 17-Dec. 7)			
			Pounds	
1	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	19	95 meal 241 hulls 230 hay	$3.80
2	Cottonseed meal ⅔ Corn-and-cob-meal ⅓ Cottonseed hulls Mixed alfalfa hay	19	88 meal 40 corn 266 hulls 257 hay	4.40
3	Cottonseed meal ⅓ Corn-and-cob-meal ⅔ Cottonseed hulls Mixed alfalfa hay	19	66 meal 103 corn 261 hulls 228 hay	4.51
	Regular Feeding Period (Dec. 7-March 17)			
1	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	100	201 meal 486 hulls 338 hay	6.85
2	Cottonseed meal ⅔ Corn-and-cob meal ⅓ Cottonseed hulls Mixed alfalfa hay	100	143 meal 72 corn 464 hulls 323 hay	6.63
3	Cottonseed meal ⅓ Corn and-cob meal ⅔ Cottonseed hulls Mixed alfalfa hay	100	114 meal 234 corn 430 hulls 216 hay	6.95
	Preliminary and Regular Periods Combined (Nov. 17-March 17)			
1	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	119	179 meal 435 hulls 315 hay	6.22
2	Cottonseed meal ⅔ Corn-and-cob meal ⅓ Cottonseed hulls Mixed alfalfa hay	119	133 meal 65 corn 425 hulls 310 hay	6.19
3	Cottonseed meal ⅓ Corn-and-cob meal ⅔ Cottonseed hulls Mixed alfalfa hay	119	130 meal 211 corn 400 hulls 218 hay	6.83

During the preliminary period, the calves made both rapid and economical gains, notwithstanding the fact that they had been dehorned and castrated. It cost $3.80, $4.40, and $4.51 to make 100 pounds of gain in live weight in Lots 1, 2, and 3, respectively, during the preliminary period. In this period, therefore, the calves which ate nothing except cottonseed meal, hulls, and alfalfa hay made the cheapest gains. This, however, was not true of the test when taken as a whole.

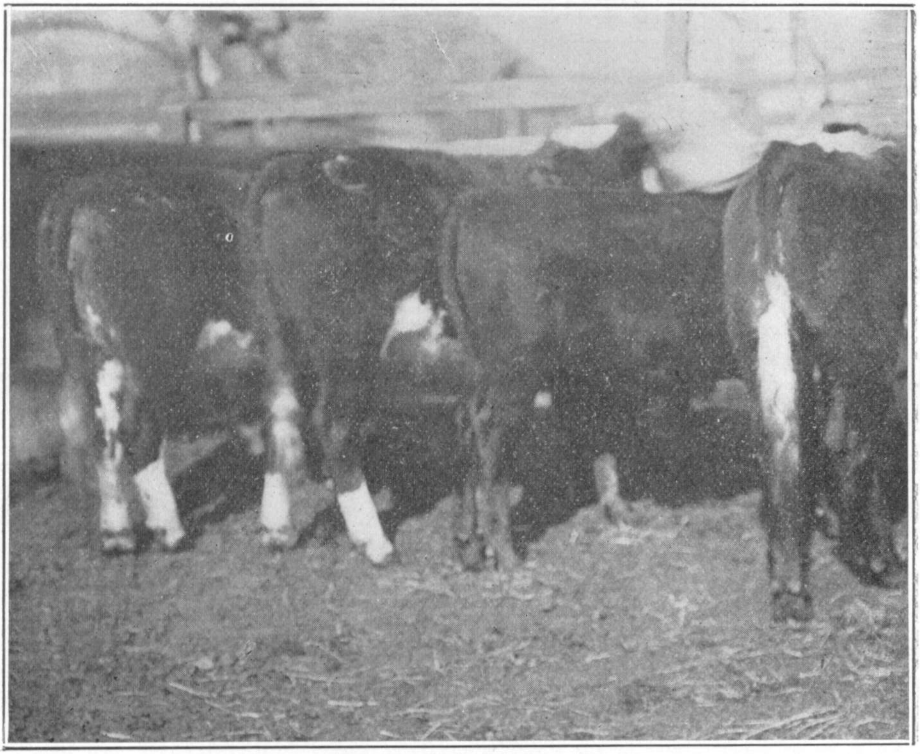
After the calves had been on feed some weeks, with the "fill" not taken into consideration, the gains were not made as cheaply as at first. Under average feeding conditions the cheapest gains are made during the first few weeks of the fattening process; the expensive gains are usually made near the close of the feeding period. During the regular feeding period it cost $6.85, $6.63, and $6.95 to make 100 pounds of gain in Lots 1, 2, and 3, respectively. The cheapest gains were made by the calves in Lot 2, where the small amount of corn-and-cob meal was fed along with the cottonseed meal. The most expensive gains were made in Lot 3, where the calves received a heavy proportion of corn-and-cob meal.

The cost of the gains, however, does not determine absolutely the final profits. While the cost of the gains is a very important factor in determining final profits, there are other factors which must be taken into consideration as well. The final selling price of the cattle must also be considered as an important factor. If expensive gains are accompanied by a proportionate increase in the final value and selling price of the cattle, the cost of the gains is a minor consideration, but if expensive gains do not increase the final selling price of the animal in proportion to the increased expense of making the gains, those feeds which have caused the expensive gains should be eliminated.

When the preliminary and the regular periods are combined into one period of 119 days, it cost $6.22, $6.19, and $6.83 to produce 100 pounds of gain in Lots 1, 2, and 3, respectively, Lot 2 still showing up to the best advantage and Lot 3 to a considerable disadvantage.

PRICES REALIZED ON EACH KIND OF FEED WHEN THE PRICES OF THE OTHER FEEDS ARE FIXED.

As previously stated, the cottonseed meal cost $26.00 a ton and the hulls $7.00 a ton, the hay being valued at $15.00 a ton and the corn at 70 cents a bushel. Before a farmer spends $26.00 for a ton of cottonseed meal and $7.00 for a ton of hulls to be used as a feed for cattle, he should know whether or not he will get his money back in the shape of profits on the cattle. In other words, the farmer should know whether he will be able to realize a profit on the money invested in the feed. When he has hay and corn on his farm, he expects to sell them at the highest possible price. When, in addition, he has cattle, the farmer often hesitates as to the best method of disposing of his corn and hay. The question arises in his mind, Should I feed the hay and corn to the calves and steers, or should I sell these feeds directly upon the market?



LOT 2. A picture to show the general quality and finish of the calves at the close of the test, March 17, 1911. These calves were fed a ration of cottonseed meal 2-3, plus corn-and-cob meal 1-3, cottonseed hulls and alfalfa hay. Both the corn and the hay were sold for more money through these calves than could have been obtained for them in the shape of corn or hay.

The following table throws some light on this problem:

TABLE 4.—*Prices Realized on Each Feed When Fed to Beef Calves.*

	LOT 1	LOT 2	LOT 3
Prices realized on each ton of cottonseed meal when the prices on the other feeds are fixed	$36.10	$42.18	$36.50
Prices realized on each ton of hulls when the prices on the other feeds are fixed	11.15	12.05	10.40
Prices realized on each bushel of corn when the prices on the other feeds are fixed	-----	1.90	0.95
Prices realized on each ton of mixed alfalfa hay when the prices on the other feeds are fixed	20.72	20.92	21.25

While the cottonseed meal cost only $26.00 a ton, it was fed to the calves and sold, by means of them, for $36.10 to $42.18 a ton. The hulls cost only $7.00 a ton, and they were resold, by means of the calves, for $10.40 to $12.05 a ton. If the corn had been sold upon the market, it would not have brought more than 60 cents a bushel during the fall of 1910 (it was charged against these calves, however, at 70 cents a bushel), but when it was fed to these calves it was sold, by means of the calves, for 95 cents a bushel in Lot 3 and $1.90 a bushel in Lot 2. If the mixed alfalfa hay had been sold as hay, it would not have brought more than $15.00 a ton on the farm, but it was sold through the calves for $20.72 to $21.25 a ton.

The results tend to show that the farmer can usually afford to buy certain outside feeds—feeds which had not been grown on the farm—for feeding his animals, while he can almost always afford to feed his home-grown feeds to live stock rather than sell them upon the market.

FINANCIAL STATEMENT.

These calves were raised on the farm on which they were fattened, so the initial or fall price is an estimated one. Their estimated value was placed at 3½ cents a pound on the farm, without shrink, when these experiments began, November 17, 1910.

When they were ready to be sold, buyers visited the farm to make bids. At the time of sale, the beef market was on a rapid decline, so they did not sell as well as was expected. They were sold March 17, 1911 ,the calves in Lot 1 selling for $5.01 per hundred-weight on the farm, those in Lot 2 bringing $5.11 per hundred-weight, and those in Lot 3 selling for $5.26 per hundred-weight. All the sales were based on the farm weight, after a 3 per cent shrink. They were shipped to the Cincinnati market where complete slaughter records were secured.

TABLE 5.—*Financial Statement.*

Lot 1. Cottonseed meal, cottonseed hulls, mixed alfalfa hay:

To 27 calves, 9,120 lbs. at 3½ cents per lb.	$319.20	
To 9,821 lbs. cottonseed meal at $26 a ton	127.67	
To 23,908 lbs. cottonseed hulls at $7 a ton	83.68	
To 17,320 lbs. mixed alfalfa hay at $15 a ton	129.90	
Total expense	$660.45	
By sale of 27 calves, 14,172 lbs. at $5.01 per cwt		$710.02
Total profit	$ 49.57	
Profit per calf	1.84	

Lot 2. Cottonseed meal 2-3, corn-and-cob meal 1-3, cottonseed hulls, mixed alfalfa hay:

To 24 calves, 7,984 lbs., at 3½ cents per lb.	$279.44	
To 6,682 lbs. cottonseed meal at $26.00 a ton	86.87	
To 3,298 lbs. corn-and-cob meal at 70 cts. a bu.	32.98	
To 21,418 lbs, cottonseed hulls at $7.00 a ton	74.96	
To 15,630 lbs. mixed alfalfa hay at $15 a ton	117.23	
Total expense	$591.48	
By sale of 24 calves, 12,633 lbs. at $5.11 per cwt.		$645.55
Total profit	$ 54.07	
Profit per calf	2.25	

Lot 3. Cottonseed meal 1-3, corn-and-cob meal 2-3, cottonseed hulls, mixed alfalfa hay:

To 26 calves, 8,531 lbs, at 3½ cents a lb....	$298.59	
To 7,353 lbs. cottonseed meal at $26.00 a ton..	95.59	
To 11,963 lbs. corn-and-cob meal at 70 ct. per bu	119.63	
To 22,687 lbs. cottonseed hulls at $7.00 a ton...	79.40	
To 12,363 lbs. mixed alfalfa hay at $15 a ton..	92.72	
Total expense	$685.93	
By sale of 26 calves, 13,774 lbs. at $5.26 per cwt.		$724.51
Total profit	$ 38.58	
Profit per calf	1.48	

The above shows that all of the calves were fed at a profit, the lowest being $1.48 per calf in Lot 3, and the highest $2.25 per calf in Lot 2. What do these profits mean? They mean the corn and the hay raised on the farm were sold, through the calves, at 70 cents a bushel and $15.00 a ton respectively; that the money expended for cottonseed meal and hulls was all returned to the owner; that the fertilizer value of these feeds was left on the farm, and, in addition, each calf returned the above additional profits. The monetary returns were satisfactory as the farm feeds were sold for more, by means of the calves, than could have been secured for them on the market, and their fertilizing value was left on the farm in the shape of barn-yard manure.

The calves in Lot 3, the ones which received the heavy ration of corn-and-cob meal, returned the smallest profit, notwithstanding the fact that they sold for the highest price at Cincinnati. The increase in the price did not overcome the added expense of feeding a heavy ration of corn-and-cob meal. While it did not pay to feed the heavy ration of corn-and-cob meal, it did pay to feed the small amount of corn-and-cob meal which was used in Lot 2, as the calves in this lot proved to be the most profitable ones fed. This indicates that, when fattening beef calves with cottonseed meal and corn-and-cob meal as the concentrates, one-third of the concentrated part of the ration can profitably consist of corn-and-cob meal, while it is less profitable to have corn-and-cob meal constitute two-thirds of the concentrated part of the ration.

However, there is one factor, that has not been taken into consideration which, if considered, adds to the profits of Lots 2 and 3, especially the latter. Some undigested corn passed through the calves in these two lots; if hogs followed them they would derive no little benefit from the droppings. In fact several hogs did follow the steers in Lot 3, but no record was kept of their gains. These gains should be credited to the calves.

SLAUGHTER RECORDS.

As stated before, these calves were all shipped to the Cincinnati market, where full slaughter data were secured. The animals were driven 9 miles from the farm to the railroad, and on account of unusual delays were on the cars 67 hours before reaching Cincinnati. The slaughter results are given in the following table:

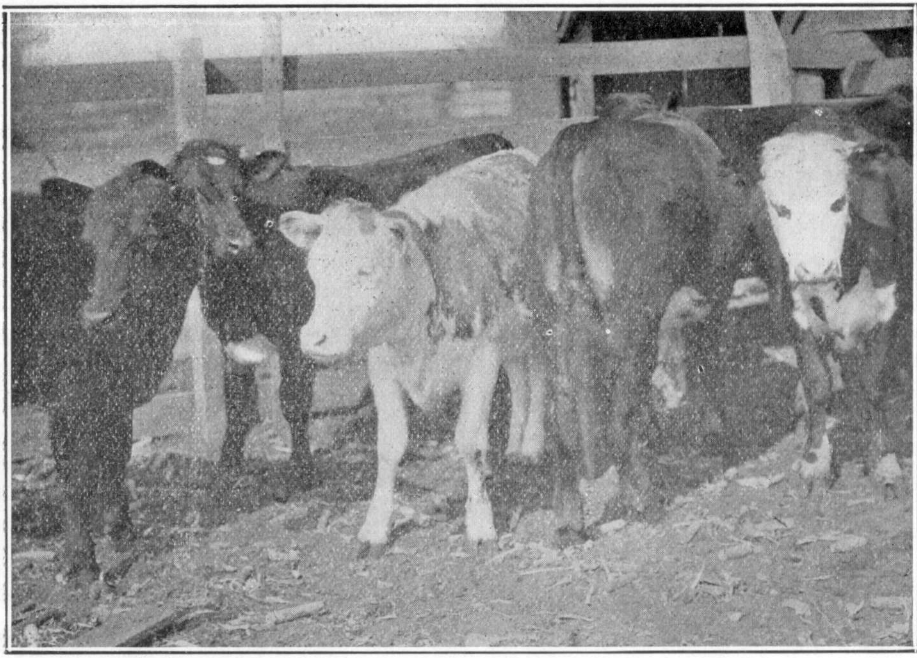
TABLE 6.—*Slaughter Data.*

Lot	Number of calves	Total weight on farm after 3 per cent shrink	Total live weight at Cincinnati	*Total shrink on whole lot	Average shrink of each calf	Per cent dressed out by farm weights	Per cent dressed out by market weights
		Pounds	Pounds	Pounds	Pounds	Per Cent	Per cent
1	27	14172	13050	1123	41.6	47.6	51.7
2	24	12633	11740	893	37.2	47.8	51.5
3	26	13774	12700	1074	41.3	48.9	53.1

The calves of Lot 3, the ones which received the large proportion of corn-and-cob meal, dressed out the highest, each calf in this lot dressing 53.1 per cent. by the market weights. The calves in Lots 1 and 2 dressed out 51.7 and 51.5 per cent., respectively.

The trip was a hard one on the calves and, when the size of the animals is taken into consideration, they shrank heavily on the road to Cincinnati. The average loss in weight for each calf was 41.6 pounds in Lot 1, 37.2 pounds in Lot 2, and 41.3 pounds in Lot 3.

*After 3 per cent shrink.



LOT 3. A picture to show the quality and finish of some of the calves at close of test, March 17, 1911. This test indicates that the farmer cannot afford to sell his corn and and hay as raw farm products. They should be turned into meat and sold as such.

SUMMARY.

TABLE 7.—*Summary Table.*

	LOT 1	LOT 2	LOT 3
Number of calves in each lot	27	24	26
Ration	Cottonseed meal Cottonseed hulls Mixed alfalfa hay	Cottonseed meal ⅔ Corn-and-cob meal ⅓ Cottonseed hulls Mixed alfalfa hay	Cottonseed meal ⅓ Corn-and-cob meal ⅔ Cottonseed hulls Mixed alfalfa hay
Total days fed	119	119	119
Average weight when feeding began	338 pounds	333 pounds	328 pounds
Average final weight	541 pounds	543 pounds	546 pounds
Total gain of each calf, Nov. 17, 1910 to Mar. 17, 1911	203 pounds	210 pounds	218 pounds
Average daily gain of each calf, Nov. 17, 1910 to March 17, 1911	1.71 pounds	1.76 pounds	1.83 pounds
Pounds feed to make 100 pounds gain, Nov. 17, 1910 to March 17, 1911	179 pounds meal 435 pounds hulls 315 pounds hay	133 pounds meal 65 pounds corn 425 pounds hulls 310 pounds hay	130 pounds meal 211 pounds corn 400 pounds hulls 218 pounds hay
Cost to make 100 pounds gain, Nov. 17, 1910, to Mar. 17, 1911	$6.22	$6.19	$6.83
Prices realized on each ton of cottonseed meal when other prices are fixed	$36.10	$42.18	$36.50
Prices realized on each ton of hulls when other prices are fixed	$11.15	$12.05	$10.40

	LOT 1	LOT 2	LOT 3
Price realized on each bushel of corn when other prices are fixed	------	$1.90	$0.95
Price realized on each ton of hay when other prices are fixed	$20.72	$20.92	$21.25
Fall price of calves per cwt.	$3.50	$3.50	$3.50
Selling price of calves per cwt.	$5.01	$5.11	$5.26
Profit on each calf above all expenses	$1.84	$2.25	$1.48

Summary Statements.

1. The animals used in the experiment were calves ranging from 6 to 8 months of age.
2. The feeding was begun November 17, 1910, and continued until March 17, 1911.
3. The 77 calves were divided into three lots and each lot fed upon the following feeds:

Lot 1.—Cottonseed meal,
Cottonseed hulls,
Mixed alfalfa hay.

Lot 2:—Cottonseed meal 2-3,
Corn-and-cob meal 1-3,
Cottonseed hulls,
Mixed alfalfa hay.

Lot 3.—Cottonseed meal 1-3,
Corn-and-cob meal 2-3,
Cottonseed hulls,
Mixed alfalfa hay.

4. During the whole feeding period, each calf in Lots 1, 2, and 3 made an average daily gain of 1.71, 1.76, and 1.83 pounds, respectively.

5. When the whole feeding period is taken into consideration, the following pounds of feed were required to make 100 pounds of gain:

Lot 1:—179 pounds of cottonseed meal, 435 pounds of hulls, and 315 pounds of hay.

Lot 2:—133 pounds of cottonseed meal, 65 pounds of corn-and-cob meal, 425 pounds of hulls, and 310 pounds of hay.

Lot 3:—130 pounds of cottonseed meal, 211 pounds corn-and-cob meal, 400 pounds of hulls, and 218 pounds of hay.

6. When the whole feeding period is taken into consideration, each 100 pounds of gain in Lots 1, 2, and 3, cost $6.22, $6.19, and $6.83, respectively.

7. By means of the calves, each ton of alfalfa hay was sold for $20.72, $20.92, and $21.25 in Lots 1, 2, and 3, respectively, when the prices of the other feeds were fixed.

8. By means of the calves, each bushel of corn was sold for $1.90 and $0.95 in Lots 2, and 3, respectively, when the prices of the other feeds were fixed.

9. Cottonseed meal cost $26.00 a ton, but, by means of the calves, was sold for $36.10, $42.18, and $36.50 a ton in Lots 1, 2, and 3, respectively, when the prices of the other feeds were fixed.

10. Cottonseed hulls cost $7.00 a ton, but, by means of the calves, each ton was sold for $11.15, $12.05, and $10.40 in Lots 1, 2, and 3, respectively, when the prices of the other feeds were fixed.

11. The calves cost $3.50 per hundred-weight at the beginning of the test. At the close they sold for $5.01, $5.11, and $5.26 per hundred-weight in Lots 1, 2, and 3, respectively.

12. Each calf netted a clear profit of $1.84, $2.25, and $1.48 in Lots 1, 2, and 3, respectively.

13. The profits were satisfactory, as the farm crops were sold for considerably more, by means of the calves, than if they had been sold as farm crops. The value of the manure should be considered also.

Part II.

Fattening Calves in Winter on Cottonseed Meal, Cottonseed Hulls, and Peavine Hay.

OBJECTS.

Fifty-two calves were used in this experiment, the main objects of which were:

1. To determine whether or not young beef calves can be fattened profitably for the spring market on a feed of cottonseed meal, cottonseed hulls and mixed peavine hay.
2. To study the value of shelter for young calves while being fattened.

The 52 calves were divided into two lots when the test began on December 7, 1910. One lot was fed under the shelter of a good barn, the other lot being fed in a corn-stalk field with no shelter at all except some trees. It was subsequently seen, however, that these young calves would not thrive during the winter months without a shelter to turn the cold rains, so on February 11, 1911, they were brought into the barns and placed under the sheds with the other calves. After February 11 the 52 head of calves were fed as one lot.

The work was done in cooperation with Mr. E. F. Allison of Sumter county, Alabama, who had kindly agreed to cooperate in experimental work with beef cattle and hogs. Mr. Allison furnished the calves and the feed while the Station and the Bureau of Animal Industry provided a trained man to be stationed on the farm to look after the experiment. Mr. L. W. Shook lived on the farm and had personal charge of the work.

THE CALVES.

The majority of the calves used in the experiment were raised on the farm of Mr. Allison, near Bellamy, Alabama. A few calves were purchased from neighbors. More than half of those raised on Mr. Allison's farm were grade Aberdeen-Angus of excellent quality. The ones which were purchased from neighbors were of common quality and showed very little beef blood. As a whole, they were not as large or as good in quality as were the calves which were used in the other two tests reported in this bulletin. When the test began they had attained an average weight of 313 pounds. The calves were born during the spring of 1910, so were from 6 to 8 months old when the test began, December 7, 1910. They were valued at 3 cents a pound at the beginning of the experiment.

PLAN OF THE WORK.

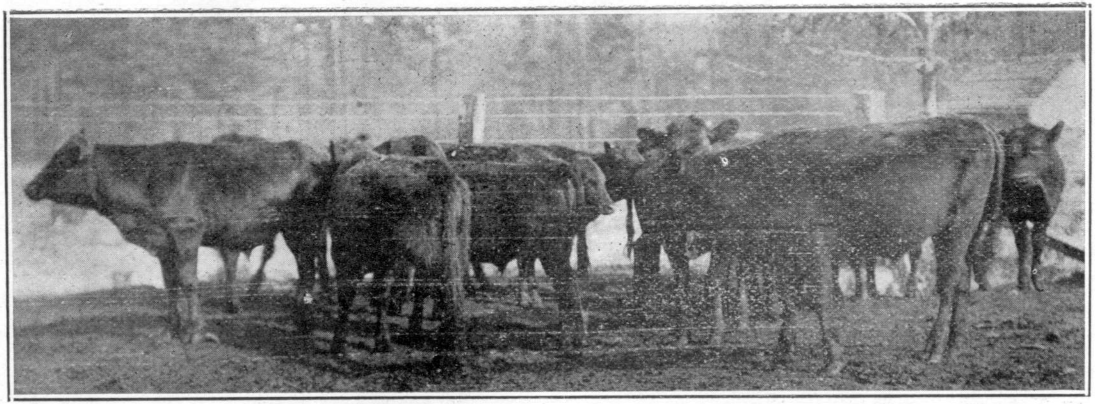
At the beginning of the test the 52 calves were divided into two lots of 26 each. One lot was fed in a small paddock across the west side of which extended a good shelter. As previously stated, the intention at first was to feed the second lot of calves without shelter; that is, they were to be fed in a corn field where no shelter, except trees, was available. All were started on feed December 7, 1910, but it was seen that the calves without shelter were not making satisfactory and economical gains, as the winter was unusually wet and cold, so on February 11, 1911, the field lot of calves was brought to the barn and placed with the other calves. The whole 52 head were fed together in one lot from February 11 to the end of the test, March 29, 1911.

On account of the fact that the two lots were finally thrown together as one, the test is presented in this publication as one lot.

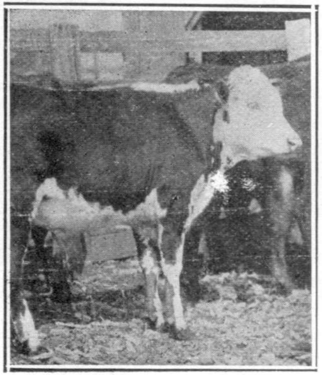
PRICES AND QUALITY OF THE FEEDS.

Cottonseed meal, cottonseed hulls, and mixed cowpea hay were the feeds used. The cowpea hay was grown upon the farm; the other two feeds were purchased on the market. On March 20, 1911, the supply of cowpea hay was exhausted and a change was made to a rather poor quality of hay composed of crab grass with a small trace of lespedeza and peavines. The feeds were valued as follows:

Cottonseed meal	$26.00 a ton
Cottonseed hulls	7.00 a ton
Mixed peavine hay	15.00 a ton



There were 52 calves in this lot, but the above group shows the average quality very well. These calves were started on feed December 7, 1910. They were fed until March 29, 1911, on a ration of cottonseed meal, cottonseed hulls and pea-vine hay. At the beginning of the test they averaged 313 pounds in weight, and at the close 452 pounds. They cost 3 cents to begin with and sold for $5.55 per hundred-weight. Each calf netted a clear profit of $3.50.



A type in which the feeder takes great delight.

DAILY RATIONS.

During the first month no hay was fed, but it was thought that it would be profitable to use some hay along with the hulls, so it was provided after the first month.

It should be remembered in studying the following daily feeds, that these were young and small calves. Their average weight was only 313 pounds when the test began.

TABLE 8.—*Daily Ration for Each Calf by Monthly Periods.* (Dec. 7, 1910-March 29, 1911.)

Periods	Cottonseed Meal	Cottonseed Hulls	Hay
	Pounds	Pounds	Pounds
First 28 days	2.84	10.20	0
Second 28 days	3.11	10.40	2.04
Third 28 days	3.27	9.94	2.04
Fourth 28 days	3.09	9.50	1.92

During no period did the calves average eating more than 3.27 pounds each of cottonseed meal daily. Even with this small allowance of the meal a few calves scoured. They were given a definite number of pounds of hulls along with the meal, and all of the hay they would eat up clean after each meal. They ate, on the average, practically 10 pounds of hulls per calf per day, and slightly more than two pounds of hay. Many feeders would criticize the above rations as being too small, but satisfactory gains were made.

WEIGHTS AND GAINS.

The calves did not make unusually large gains, but when their size is taken into consideration it is seen that they increased in weight at a reasonable rate. The feeding period was continued for 112 days and during this time an average daily gain of 1.24 pounds was secured.

TABLE 9.—*Weights and Gains.*
(Dec. 7, 1910—March 29, 1911.)

Number of calves	Average initial weight of each calf	Average final weight of each calf	Average total gain of each calf	Average daily gain of each calf
	Pounds	Pounds	Pounds	Pounds
52	313	452	139	1.24

At the inauguration of the experiment each calf weighed 313 pounds; at the close they had attained an average weight of 452 pounds, hence during the feeding period of 112 days, (Dec. 7, 1910, to March 29, 1911) each calf made a total gain of 139 pounds. The animals were thrifty throughout the whole test.

QUANTITY AND COST OF FEED REQUIRED TO MAKE 100 POUNDS OF GAIN.

Considering that these calves were fattened in the winter time and upon dry feeds altogether, the gains as shown in the table below were produced at an unusually small expense. This was due largely to the fact that the animals were young. The younger the animal the more cheaply can the gains be made. As a rule, the feeder cannot expect to produce gains as cheaply on mature as on young cattle.

TABLE 10.—*Quantity and Cost of Feed to make 100 Pounds of Gain.*

Number of animals	Ration	Pounds of feed required to make 100 pounds of gain	Cost of feed to make 100 pounds of gain
		Pounds	
52	Cottonseed meal	249 meal	
	Cottonseed hulls	808 hulls	
	Mixed cowpea hay	121 hay	$6.97

It is seen that 249 pounds of cottonseed meal, 808 pounds of cottonseed hulls, and 121 pounds of hay were required to make 100 pounds of gain; or, when feeds were valued as on page 184 it cost $6.97 to make 100 pounds of increase in live-weight.

PART II. Two good individuals. These two represent the best type of calves in this test. They are high grade Aberdeen-Augus calves and are the kind that good feeders like to obtain. The picture was taken about the middle ofthe test.

AMOUNT REALIZED ON EACH TON OF FEED WHEN THE PRICES OF OTHER FEEDS ARE FIXED.

This test again emphasizes the facts, first, that the farmer can well afford to buy commercial feeds for his beef animals during the fattening process, and second, when he has home-raised feeds to sell, greater prices can be realized on them when they are sold by means of live stock than when sold upon the general grain or hay market. Each ton of feed used was sold, by means of the calves, for the following prices:

Price realized on each ton of cottonseed meal when other prices are fixed	$46.32
Price realized on each ton of cottonseed hulls when other prices are fixed	13.24
Price realized on each ton of mixed hay when other prices are fixed	56.61

Cottonseed meal cost $26.00 a ton, but it was sold, by means of the calves, for $46.32 a ton. The cottonseed hulls cost $7.00 a ton, which was nearly doubled by means of the calves, the price realized being $13.24 a ton. The price realized on the hay was, of course, abnormally high, as not much hay was fed: only 4.37 tons were used throughout the whole test, but this small amount was sold, by means of calves, for $56.61 a ton when cottonseed meal and hulls were valued at $26.00 and $7.00 a ton, respectively.

FINANCIAL STATEMENT.

At the beginning of the experiment the calves were valued at 3 cents a pound. When they were ready to sell, March 29, 1911, they were shipped to New Orleans where they sold for an average of $5.55 per hundred-weight. All expenses were taken into consideration in the financial statement below, such as freight, feed, yardage, and commission for selling in New Orleans. The calves were not sold by farm weight, so the financial statement is based on New Orleans weights and prices.

TABLE 11.—*Financial Statement.*

To 52 calves, 16,304 lbs., at 3 cents per lb........$	489.12
To 17900 lbs. of cottonseed meal at $26.00 a ton..	232.70
To 58,303 lbs. of cottonseed hulls at $7.00 a ton..	204.06
To 8,743 lbs. of mixed peavine hay at $15.00 a ton..	65.57
To shipping expenses, commission, yardage, etc., on 52 calves	114.92
Total expense ....$	1,106.37
By sale of 52 calves, 23,212 lbs., at $5.55..........$	1,288.27
Total profit ....$	181.90
Profit per calf	3.50

After all expenses were charged against the calves they netted a clear profit of $3.50 each. This was a satisfactory profit. It cost $2.21 to ship each calf to New Orleans and pay all the selling expenses upon their arrival; the total shipping expenses amounted to 49 cents for each 100 pounds live weight.

SLAUGHTER RECORDS.

As stated before, these calves were shipped to New Orleans where slaughter records were secured. They were driven three miles to the railroad at Bellamy, Alabama, to be loaded on the cars.

TABLE 12.—*Slaughter Data.*

Number of calves	Average farm weight without shrink	Average market weight at New Orleans	Shrinkage of each calf in transit	Per cent dressed out by: Shrunk farm weight	Per cent dressed out by: Market weight
	Pounds	Pounds	Pounds	Per cent	Per cent
45	455	443	12	52.8	52.7

There were 52 calves altogether, but the dressed weights of only 45 were secured. The animals lost an average of 12 pounds each during the trip to New Orleans; this was an unusually small shrinkage. They dressed out 52.7 per cent by New Orleans weights, and 52.8 per cent by farm weights, after a 3 per cent shrink.

SUMMARY.

TABLE 13.—*Summary Table.*

Total number of calves 52
Average weight of each calf at beginning of test (December 7, 1910) .... 313 pounds
Average weight of each calf at end of test, (March 29, 1911) .... 452 pounds
Average gain of each calf .... 139 pounds
Average daily gain of each calf for 112 days.... 1.24 pounds
Pounds feed required to make 100 pounds of gain:
Meal .... 249 pounds
Hulls .... 808 pounds
Hay .... 121 pounds
Cost to make 100 pounds of gain.................. $6.97
Price realized on each ton cottonseed meal........... $46.32
Price realized on each ton cottonseed hulls $13.24
Price realized on each ton hay $56.61
Average value of calves at beginning of test (December 7, 1910), per cwt. $3.00
Selling price of calves at New Orleans (March 29, 1911), per cwt. $5.55
Total profit on each calf $3.50

Summary Statements.

1. The calves used in this test were from 6 to 8 months old when the experiment began, December 7, 1910.

2. They were valued at $3.00 per hundred-weight when the test began.

3. At the beginning of the test the calves averaged 313 pounds in weight; at the close (March 29, 1911) they had attained an average weight of 452 pounds. They made an average daily gain of 1.24 pounds.

4. There were required 249 pounds of cottonseed meal, 808 pounds of cottonseed hulls, and 121 pounds of mixed cowpea hay to make 100 pounds of increase in live weight. The cost of 100 pounds gain was $6.97.

5. The price realized for each feed when sold through the calves, and when the prices of the other feeds were fixed, was as follows:

Cottonseed meal	$46.32 a ton.
Cottonseed hulls	13.24 a ton.
Peavine hay	56.61 a ton.

6. On March 29, 1911, the calves were shipped to New Orleans and sold for $5.55 per hundred-weight. Each calf netted a clear profit of $3.50.

Part III.

Wintering Calves and Fattening Them the Following Summer on Pasture.

This work was carried on in cooperation with Cobb and McMillian, of Sumter County, Alabama. As in the previous tests, these farmers furnished the cattle and the feed, and the Alabama Experiment Station and the Bureau of Animal Industry placed a trained man upon the farm to carry on the experimental work. One of the authors of this bulletin, Mr. W. F. Ward, was stationed on the farm and had personal supervision of the test.

PLAN AND OBJECT OF THE WORK.

The calves in this experiment were born during the spring of 1909. During the summer of 1909 they were with their mothers on a reasonably good pasture and received no particular attention, except being salted regularly. When fall arrived and the pastures were exhausted they were taken from their mothers, weaned, tagged, dehorned, and the males castrated. They were then put up in an acre lot in which there was no grass, and fed all winter on a ration of cottonseed meal, corn chops, cottonseed hulls, and mixed alfalfa hay. The object was to give them sufficient feed to produce good gains all through the winter months, but not to fatten them for the market until the pasture was available the following spring. By the latter part of March, 1910, sweet clover (Melilotus) had appeared, so the calves were changed from the winter feed to this pasture and fed some cottonseed cake and alfalfa hay in addition. They were kept upon this pasture until June 22, 1910, when they were sold. During the latter part of the grazing season there was some Japan clover (Lespedeza) and Bermuda in the pasture. During all this time the calves were given a small daily feed of cottonseed cake along with the pasture.

The object of the work was to determine the profit, if any, in handling and feeding beef calves in accordance with the above plan.

THE CALVES.

The 34 calves used in this test were a good grade; none of them was pure bred, but the majority contained from one-half to three-fourths of Aberdeen-Angus, Hereford, or Shorthorn blood. The majority of the calves were raised on the farm where the experimental work was done; some few of them, however, were purchased from neighbors just before the inauguration of the experiment. As before stated, they had all been born during the spring of 1909, so were from seven to eight months old when they were first weighed, December 3, 1909. For their age, they were not large, although they were larger than the avergae calves of the State. At the beginning of the work their average weight was 386 pounds.

PART III. **Picture taken at beginning of test, December 3, 1909. At this time the calves averaged 386 pounds in weight and were frcm 6 to 8 months old. They were fed through the winter on a ration of cottonseed meal, corn chops, cottonseed hulls and mixed alfalfa hay. It cost $10.90 to feed each calf from December 3, 1909 to March 24, 1911. They averaged 512 pounds in weight March 24, 1911, so made good gains during the cold months. When spring came they were turned into a pasture and fed cottonseed cake as a supplementary feed.**

FEED AND MANAGEMENT.

December 3, 1909, the calves were placed in the acre lot, in which was a good shed that afforded ample protection from cold rains and wind. On the above date the winter feeding began. They were salted at regular intervals. Good, clean, fresh water was kept in troughs all of the time. The hay racks and the feed bunks, or troughs, were all under shelter so that the calves could eat in a comfortable place no matter how inclement the weather became.

During the winter months they were fed twice daily, once early in the morning and again an hour or so before dark.

When grass appeared in the spring (March 22, 1910), each calf was weighed and all turned upon the pasture to be fattened on grass. While on pasture they were fed only once a day, and this was done about sun-down, or the cool part of the afternoon, so that all would come out to the feed troughs. The feed, which consisted of cottonseed cake and alfalfa hay, was not thrown upon the ground; the cake was placed in feed troughs situated at convenient places in the pastures, and the hay was fed from hay racks. When cattle are thus fed in properly constructed hay racks and troughs practically no feed is wasted.

The pasture was not free from ticks, so the calves became slightly infested. However, they were dipped at irregular intervals and very few ticks appeared on them. No Texas fever cases developed.

A good supply of water was afforded by a creek and an artificial pool.

THE PASTURE.

In the western part of Alabama sweet clover (Melilotus) appears earlier than any other pasture plant. In the spring of 1910 this clover pasture was ready for grazing by March 22, but it did not afford complete and satisfactory grazing at this early date. However, no hay was used to supplement the pasture until April 29, when a small allowance of freshly-cut alfalfa hay was added to the pasture and cake ration. Later on in the season the sweet clover died down, when Japan clover (Lespedeza), some Bermuda, and carpet grass constituted the main grazing plants.

The pasture had been in cultivation the season of 1909 so did not furnish ample grazing as the grasses had not become thoroughly established. Still the calves made good and economical gains during the pasture season. The 34 animals were grazed upon a field which contained practically 100 acres.

CHARACTER AND PRICES OF FEEDS.

Cottonseed meal, cottonseed cake, cottonseed hulls, corn chops and freshly-cut alfalfa hay were all used at various times throughout the test. The purchased feeds were charged against the calves at the market prices. Estimated prices, corresponding as nearly as possible to the market prices, were placed upon the two feeds which were grown upon the farm. The folloing prices were placed upon the feeds:

Cottonseed meal	$26.00	a ton.
Cottonseed cake (broken)	26.00	a ton.
Cottonseed hulls	7.00	a ton.
Corn	.70	a bushel.
Alfalfa hay	15.00	a ton.
Pasture (per head)	.50	a month.

During the winter months a hay made up of a mixture of Johnson grass and alfalfa was fed, but that which was fed along with the pasture was practically all freshly-cut alfalfa. The corn, which was grown on the farm, was used in the shape of corn chops, the shelled corn being run through a grinder and crushed into coarse meal. The cottonseed meal and the cottonseed cake were both purchased from a near-by oil mill. The cake had been broken into nut size and sacked; this had been done at the mill. All of the feeds were of good quality.

DAILY RATIONS.

As noted in the early part of this bulletin, young animals must be fed with a great deal of care and skill; they require more care and attention than steers and oxen. These calves were fed at practically the same hour each day, and received a definite amount of feed. This daily allowance of feed was limited, and it was expected that the troughs would be clean within an hour after each feeding.

TABLE 14.—*Daily Feed for Each Calf for the Whole Period.* (Dec. 3, 1909—June 22, 1910).

Periods	DAILY RATION	
	Winter Period (December 3-March 24)	Pasture Period (March 25-June 22)
	Pounds	Pounds
First 28 days	2.18 cottonseed meal 1.38 corn chops 3.93 mixed alfalfa hay 7.13 cottonseed hulls	3.23 cottonseed cake
Second 28 days	1.68 cottonseed meal 2.40 corn chops 3.99 mixed alfalfa hay 7.23 cottonseed hulls.	3.85 cottonseed cake 1.59 alfalfa hay.
Third 28 days	1.38 cottonseed meal 1.07 corn chops 3.82 mixed alfalfa hay 9.39 cottonseed hulls	5.00 cottonseed cake 2.74 alfalfa hay
Fourth 28 days	1.48 cottonseed meal .72 corn chops 3.36 mixed alfalfa hay 10.24 cottonseed hulls	Last 5 days: 5.00 cottonseed cake 2.74 alfalfa hay

It will be seen that the calves did not get a heavy grain ration at any time. The first 28 days of the winter period each calf was given practically 3.5 pounds of grain each day; during the second period of 28 days, the quantity was raised to four pounds for each calf daily. This large amount, however, was too expensive, so the grain part of the ration was reduced considerably during the third period of 28 days. The object was to get these calves through the winter as cheaply as possible, and still produce reasonable and steady gains. The pasture was looked forward to as the feed for making rapid and cheap gains, so the high-priced winter feeds were used as sparingly as possible. It will be seen later, however, that the calves made satisfactory gains in the winter months.

During the winter months a definite amount of cottonseed hulls was weighed out to the animals at each feed. It is seen that for the first 28 days, each calf ate 7.13 pounds of hulls.

daily, while during the last 28 days, the daily allowance was raised to 10.24 pounds. Alfalfa hay was fed ad libitum; they were given all they cared to eat after receiving the regular feed of hulls and concentrates. They did not consume much alfalfa hay, however, as each calf did not average as many as four pounds daily.

PART III. General view of calves about the middle of the pasture season. They were fed cottonse cake and alfalfa hay along with pasture. They were fed on pasture from March 25, 1910, to Ju 22, 1910. When the test closed each calf weighed 628 pounds, and was from 15 to 16 months o While on pasture, each calf ate 4.06 pounds of cottonseed cake and 1.55 pounds of alfalfa h daily. They sold for 5 1-2 cents apound, and made a clear profit of $1.86 each.

When the pasture season arrived, March 25, 1910, the calves were turned upon grass and given an average daily feed of 3.23 pounds of cottonseed cake for the first 28 days. The pasture was not good at this early date and the calves made only 0.23 of a pound average daily gain per head during the first period. It would probably have been profitable to have supplemented the pasture with some alfalfa hay during this period, but the hay could not be secured. By April 29 a new crop of alfalfa had been cut, so that date marked the beginning of the use of the hay. After this date hay was fed each day until the calves were sold. During the last 33 days of the test each calf was given a daily feed of five pounds of cottonseed cake and 2.74 pounds of alfalfa hay in addition to the pasture.

WEIGHTS AND GAINS.

These calves were larger than those used in the test reported in Part I. When the test began the calves averaged 386 pounds in weight; when it closed, they averaged 628 pounds, or they made an average total gain of 242 pounds each from December 3, 1909, to June 22, 1910. Taken as a whole, the gains were entirely satisfactory.

TABLE 15.—*Total and Daily Gains.*

Period	Number of calves	Number of days fed	Average initial weight of each calf	Average final weight of each calf	Average total gain of each calf	Average daily gain of each calf
			Pounds	Pounds	Pounds	Pounds
Winter Period (Dec. 3-Mar. 24)	34	112	386	512	126	1.13
Pasture Period (March 25-June 22)	34	89	509	628	119	1.33

The calves were in the test 201 days. For the first 112 days they were on dry winter feed; during the final 89 days they were on pasture. Each calf made an average total gain of 126 pounds from December 3, 1909, to March 24, 1910, or, an average daily gain of 1.13 pounds. This was satisfactory. On March 24, they averaged 512 pounds in weight and were from 11 to 12 months of age.

During the pasture season of 89 days (March 25 to June 22), the calves made an average total gain of 119 pounds each, or, an average daily gain of 1.33 pounds. These gains were also satisfactory, but nothing unusual. When the test closed on June 22 the calves had reached an average weight of 628 pounds. They were from 14 to 15 months old at this time.

QUANTITY AND COST OF FEED REQUIRED TO MAKE 100 POUNDS GAIN IN WEIGHT.

The table below shows the average daily ration for each calf, the pounds of feed required to make one hundred pounds of increase in live weight, and the cost to make the gains. In this connection, it should be remembered that these were young and small animals. As a result of their being young and small their daily feed was small and their gains were made economically.

TABLE 16.—*Average Daily Ration and Quantity and Cost of Feed to Make 100 Pounds of Gain.*

Period	Ration	Average daily feed per calf	Pounds feed to make 100 pounds of gain	Cost to make 100 pounds of gain
		Pounds	Pounds	
Winter Period (Dec. 3-Mar. 24)	Cottonseed meal Corn chops Cottonseed hulls Mixed alfalfa hay	1.68 meal 1.39 corn 8.49 hulls 3.77 hay	149 meal 123 corn 754 hulls 335 hay	$8.63
Pasture Period (March 25-June 22)	Cottonseed cake Alfalfa hay	4.06 cake 1.55 hay	305 cake 116 hay	$4.84

It cost $8.63 to make 100 pounds of gain during the winter period, but the same gains were made for only $4.84 when the calves were on pasture and receiving a partial ration of cottonseed cake and alfalfa hay. This strikingly illustrates the importance and value of pastures. During the winter months expensive gains are almost always encountered no matter what kind of live stock is being raised or fattened. This condition of affairs is usually due to two factors. First, the feeds which are used during the winter months are the high-priced ones, and second, smaller gains are usually secured (especially with young and growing stock) during the cold months, and small gains are almost always expensive.

The cost of the summer gains was small compared with that of the winter gains, yet the summer gains were unusually expensive. In previous pasture-feeding work* in this State, summer gains were made for $2.56 to $3.24 per hundred pounds increase in live weight when cake was fed along with the pasture. The short pasture during the early part of the test probably accounts for the expensive gains; the calves made a daily gain of only 0.23 of a pound during the first 28 days of the summer feeding.

*See Alabama Station bulletin No. 151, or Bureau of Animal Industry bulletin No. 131.

PRICES REALIZED FOR THE FEEDS AS A RESULT OF FEEDING THE CALVES.

It will be seen below that excellent prices were realized upon all of the feeds used during the fattening period. By means of the calves the feeds were sold for a greater price than they would have brought had they been placed upon the open grain or hay markets. The feeds brought the following prices as a result of being fed to the calves:

Cottonseed meal was sold, by means of the calves, for	$45.93 a ton.
Corn chops was sold, by means of the calves, for	1.37 a bushel.
Cottonseed hulls were sold, by means of the calves ,for	10.99 a ton.
The hay fed in the winter time was sold, by means of the calves, for	23.89 a ton.
Cottonseed cake was sold, by means of the calves, for	35.82 a ton.
Alfalfa hay was sold, by means of the calves, for	21.48 a ton.
Pasture rented (per month per calf) for	1.06

Cottonseed cake cost $26.00 a ton, but was resold, by means of the calves, for $35.82 a ton. If the hay had been sold on the hay market it would have brought approximately $15.00 a ton, but when it was fed to the calves and marketed by means of them each ton realized from $21.48 to $23.89. When measured in terms of profits made on the calves, the pasture was rented for $1.06 a month for each calf. If the corn had been hauled to town and sold it would not have brought over 70 cents a bushel, but when it was fed to the calves each bushel realized $1.37. The cottonseed meal and hulls were sold through the calves for $45.93 and $10.99 a ton, respectively.

These results all emphasize the fact that the farmer can usually sell his farm crops, by means of some kind of live stock, for more than can be obtained for them when placed on the market as raw farm products.

RT III. A close view of some of the calves while eating cottonseed cake. Picture taken May 17, 1910. Calves sold June 22, 1910.

FINANCIAL STATEMENT.

As stated before, the majority of these calves were raised on the farm where the work was done. As they were not purchased on the open market an estimated fall value was placed upon them. They were estimated to be worth 3 1-2 cents a pound when the winter work began, December 3, 1909. They were fed through the winter, all feeds being charged against them at the regular market prices, so by the time spring arrived they had cost considerably more than the above fall price. The following statement shows the complete cost of the calves up to March 24, 1910:

TABLE 17.—*Total Cost of the Calves on March 25, 1910.*

To 34 calves, 13,118 pounds at 3 1-2 cents (fall value) .	$459.13
To 6,414 pounds cottonseed meal at $26.00 a ton....	83.38
To 5,303 pounds of corn chops at 70 cents a bushel....	66.21
To 32,356 pounds of cottonseed hulls at $7.00 a ton..	113.25
To 14,380 pounds of mixed alfalfa hay at $15.00 a ton.	107.85
Total cost of calves March 25, 1910............	$829.82

On March 25, 1910, the 34 calves weighed 17,313 pounds, and their total cost had reached $4.79+ per hundred-weight, consequently they were valued at this sum at the beginning of the pasture work. It cost $10.90 to feed each calf from December 3, 1909, to March 25, 1910.

TABLE 18.—*Results of Fattening the Calves on Pasture.*

To 34 calves, 17,313 pounds at $4.79+ per cwt. . . . . $	829.82
To 12,291 pounds of cottonseed cake at $26.00 a ton. .	159.78
To 4,691 pounds of alfalfa hay at $15.00 a ton. . . .	35.18
To total pasture rent, 89 days (March 25 to June 22) at 50 cents per head per month.	50.43
Total expense . . . . $	1,075.21
By sale of 34 calves, 20,702 pounds at 5 1-2 cents a pound . . . . $	1,138.61
Total profit . . . . $	63.40
Profit per calf	1.86

These calves were sold June 22, 1910, for 5 1-2 cents a pound on the farm, after a 3 per cent shrink. They were shipped to the Meridian, Mississippi, market for slaughter.

The above shows that a profit of $1.86 was made on each calf after all expenses were taken into account. The financial statement means that the calves were put into the test at 3 1-2 cents a pound in the fall of 1909; that the alfalfa hay, which was grown on the farm, was sold for $15.00 a ton; that the corn which was also produced on the farm was disposed of for 70 cents a bushel; and finally, an additional profit of $1.86 was made on each calf. This was satisfactory, especially when it is recalled that a large amount of manure was produced while the calves were being fed.

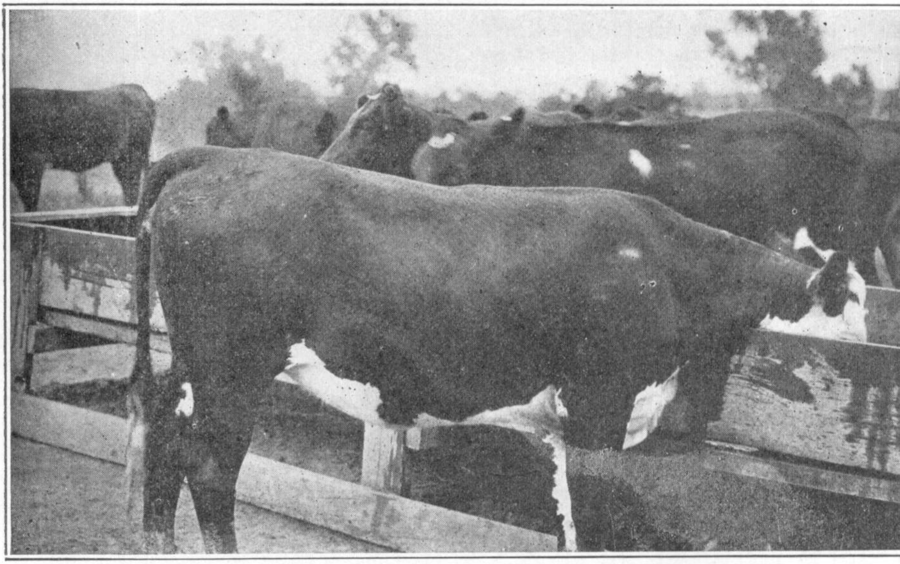
SLAUGHTER RECORDS.

The calves were shipped to Meridian, Mississippi, for slaughter. They were driven to Scooba, Mississippi, a distance of 11 miles, to be loaded on the cars. Through a misunderstanding the live weights were not secured at Meridian but the individual weights of the dressed carcasses were all obtained.

TABLE 19.—*Slaughter Data.*

Number of calves	Total weight on farm	Total weight of carcasses in Meridian	Per cent dressed out by farm weights	Per cent dressed out by farm weight after 3 per cent shrink
	Pounds	Pounds	Per cent	Per cent
34	21342	11258	52.8	54.4

It will be seen that the calves dressed out, by tota. farm weights, 52.8 per cent. The carcasses were good ones and made an excellent appearance when hung up in the cooler.



PART III. Picture showing one of the best individuals. This is a grade Hereford. Picture taken May 17, 1910. Calves sold June 22, 1910. This calf is eating cottonseed cake.

SUMMARY.

TABLE 20.—*Summary Table.*

Cost of calves, fall of 1909 ....$3.50 per cwt.
Average weight of calves December 3, 1909......386 pounds
Average daily ration from December 3, 1909—
March 24, 1910:..........1.68 pounds cottonseed meal,
1.39 pounds corn chops,
8.49 pounds cottonseed hulls,
3.77 pounds mixed alfalfa hay.

Average weight of calves March 24, 1910 ....512 pounds
Average daily gain during the winter months....1.13 pounds
Cost to make 100 pounds increase in live weight during the winter months ....$ 8.63
Cost to feed each calf through the winter months......$10.90
Total cost of calves, per hundred-weight, when pasture appeared in spring, March 24, 1910 ....$4.79 +
Cost to make 100 pounds increase in live weight on pasture ....$ 4.84
Each ton of cottonseed cake was sold, by means of the calves, for $35.82
Each ton of alfalfa hay was sold, by means of the calves, for $21.48
Selling price of calves per hundred-weight on farm, after 3 per cent. shrink ....$ 5.50
Profit on each calf ....$ 1.86

Summary Statements.

1. The calves used in this work were of a good grade. They were from 7 to 8 months old when the test began.

2. They were fed through the winter of 1909-10 on cottonseed meal, corn chops, cottonseed hulls, and mixed alfalfa hay. In the spring of 1910 the calves were put in a pasture and finished for the market on pasture, cottonseed cake, and alfalfa hay.

3. During the winter season (December 3, 1909-March 24, 1910) the calves made an average total gain of 126 pounds, or an average daily gain of 1.13 pounds.

4. During the pasture season (March 25, 1910-June 22, 1910) the calves made an average total gain of 119 pounds, or an average daily gain of 1.33 pounds.

5. During the winter season (December 3, 1909-March 24, 1910) 149 pounds of cottonseed meal, 123 pounds of corn chops, 754 pounds of hulls, and 335 pounds of hay, at a total cost of $8.63, were required to make 100 pounds of increase in live weight.

6. During the pasture season (March 25, 1910-June 22, 1910) 305 pounds of cottonseed cake and 116 pounds of

alfalfa hay, at a total cost of $4.84, were required to make 100 pounds of increase in live weight.

7. Each ton of cottonseed cake was sold, by means of the calves, for $35.82 when the other feeds are valued as indicated in this bulletin.

8. Each ton of alfalfa hay was sold, by means of the calves, for $21.48 when the other feeds are valued as indicated in this bulletin.

9. The calves cost $3.50 per hundred-weight in the fall of 1909. It cost $10.90 to feed each calf from December 3, 1909 to March 24, 1910. By March 24, 1910, the calves had cost $4.79 + per hundred-weight.

10. On June 22, 1910, the calves sold on the farm for $5.50 per hundred-weight, after a 3 per cent. shrink.

11. A clear profit of $1.86 was made on each animal.

Part IV.
General Statements.

While the calves in Parts I, II, and III were fattened in different ways and by different methods, all were raised and handled in the same manner up to the time of being placed in the dry lots. All were born during the spring months and ran with their mothers on a reasonably good pasture during their first summer; they ate nothing but mother's milk and pasture grasses during this time. When the pasture season closed, which was practically December 1 each year, the calves were weaned, dehorned, the males castrated, and all placed in feed lots to be fattened. At this time the different methods as outlined in the different Parts were introduced. In Part I the calves were divided into three lots and fattened upon various feeds for the early spring market; in Part II the calves were all fed in the same lot and finished for the early spring market on cottonseed meal, cottonseed hulls, and peavine hay; in Part III they were carried through their first winter on a ration slightly below a full feed and fattened the following summer on pasture supplemented by cottonseed cake and alfalfa hay.

As a matter of fact, the winter feeding should have been inaugurated before December 1, as the calves lost some of their calf-fat, due to short pastures and decreased milk supply, before the feeding periods began. In farm practice it would be wise either to begin the winter feeding by November 1 or to have an oat or rye pasture for the young animals to graze upon after the permanent pastures are killed by frost.

To feed calves as these were fed it is best to have them born as early as possible in the spring. This gives them an opportunity to attain a reasonable size and age by the time they are ready for sale the following spring or early summer. The southern markets prefer larger carcasses than the ones obtained from these calves. In some sections of America, where the cows must be housed during the winter months, it is more desirable to have the calves born in the fall of the year, as the farmer has more time to care for the small animals during the winter than during the summer months, and too, the calves are weaned at the season—spring—when their growth is least retarded, but in the South, where range conditions yet obtain, to have the calves come in the fall would involve the risk of losing both the mothers and the offspring.

The calves in Part I were sold March 17, those in Part II March 29, while those in Part III were fattened on pasture during the latter part of the feeding period and not disposed of until June 22. The calves in Part I and II were practically one year old when sold, while those in Part III were from fourteen to sixteen months of age at the time of slaughter. As stated in the introduction, there are some advantages in selling calves at an early age. On the other hand, the farmer experiences difficulties in feeding young animals which are not encountered in feeding old and mature animals. In the first place, it would seldom, or never, pay to finish a poor grade of young calves for the market as our markets sharply discriminate against young animals which carry a predominance of Jersey or scrub blood. In the second place, the farmer who feeds young animals of any kind must be a careful and watchful feeder. An old animal may be fed and handled carelessly and satisfactory results still be obtained, but not so with the young animal. A single case of over-feeding may so derange the intestinal track of the young animal that further development is impossible.

But the preceding tests indicate that excellent profits may be made on calves when they are fed properly, handled carefully, and sold in a business-like way. In Part I a clear profit of \$1.84, \$2.25, and \$1.48 was realized on each calf in their respective lots; in Part II, where nothing was fed except cottonseed meal, cottonseed hulls and peavine hay, a profit of \$3.50 was realized on each animal; and in Part III, where the animals were fed a light ration of grain and hay throughout the winter months and finally finished on pasture, \$1.86 profit was realized on each calf.

The reader should understand that these different experiments are not directly comparable but they do, in a general way, teach us some lessons. The difference in profits between the calves in Parts I and II was due largely to the selling price; those in Part II simply sold to greater advantage. This difference in profits in favor of the calves in Part II was not due to the fact that they made gains more economically than those in Part I. On the contrary, the calves in Part I made 100 pounds of gain for $6.22, $6.19, and $6.83 in the respective lots, while the same gain cost $6.97 in Part II. While the calves in Part II were a cheaper grade than those in Part 1 (the calves in Part II were valued at 3 cents a pound when the test began, while those in Part I were valued at 3½ cents a pound) still they sold for practically the same price when placed on the market; there was a difference of one-half a cent a pound in favor of the calves in Part II. The calves in Part I were sold on the Cincinnati market, while the ones in Part II were shipped to New Orleans. At the present time, and, in fact, for some years past, both cattle and hogs have been selling for better prices on the southern than on the northern markets.

While the calves in Part III sold for a better price than those in the other tests, still they were not as profitable as some of the others. The selling price alone does not determine the final profit; other factors must be considered. It is seen that the winter gains in this test were expensive, costing $8.63 to make 100 pounds. While the cost of the subsequent pasture gains was small as compared to the winter gains they were not sufficiently cheap to overcome the preceding high-priced gains and thereby make a profit that was entirely satisfactory. Notwithstanding the fact that a profit was made on these calves, the authors are of the opinion that a greater profit would have been made if they had been fed more liberally during the winter months and sold in March or April instead of in June. The expensive winter gains were due to the fact that the animals were held below a full ration; the nearer the feeder approaches a mere maintenance ration the more expensive the gains. If the calves had been given a full feed, or almost a full feed, during the winter months, their gains would have been considerably greater than they were and at the same time more economical. The test, however, does illustrate the value of pastures for making cheap gains.

This experimental work is being continued, but at the present time the following general conclusions, based on the work already done, can be drawn:

1. A farmer may expect to obtain a reasonable profit on beef calves when he raises and fattens them on his farm and sells them when they are twelve to fourteen months old. That is, the farmer who feeds his corn and hay to these young animals can realize more on these raw farm products, when sold through the calves, than when sold as corn or hay. At the same time a large amount of manure is made on the farm to enrich the soil.

2. In the South, at least in Alabama at the present time, the calves should be born during the early spring months.

3. The southern feeder has the choice of many different feeds suitable for fattening calves. With reference to the feeds reported in this bulletin the following conclusions are warranted:

A. When fattening calves, it pays to feed a ration made up of one-third corn-and-cob meal and two-thirds cottonseed meal when corn is valued at 70 cents a bushel and meal at $26.00 a ton.

B. It is not profitable for two-thirds of the concentrated part of the ration to be composed of corn-and-cob meal when the feeds are valued as above.

C. Young calves can be finished for the market at a profit on cottonseed meal, cottonseed hulls, and peavine hay, but it is more profitable to introduce corn-and-cob-meal to take the place of part of the cottonseed meal.

4. When shall the calves be sold? The tests seem to indicate that it is more profitable to feed a heavy ration and sell the calves at the end of the winter months, when the prices are normally high, than to hold them until the early summer months. Light winter feeding goes hand in hand with expensive gains; while the subsequent pasture gains are made more cheaply than the winter gains, they are not made economically enough to overcome, or counteract, the preceding high-priced slowly-made winter gains, together with the normal depreciation in the value of cattle from March or April to June or July.

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ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

HEADING OFF BOLL WEEVIL PANIC

BY

W. E. HINDS

Entomologist.

Opelika, Ala.

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1911

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HEADING OFF BOLL WEEVIL PANIC

By W. E. Hinds, Entomologist.

The boll weevil entered Alabama during the fall of 1910 and in that season infested, wholly or partly, five counties. In the area that year infested, was grown less than 15,000 bales in 1910. During the season of 1911 the pest has advanced until twelve counties are now included within, or crossed by, the line of infestation. The weevil spread now reaches into territory where cotton is grown extensively. Fully 90,000 bales were grown in 1910, within the area now infested in Alabama. This area usually produces about 1-12 of our state crop.

EFFECTS OF WEEVIL OCCURRENCE ON COTTON PRODUCTION.

It is time therefore, for a definite, concerted movement here in Alabama which may help to prevent such losses as have occurred in Mississippi, Louisiana and other infested states. In some parts of these states the losses have been enormous. For instance, in Louisiana, the cotton crop in 1910 was but approximately 25 per cent. of the crop of 1906 when the weevil had but recently entered the State. In some parishes in Louisiana, as for instance the two raising the largest quantity of cotton, St. Landry produced in 1906 about 69,000 bales but in 1910 only 15,000 bales. Caddo parish produced in 1906 nearly 54,000 bales and in 1910, less than 21,000 bales. In Mississippi possibly the greatest loss sustained in any county was that of Adams county producing nearly 24,000 bales in 1906 and 1,062 in 1910. Unquestionably it will take such counties many years to even recover this lost ground.

In the seven southwestern counties of Mississippi first infested in 1907 and 1908, the crop in 1906 was 158,578 bales but in 1910 only 24,014 bales or about 15.14 per cent. of their normal crop. The next twelve counties to be infested partly in 1908 but mostly in 1909 had their crop cut from 214,115 bales in 1906 to 135,457 in 1910 the first year after general infestation occurred. This was a loss of more than 35 per cent. of their normal crop. Taking together the twenty-two Mississippi counties brought wholly within the weevil area during 1907-9, we find the cotton yield decreased from 451,612 bales in 1906 to 235,241 bales in 1910. This is but 52 per cent. of the 1906 crop which was close to the average. Comparing this tremendous reduction within the infested area with conditions in a total of 53 counties not touched by the line of 1909, we find that their combined yield was 987,527 bales in 1906 and 964,542 bales in 1910. In general then it appears that the normal 1910 crop, regardless of boll weevil influence, should have been about 2.4 per cent. short of that of 1906. Even with this allowance for a less favorable season, it appears that the weevils directly and indirectly have cut the crop just in half in Mississippi territory infested from one to three years.

A broader and more general view of the weevil effect in decreasing cotton yields may be had by studying the figures for several states during a series of years, showing average yields before and after infestation occurred.

TABLE 1.
Influence of Boll Weevil on Cotton Yield Per Acre.

		1894	Bales per acre	1898	Bales per acre	1902	Bales per acre
Alabama	*A.	2.664,861		3,003,176		3,501,614	
	†Y	900,439	.337	1,176,042	.391	977,045	.279
Mississippi	A	2,826,272		2,900,298		3,183,989	
	Y.	1,231,227	.435	1,247,128	.429	1,451,750	.455
Louisiana	A.	1,313,296		1,281,691		1,617,586	
	Y.	760,757	.579	717,749	.560	886,365	.548
Texas	A.	6,854,621		6,991,904		7,640,531	
	Y.	3,140,392	.458	3,363,109	.481	2,491,394	.326

		1906	Bales per acre	1909	Bales per acre	1910	Bales per acre
Alabama	*A.	3,658,000		3,471,000		3,560,000	
	†Y.	1,263,674	.345	1,065,377	.307	1,221,225	.343
Mississippi	A.	3,408,000		3,291,000		3,317,000	
	Y	1,521,491	.446	1,109,580	.337	1,254.419	.377
Louisiana	A.	1,739,000		930,000		975,000	
	Y.	979,270	.563	269,573	.290	256,375	.263
Texas	A.	8,894,000		9,660,000		10,060,000	
	Y.	4,066,472	.457	2,554,520	.264	3,072,932	.305

*A. Represents acreage in cotton.
†Y. Refers to yield.

TABLE 2.
Effect of Weevil Infestation on Cotton Yield Per Acre.

		1894	1898	1902	1906	1909	1910
Ala.	*A.	0.337	0.397	0.279	0.345	0.307	0.343
	†B.	None	None	None	None	None	None
Miss	A.	0.435	0.429	0.455	0.446	0.337	0.377
	B.	None	None	None	None	9-10 p. ct.	14 p. ct.
La.	A.	0.579	0.560	0.548	0.563	0.290	0.263
	B.	None	None	None	23 p. ct.	100 p. ct.	100 p. ct.
Tex.	A.	0.458	0.481	0.326	0.457	0.264	0.305
	B.	¼ of 1 p.ct.	11 p. ct.	36-33 p ct.	70-72 p.ct.	78-82 p.ct.	80-84 p.ct.

*A. Refers to portion of bale per acre.
†B. Approximate percentage of state acreage under weevil infestation.

A few general statements relative to some of the figures given above may help still further toward the formation of a proper idea of their significance. The five years selected are representative of conditions existing at intervals from the time when there was practically no infestation (1894) to the time of the most recent complete figures now available (1910). Yields per acre by states can be determined very closely from figures of state acreage and state yields published annually by the U. S. Census Bureau. But these reports do not give acreage by counties for each year and we therefore find it impossible to determine and compare acreage yields in counties in the infested area for each year with yields in other counties outside the weevil line. As Louisiana is the only state yet completely infested, that is the only case where the decreased yield actually occurring in the infested area is not raised by combination with figures from other counties in the state where there is no infestation. Extreme drought has also seriously affected Texas especially in 1909 and 1910.

From a close study of the foregoing statements and of the tables, it would appear that we may reasonably expect the boll weevil not only to cause a considerable reduction in the acreage devoted to cotton in the infested area but also to cause a decrease of between 25 and 50 per cent in the average yield per acre obtainable under conditions of infestation. When we consider further that the average yield in Alabama for the six representative years considered above is but little more than three-fourths of the average yield in the other three states taken together, I believe it will be very evident to all that some change is absolutely essential in Alabama in the direction of securing immediate diversification of crops and other changes in our agricultural and economic systems if we shall be successful in preventing large loss from the boll weevil.

Much of this tremendous loss might have been prevented had the people of these sections been ready to adopt certain changes in their agricultural methods which have been shown necessary in all sections where the weevil has gone. It is well known that the weevil has everywhere forced the raising of a greater variety of crops, some reduction in the cotton acreage to be worked by each mule and some change in the advance system under which most of the cotton crop has heretofore been grown. It has usually required from three to five years for these necessary changes to become generally adopted and invariably thereafter greater prosperity has resulted than was experienced before the advent of the weevil.

It is evident, therefore, that the first few years under weevil conditions constitute the critical period in the fight against this pest. During this period there has existed in most localities a more or less well defined business panic with failures of merchants, reduction of crops, curtailment of advances, the moving of tenant labor and frequently a considerable depreciation in real estate values. All this can be clearly shown to result from the policy of delaying the adoption of the changes which the boll weevil situation everywhere requires until after the loss of several crops has finally forced their adoption. The results of the work done with the U. S. farm demonstration agents have shown conclusively that it is possible by using proper methods to so control the weevil that cotton yields may be fully maintained. Every effort must be made to further the general adoption of such successful methods of cotton culture both within and without the weevil infested area.

Clearly then, much of the loss might be prevented wherever these changes could be brought about in advance of the abundant occurrence of the weevil. Alabama should profit by the sad experience of neighboring infested states and avoid these losses and the consequent decrease of our agricultural prosperity.

AGENCIES CO-OPERATING IN WEEVIL FIGHT IN ALABAMA.

In Alabama there are three principal co-operating agencies engaged in this fight against the boll weevil. These, in the order of their establishment are as follows:

The first agency, the State Department of Agriculture and Industries now under the direction of Commissioner R. F. Kolb was organized in 1883, and has conducted principally an educational work in the interests of the agricultural development of the State. The Commissioner of Agriculture and Industries is ex-officio, Chairman of the Alabama State Board of Horticulture which is charged with the administration of the State boll weevil quarantine regulations.

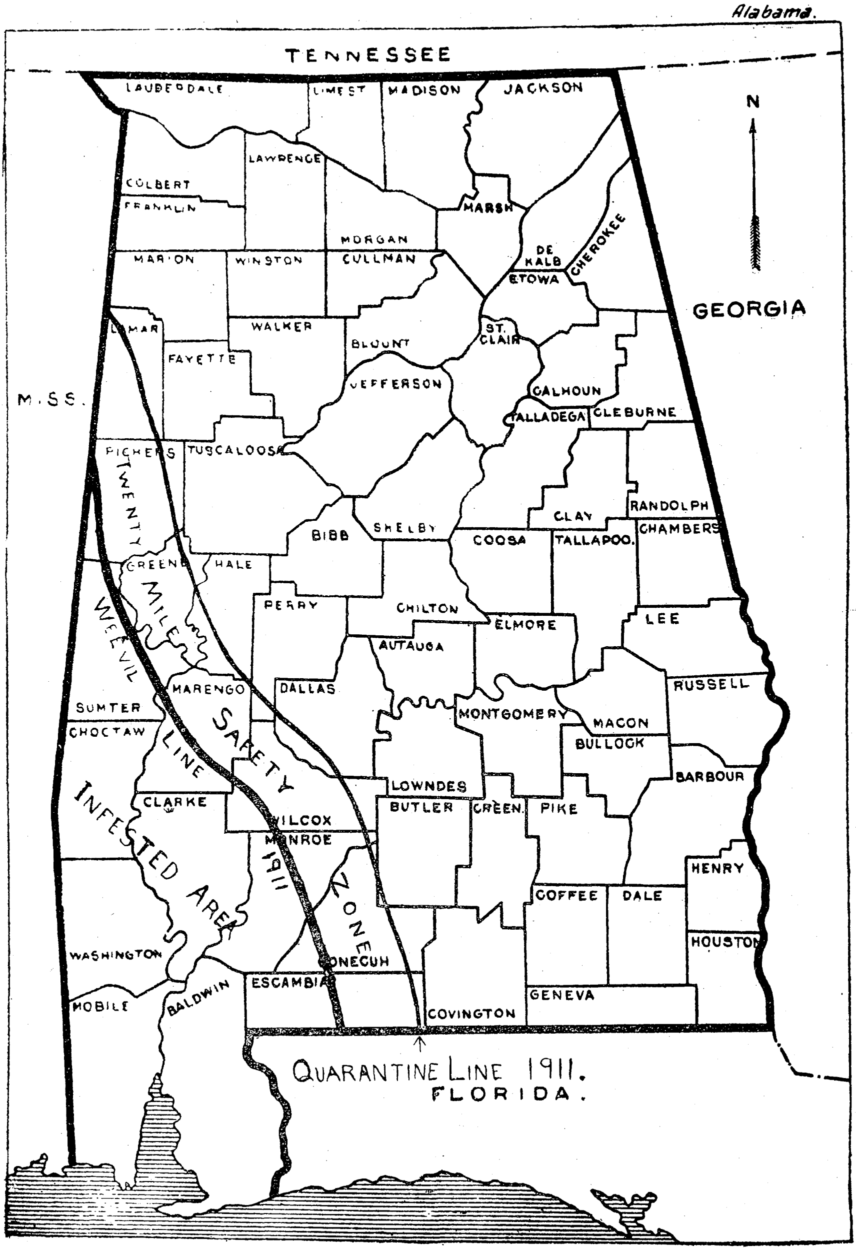
The Alabama Experiment Station located in Auburn, established in 1888 is the second agency. This Station, now under the direction of Prof. J. F. Duggar, has done a work of immeasurable value in its investigations and in its general work of educating the farmers in the use of more advanced and successful agricultural methods. As a branch of this Station, the Department of Entomology was organized in 1905. The writer became Entomologist in the fall of 1907, after having spent his entire time, summer and winter for five and one-third years in the constant study of the life and control of the boll weevil in Texas and Louisiana under the U. S. Bureau of Entomology.

The third agency, The Farmers' Co-operative Demonstration Work is a direct outcome of the campaign against the boll weevil. This, starting in 1904 in Texas, has now spread throughout the South and is becoming a national movement. The Alabama part of this work, now in charge of State Agent, B. L. Moss, is said to be more fully organized than is the work of any other state. This agency, gathering up the best that is known about fighting the weevil, seeks to make known to the average farmer and to secure the general adoption by him of better agricultural methods. In this work remarkable success is being attained. Mr. B. L. Moss was engaged in the boll weevil fight in Mississippi for three years before being placed in charge of the work in Alabama over a year ago.

From our study of the boll weevil and from our knowledge of Alabama conditions, we are convinced that the general adoption of the suggestions to be given later in this communication will aid greatly in preventing a large part of the losses in this State which otherwise the boll weevil is bound to inflict.

THE BOLL WEEVIL SITUATION.

Let us state the present situation as plainly as possible. Through the spread of the weevil to the middle of November 1911, the following counties in Alabama were brought wholly within the infested area: Mobile, Baldwin, Washington, Clarke, Choctaw and practically all of Sumter, while the weevil line crosses through the southwestern corner of Pick-



ALABAMA WEEVIL LINE OF 1911 AND QUARANTINED AREA ens, includes nearly half of Marengo, one-third of Wilcox, two-thirds of Monroe, a small corner of Conecuh and one-half of Escambia counties. The area newly infested this season produces more than five times as much cotton as does that reached first in 1910. The advance of the weevil is certain to continue until every cotton field in the State will finally be more or less affected. Wherever the weevil once reaches it is practically certain to remain and to be a factor which must thereafter always be considered in the production of cotton.

This is not a passing problem. The weevil attacks nothing but cotton. It can be fairly well controlled and the profitable production of cotton continued by the adoption of various changes in the method of raising the crop so that injury by the weevils may be very largely reduced or avoided. The effectiveness of these changes has been so abundantly demonstrated as to be now established beyond all reasonable question.

Loss by the boll weevil occurs particularly in two ways. First, by the actual destruction of cotton squares and bolls which occurs wherever weevils exist and about in proportion to the number of weevils produced, especially during the period before the maturity of the crop. This loss may vary from a small percentage to the complete destruction of the crop. Where the best methods of raising cotton are used it may be reduced to a common average of between five and ten per cent. of the crop which might be secured with the same methods but without the weevils. Where no attention is paid to these improved methods, the loss averages between twenty-five and fifty per cent. of the usual crop obtainable without the weevil. Under nearly all conditions of soil and climate it is certain that the careless farmers will suffer more heavily from boll weevil infestation than will the best farmers in the same location.

The greatest problem today is not how to fight the boll weevil successfully, but rather how to secure the general adoption by the average farmer and in advance of serious weevil infestation, of those measures and methods in the culture of cotton and other crops which have been found in the experience of the best farmers in several states and throughout the infested area to be effective and profitable in fighting the weevil, reducing injury by that pest to a minimum and making the user of these ideas more successful and prosperous in spite of the presence of the weevil than he ever was before its occurrence. The real objective in all this campaign is not to secure the raising of more bales of cotton annually, but rather to secure the greater prosperity and happiness of all those engaged in any degree in cotton cultivation and through them to secure the prosperity of all business interests, especially in this Southland.

The second and greatest damage done by the weevil does not result usually from its destruction of cotton directly but rather through the condition of "panic" which has usually followed during the first few years of weevil occurrence in any locality. In extreme cases this "panic" has bankrupted bankers and merchants, ruined large planters, paralyzed all business activity and driven tenants and movable laborers completely out of the locality.

We all know that the feeling of "panic" is extremely contagious and that its prevalence only makes loss the greater and more certain in any emergency. It seems very certain that the attitude of leading men in any community will determine the attitude of the crowd that is accustomed to follow or depend upon them. A feeling of "panic" among bankers, merchants and large planters is sure to spread quickly and widely among small farmers and tenants. We believe that such a panic can be prevented almost entirely by timely, intelligent, and unselfish co-operative action on the part of these leading men. Such action we are striving to secure for Alabama in the present crisis and to that end we ask careful consideration of every suggestion which may promise effective help in this time of serious need.

SUGGESTIONS FOR MORE EFFECTIVE WEEVIL FIGHT

Plan for bankers, cotton factors, merchants and others relative to loans or advances to cotton planters secured by real estate, crops or other farm products.

1. *General Considerations.*

The calling in of existing loans or refusal to make any new ones on account of boll weevil occurrence would be a first step in starting the "panic" which we are seeking to avoid. Tenants who have been receiving heavy advances must doubtless still be helped to some extent or they will simply be forced to move—again starting "panic." Upon the increase in agricultural prosperity generally, depends very largely the prosperity of a majority of all other business interests in Alabama.

Therefore, it appears to be the part of sound business policy for bankers, cotton factors, merchants and farmers to stand shoulder to shoulder in this fight for mutual help and protection, each doing his part intelligently, courageously, and unselfishly. With such co-operation the re-adjustment necessary to meet new conditions can most easily be made, losses will be minimized and victory in the fight against the boll weevil will be certain. The blacks can and must be directed and helped by the more intelligent whites for the common good of both races.

The announcement of the general adoption of a carefully considered plan for dealing with the situation will go far toward removing the danger of "panic" and aid greatly in securing the immediate adoption of the changes necessary to successfully meet boll weevil conditions. Any feasible plan must be sufficiently elastic to be readily adaptable to the needs of various localities in the State. It should be designed to make the farmer generally independent of advances as quickly as may be possible and to aid in retaining tenants and laborers on our farms throughout the State. If adopted and adhered to by a majority of business men the most powerful lever available—the financial—may thus be made to aid in meeting successfully the boll weevil crisis.

2. *The Plan.*

A. For their own protection bankers, merchants and others making what we may call agricultural loans, should understand and agree among themselves that they will continue to make such loans in boll weevil territory, as a rule, only in accordance with a general policy of requiring an agreement on the part of the borrower to adopt such practices as will make their investment safe, and secure also the ultimate good of their client. As a general thing if such an agreement is adhered to these loans may continue to be made safely in most cases to the limit of from 50 to 75 per cent of what might be advanced otherwise if the boll weevil were not present. Loans to croppers should not be made so small as to force them to move elsewhere or as to cripple them in their work of making a crop. The aim should be to provide such help as may be absolutely essential to their stay and their success, while at the same time encouraging them to become independent of such aid and finally cash paying citizens.

B. As a rule such loans should be made conditional upon the borrower reducing his cotton acreage so that it may be possible for him to give it the best of care. This is essential to success under boll weevil conditions and will certainly result in greatest profit even without the weevil. This will allow him also to raise more food stuffs and to adopt some reasonable and profitable diversification and rotation of crops. These points should be strenuously insisted upon in most cases.

C. We believe that some arrangement can safely be made, and should be made, so that other crops than cotton may be considered as acceptable security for such loans. The raising of more live stock should also be encouraged in most cases.

D. We believe that leases for longer terms than one year should be encouraged with such provisions as will make it to the advantage of the tenant to improve the property and to remain thereon indefinitely. In most cases it would doubtless help if the notes could be made "payable on or before December 15th", so that cotton especially may be held to avoid the breaking of the market that occurs every year as the mortgaged cotton is rushed to sale at whatever price may be offered.

E. To best meet the needs in various sections of the State it would probably be best to provide Advisory Committees for at least county units to consider local conditions and arrange a program for general county following. In preparing such a program it would seem that a county committee might be provided upon which should be representatives of the Farmers' Co-operative Demonstration Work (possibly by the local county Demonstration Agent), of the business interests and also of the farmers. After duly discussing the local problems and considering fully the factors which might aid in the fight throughout their county, the conclusions of these representative men might be widely published so as to become well known throughout that county. These conclusions might then serve as a general guide for that section indicating what lenders might safely allow and reasonably require in each locality. Such agitation of the subject would certainly be exceedingly helpful and go far toward the moulding of a sound and progressive public opinion.

F. The fact that various business interests propose to adopt and support this general plan of action should then be widely published so that the attitude of the leaders in the movement might be known not only among other business men, but more generally also among the men actually engaged in farm work. Possibly action along this line might be taken officially by business men's organizations and it should certainly be taken by all parties willing to co-operate for their common welfare.

At some points in Mississippi, Produce Exchanges have been organized with very helpful results. These exchanges are formed by local merchants who agree among themselves to take every kind of produce that the farmers may offer, paying therefor the highest market prices. This plan is a strong help in persuading farmers to diversify their crops. The only really effective way to secure voluntary reduction of cotton acreage is to prove to the farmer that there are many other things that he can produce more profitably than cotton at 8 to 10 cents.

G. Of course, it is not intended to propose any stereotyped plan of action. The case of each applicant for a loan must be considered by itself with due consideration of both local conditions and personal characteristics. It is possible, however, to do this and still make in each case an intentional effort to accomplish the purposes heretofore mentioned.

The adoption of this plan by any party is nothing more than an expression of his intention in making future agricultural loans to be guided by the general principles herein set forth and by those recommended by the county committee. The purpose is to promote the immediate and general adoption of a more diversified agriculture and the practice of as many as possible of those methods in the culture of cotton which have elsewhere proven most effective in reducing boll weevil injury thereto. The methods referred to are those which taken together constitute what is commonly known as the "cultural system of controlling the Mexican cotton boll weevil." The various steps in this system may be learned by any one through their county farm Demonstration Agent or through the Alabama Experiment Station, located at Auburn.

H. Success in starting this movement immediately will depend upon someone taking the initiative in each county. Will YOU not see to it personally that the matter is considered at once in your community? If you are willing to help in this movement, do not fail to talk this matter over with your fellow citizens and see that action is taken for your county—

AT ONCE

December, 1911.

THE FIRST NATIONAL BANK

Birmingham, Ala., Dec. 19, 1911.

Dr. W. E. Hinds, Ph. D.,
Entomologist to the Experiment Station,
Auburn, Ala.

My dear Sir:

I have carefully examined the advance proofs of your Bulletin No. 159, entitled "Heading Off Boll Weevil Panic", and desire to state that your suggestions as to the course that should be pursued by the bankers, cotton growers and merchants, meets with my hearty approval. It is essential that the farmers be given the usual financial assistance, but to secure it, it is necessary for them to give the banks and merchants proper assurance that their interests will be safeguarded by common sense methods of fighting the boll weevil.

I am inclined, however, to doubt the wisdom of making the general settlement date later than December 1st, by having farmer's notes made "payable on or before December 15'', as suggested in Section D of your plan. There has already been a tendency toward earlier crops, which will be accentuated by the coming of the boll weevil, and with their notes payable on December 1st, the cotton growers will have September, October and November in which to exercise their discretion as to the marketing of cotton. It seems to me that December 1st would be about as late as would be practicable for general settlement, as there are many payments that must necessarily be made during the month of December.

With this exception, I heartily commend your plan to the banking fraternity of the State, believing that its general adoption will benefit the banking and other business interests of Alabama.

Yours very truly,

W. P. G. Harding,
President.

DEPARTMENT OF AGRICULTURE AND INDUSTRIES
STATE OF ALABAMA
MONTGOMERY

Dec. 20, 1911.

Dr. W. E. Hinds, State Entomologist,
Auburn, Ala.

Dear Sir:

I have received copy of advance proof of your Bulletin No. 159, entitled "Heading Off Boll Weevil Panic", and I have read same very carefully and give it my unqualified endorsement.

We cannot doubt that changes which you suggest are bound to take place as a result of the boll weevil's advance within the next few years. Experience in other states has shown this. I believe that the business interests of Alabama and our highest agricultural prosperity call for the immediate adoption of these changes.

You may count upon our hearty co-operation in bringing this to pass.

Yours truly,

R. F. Kolb,
Commissioner of Agriculture and Industries.

BULLETIN NO. 160 DECEMBER, 1911

ALABAMA

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

Local Fertilizer Experiments With Cotton in South Alabama in 1911

BY

J. F. DUGGAR
J. T. WILLIAMSON
L. L. GLOVER and
E. HODSON

Opelika, Ala.
Post Publishing Company
1911

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*In Co-operation with U. S. Department of Agriculture.

LOCAL FERTILIZER EXPERIMENTS WITH COTTON IN SOUTH ALABAMA IN 1911

By

J. F. DUGGAR, J. T. WILLIAMSON, L. L. GLOVER, E. HODSON

The chief object of these local fertilizer experiments or soil tests has been to ascertain the best fertilizer or combination of fertilizers for cotton, growing on each of the principal soils of the southern half of Alabama.

The results recorded in this bulletin were obtained in fertilizer experiments conducted with funds provided by the Legislature of Alabama in February, 1911.

This bulletin deals only with fertilizer experiments carried to a conclusion in 1911 in the southern half of the State. For convenience the counties grouped together in this bulletin are those lying wholly or partly south of the Central Prairie or Lime Region.

The results of fertilizer experiments made in the counties lying wholly north of the Central Prairie Region will appear in a later bulletin, which will be issued within a few weeks after this one.

Local fertilizer tests constitute only one of many lines of experiments instituted in 1911 by the Alabama Experiment Station with the support of state funds, none of which were available for experimental work prior to the present year.

Local fertilizer experiments as now conducted are made on the farms of farmers especially recommended as being men likely to take the necessary pains to secure accurate results. These experiments, located all over the State, are visited and supervised by representatives of the Experiment Station, who are expected to select and measure the land, make periodic visits, and take notes on the progress and results of the experiment, and, so far as practicable, assist in harvesting the crop. However, the late date at which this work was begun in 1911, the fact that many farmers had already fertilized their most suitable land before being invited to make these experiments, and the necessary delay in securing the services of the men who were to supervise these experiments, resulted in many cases in the selection of land and of locations which later proved not entirely satisfactory. It is expected that in future the percentage of conclusive and satisfactory experiments will be larger. However, no increase can be made in the total number of fertilizer experiments.

Small lots of carefully weighed and mixed fertilizers were supplied to each experimenter. Detailed instructions as to how to conduct the experiment and blank forms for reporting results were also furnished. Representatives of the Station inspected from one to three times all of the experiments here published except one.

The following list gives the name and address of each experimenter who has reported the results of fertilizer experiments made in 1911 in the part of the State indicated, together with the page of this bulletin where the results may be found.

COUNTY	POST OFFICE	NAME	Page
Barbour	Louisville	J. A. Richards	289
Bullock	Inverness	R. F. Hooks	289
Bullock	Union Springs	E. H. Cope	289
Butler	McKenzie	J. C. Arant	266
Coffee	Enterprise	J. W. Harry	272
Choctaw	Pushmataha	D. O. Phillips	281
Clarke	Bashi	T. M. Pugh	280
Clarke	Grove Hill	J. W. Calhoun	288
Conecuh	Belleville	B. D. Arant	284
Covington	Opp	W. A. Maloy	295
Covington	Andalusia	W. E. Bagley	295
Crenshaw	Brantley	J. W. Ellis	294
Crenshaw	Luverne	F. L. Hawkins	289
Dale	Midland City	T. W. Barrineau	292
Dale	Ozark	J. W. Byrd	269
Dallas	Selma R. No. 4	T. G. Kenan	257
Dallas	Central Mills	C. E. Shuptrine	258
Dallas	Orrville	B. F. Wilson	264
Dallas	Marion Junction	M. F. Smith	287
Escambia	Atmore	J. W. Jones	294
Escambia	Brewton	G. W. Brown	294
Geneva	Slocomb	J. G. Lewis	291
Greene	Knoxville	T. H. Chambers	248
Greene	Clinton	W. W. Morgan	295

COUNTY	POSTOFFICE	NAME	Page
Hale	Prairieville	J. H. Collins	251
Henry	Columbia	F. B. Douglas	273
Henry	Headland	R. W. Ward	294
Henry	Headland	J. T. Knowles	293
Henry	Columbia	R. L. Williams	287
Houston	Dothan	T. J. Herring	270
Lowndes	Letohatchie	J. B. Mitchell, Jr.	289
Macon	Notasulga	B. H. May	275
Macon	Ft. Davis	F. M. Davis	276
Mobile	Chunchula	W. A. Mims	285
Monroe	Monroeville	M'roe F'm Land Co.	278
Monroe	Jones Mill	A. L. Harrison	287
Montgomery	Hope Hull	Dr. Frank McLean	252
Perry	Hamburg	J. H. Lee	254
Perry	Felix	J. M. Alexander	287
Perry	Marion	Geo. W. Thomas	255
Pike	Brundidge	J. N. Colley	288
Pike	Troy	R. P. Rhodes	267
Russell	Seale	J. B. Billups	287
Sumter	Geiger	E. A. Gilbert	246
Sumter	Livingston	W. L. Ennis	249
Washington	Leroy	T. Lee Porter	283
Wilcox	Camden	G. M. Cook	260
Wilcox	Sunny South	J. D. Carmichael	263
Wilcox	Allenton	J. H. Jones, Jr	261

Plans were made and fertilizers were supplied for experiments in the following localities, where, however, the experiments were not carried out or, if carried out, no results were reported.

COUNTY	POSTOFFICE	NAME
Autauga	Autaugaville	M. M. Smith
Barbour	Clayton	L. L. White
Butler	Greenville	W. T. Thagard
Choctaw	Silas	M. Slay
Clarke	Suggsville	J. J. Hunter
Dallas	Berlin	Joe Buster
Greene	West Greene	W. M. Owens
Hale	Havana	W. T. Martin
Houston	Dothan	B. E. Napier
Marengo	Dayton	J. B. Askew
Marengo	Linden	E. W. Drinkard
Montgomery	Sellers	J. C. Mizell
Pike	Troy	H. W. Ballard
Russell	Pittsview	F. P. Pitts

The directions sent to each experimenter stated that the land employed for this test should be level and uniform, not manured in recent years, not in cowpeas the preceding year, and that it should be representative of large soil areas in its vicinity. The need of perfect uniformity and standard treatment for all plots (except as to kind of fertilizer used) was emphasized.

Fertilizers were applied in the usual manner—that is, drilled before planting, except nitrate of soda which was directed to be applied when the plants were 6 to 10 inches high.

THE FERTILIZERS USED.

The following prices are used, as representing approximately the average cash price in local markets during the last few years:

	Per Ton.
Acid phosphate (14 per cent. available)	$14.00
Cotton seed meal	$30.00
Kainit	$14.00

Prices naturally vary in different localities. Any one can substitute the cost of fertilizers in his locality for the prices given above.

In each experiment three plots were left unfertilized, these being plots 3, 7, and 11. When these yields differed widely the experiment was classed as inconclusive. The increase on plots 4 to 6 is calculated on the assumption that the gradation in fertility is uniform from plots 3 to 7; likewise the increase is calculated for plots 8 to 10 inclusive.* The following table shows what kind and amounts of fertilizers were used on certain plots; the number of pounds of nitro-

*In other words instead of calculating the increase merely by subtracting the yields of any plot from the average yield of the three unfertilized plots, (which would be incorrect and misleading unless all three unfertilized plots afforded practically the same yield), the following method is used as a means of making allowance for variations in the natural fertility of the different plots:—

(1). The difference between the yields of unfertilized plots 3 and 7, or between unfertilized plots 7 and 11 is divided by 4, because this difference must be distributed over the four intervening plots.

(2). This quotient is then added to the yield of the poorest of this unfertilized pair, thus giving the corrected or calculated yield (if unfertilized), for the fertilized plot adjacent to the poorest unfertilized one. Similarly the yield of the poorest unfertilized plot is increased by twice and three times the above quotient as a means of calculating the corrected unfertilized yield on the plots occupying respectively second and third positions from the poorest unfertilized plot of the pair.

(3). Now these calculated yields, (if the plots were unfertilized), are subtracted in regular order from the corresponding actual yield, thus giving the most accurate measure known for the increase due to the fertilizer.

gen, phosphoric acid, and potash supplied per acre by each fertilizer mixture; and the percentage composition and cost per ton of each mixture, the latter being given in order that these mixtures may be readily compared with various brands of prepared guanos.

Pounds per acre of fertilizers, nitrogen, phosphoric acid, and potash used and composition of each mixture.

Plot No.	FERTILIZERS: Amount per acre	FERTILIZERS: KIND	MIXTURE CONTAINS: Nitrogen	MIXTURE CONTAINS: †Available phosphoric acid	MIXTURE CONTAINS: Potash	COST OF FERTILIZERS: Per ton	COST OF FERTILIZERS: Per acre
	Lbs		Lbs.	Lbs.	Lbs.		
1	200	Cotton seed meal	13.58	5.76	3.54	$30.00	$3.00
		*In 100 lbs. c. s. meal**	**6.79**	**2.88**	**1.77**		
2	240	Acid phosphate	------	36.12	-----	14.00	1.68
		In 100 lbs. acid phos.	------	**15.05**	-----		
4	200	Kainit	------	------	24.60	14.00	1.40
		In 100 lbs. kainit	------	------	**12.30**		
5	200	Cotton seed meal	13.58	41.88	3.54	21.27	4.68
	240	Acid phosphate					
		In 100 lbs. above mixt.	**3.09**	**9.52**	**.80**		
6	200	Cotton seed meal	13.58	5.76	28.14	22.00	4.40
	200	Kainit					
		In 100 lbs. above mixt.	**3.39**	**1.44**	**7.03**		
8	240	Acid phosphate	------	------	-----	13.99	3.08
	200	Kainit					
		In 100 lbs. above mixt.	------	**8.21**	**5.59**		
9	200	Cotton seed meal	13.58	41.88	28.14	19.00	6.08
	240	Acid phosphate					
	200	Kainit					
		In 100 lbs. above mixt.	**2.12**	**6.54**	**4.39**		
10	200	Cotton seed meal	13.58	41.88	15.84	20.13	5.38
	240	Acid phosphate					
	100	Kainit					
		In 100 lbs. above mixt.	**2.59**	**7.75**	**2.93**		
12	240	Acid phosphate	14.00	15.05	12.30	22.17	4.88
	100	Kainit					
	100	Nitrate of soda					
		In 100 lbs. above mixt.	**3.18**	**8.20**	**2.80**		

*Average of many analysis.

†Counting all the phosphoric acid in cotton seed meal as available.

Those farmers who are more accustomed to the word ammonia than to the term nitrogen, can change the figures for nitrogen into their ammonia equivalents by multiplying by 1$\frac{3}{14}$

Price Assumed for Seed Cotton.

The price assumed is $14.00 per ton for seed, and 10 cents per pound for lint. This is equal to 3.8 cents per pound of seed cotton turning out 33 1/3 per cent of lint. Deducting 6/10 cents per pound as the average cost of picking and ginning, and we have left 3.2 cents as the net value per pound of the increase of seed cotton due to fertilizers. This latter is the figure used in all financial calculations.

SUMTER COUNTY, 1½ MILES SOUTH OF GEIGER.

E. A. Gilbert.

Light colored stiff branch-bottom with red subsoil.

This land has been long in cultivation. The preceding crop was corn. Rust and boll rot (anthracnose) did some injury; but caterpillars did little damage. The stand was good.

All fertilizers were profitable. The most profitable combination was acid phosphate and kainit, affording a profit of $12.75 per acre. Almost equally profitable ($11.42, $11.16, and $10.16 per acre) were the complete fertilizers. Kainit was most effective, being credited with an average increase of 274 pounds of seed cotton per acre, as compared with an increase of 156 pounds for acid phosphate and 133 pounds for cotton seed meal.

The percentage of profit for the investment in fertilizer is 408 per cent in the case of a mixture of acid phosphate and kainit; 188 per cent for the complete fertilizer (Plot 9), and 208 per cent for the complete fertilizer containing a half ration of kainit. See page 247.

Evidently fertilizer is a highly profitable investment on this soil.

Nitrate of soda, applied June 16th, was slightly less effective than was cotton seed meal.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	176 lbs.
To acid phosphate plot	156 lbs.
To kainit plot	140 lbs.
To acid phosphate and kainit plot	58 lbs.
Average increase with cotton seed meal	133 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	88 lbs.
To cotton seed meal	68 lbs.
To kainit plot	275 lbs.
To cotton seed meal and kainit plot	193 lbs.
Average increase with acid phosphate	**156** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	214 lbs.
To cotton seed meal plot	178 lbs.
To acid phosphate plot	401 lbs.
To cotton seed meal and acid phosphate plot	303 lbs.
Average increase with kainit	**274** lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds kainit	303 lbs.
To use of 100 pounds kainit	273 lbs.

Increase from use of nitrate of soda	11 lbs.
Increase from use of cotton seed meal	58 lbs.
Cotton seed meal better by	**47** lbs.

Experiments at Geiger and Knoxville

			Geiger			Knoxville		
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	488	176	$ 2.63	792	248	$ 4.94
2	240	Acid phosphate	400	88	1.14	704	160	3.44
3	000	No fertilizer	312	----	------	544	----	------
4	200	Kainit	520	214	5.45	560	12	—1.02
5	200 240	Cotton seed meal Acid phosphate	544	244	3.13	872	320	5.56
6	200 200	Cotton seed meal Kainit	648	354	6.93	896	340	6.48
7	000	No fertilizer	288	----	------	560	----	------
8	240 200	Acid phosphate Kainit	776	489	12.57	680	130	1.08
9	200 240 200	Cotton seed meal Acid phosphate Kainit	832	547	12.42	768	228	1.22
10	200 240 100	Cotton seed meal Acid phosphate Kainit	800	517	11.16	784	254	2.75
11	000	No fertilizer	282	----	------	520	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	752	470	10.16	928	408	8.18

GREENE COUNTY, 16 MILES NORTH OF EUTAW, NEAR KNOXVILLE.

T. H. CHAMBERS.

Gray sandy land, with red clay subsoil.

This land has been cleared for about 60 years. The preceding crops were oats followed by corn. The stand of cotton was good. There was no rust reported. The most profitable application was the complete fertilizer containing nitrate of soda. (Plot 12,) which afforded a profit of $8.18 per acre, or 188 per cent on the investment in fertilizers. The most profitable single application was cotton seed meal, which gave a profit of $7.94 per acre, or 165 per cent on the investment in fertilizers. See page 247.

The average estimated increase of seed cotton per acre was 209 pounds for cotton seed meal; 60 pounds for acid phosphate; there was a loss of 5 pounds where kainit was used.

Nitrate of soda applied June 14th was much more effective than an earlier and larger application of cotton seed meal.

Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	248 lbs.
To acid phosphate plot	160 lbs.
To kainit plot	328 lbs.
To acid phosphate and kainit plot	98 lbs.
Average increase with cotton seed meal	**209** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	160 lbs.
To cotton seed meal plot	72 lbs.
To kainit plot	118 lbs.
To cotton seed meal and kainit plot	—112 lbs.
Average increase with acid phosphate	**60** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	12 lbs.
To cotton seed meal plot	92 lbs.
To acid phosphate plot	—30 lbs.
To cotton seed meal and acid phosphate plot	—92 lbs.
Average increase with kainit	**—5** lbs.
Increase from use of cotton seed meal	98 lbs.
Increase from use of nitrate of soda	252 lbs.
Nitrate better by	154 lbs.

SUMTER COUNTY, 4 MILES EAST OF LIVINGSTON.

W. L. Ennis.

Sandy loam, yellow clay subsoil.

This land was in cotton in 1910. There was some damage by the cotton caterpillar and wilt. The stand was fairly good. The figures here published do not include the first picking, the seed cotton of this picking having been accidentally mixed by laborers. Fortunately the first picking included only a small part of the total crop. Mr. Ennis believes that the yields made at second and third pickings represent fairly well the relative effects of the different fertilizers.

The most profitable application was kainit applied alone, which afforded an increase worth $9.10 per acre in the later pickings, or 650 per cent on the investment in fertilizers. In all combinations where kainit was included the applications were highly profitable. The average estimated increase of seed cotton in the second and third pickings was with cotton seed meal, 50 pounds per acre; with acid phosphate, 26 pounds; and with kainit 310 pounds.

Nitrate of soda, applied May 28th, afforded in the last two pickings a larger yield than did cotton seed meal.

Yields and increases in crop of second and third pickings at Livingston

Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per cotton	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	400	96	$ .07
2	240	Acid phosphate	376	72	.62
3	000	No fertilizer	304	----	------
4	200	Kainit	608	328	9.10
5	200 240	Cotton seed meal Acid phosphate	336	80	—2.12
6	200 200	Cotton seed meal Kainit	624	392	8.14
7	000	No fertilizer	208	----	------
8	240 200	Acid phosphate Kainit	584	370	8.76
9	200 240 200	Cotton seed meal Acid phosphate Kainit	616	396	6.59
10	200 240 100	Cotton seed meal Acid phosphate Kainit	432	206	1.21
11	000	No fertilizer	232	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	520	288	434

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot .... 96 lbs.
To acid phosphate plot .... 8 lbs.
To kainit plot .... 64 lbs.
To acid phosphate and kainit plot .... 26 lbs.

Average increase with cotton seed meal .... **50** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot .... 72 lbs.
To cotton seed meal plot ....—16 lbs.
To kainit plot .... 42 lbs.
To cotton seed meal and kainit plot .... 4 lbs.

Average increase with acid phosphate .... **26** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot ....328 lbs.
To cotton seed meal plot .... 296 lbs.
To acid phosphate plot .... 298 lbs.
To cotton seed meal and acid phosphate plot ....316 lbs.

Average increase with kainit .... **310** lbs

Increase from use of different quantities of kainit:	
To use 200 pounds kainit	316 lbs.
To use 100 pounds kainit	126 lbs.
Increase from use of nitrate of soda	108 lbs.
Increase from use of cotton seed meal	26 lbs.
Nitrate better by	**82** lbs.

HALE COUNTY, 1 MILE NORTHEAST OF GALLION.

J. H. COLLINS.

Black prairie upland.

For several years preceding, the land has been in Johnson grass, cut for hay; preparation consisted of broadcast plowing, harrowing, bedding, and use of sweep. The stand was good, but the crop was late in coming up.

Worms were not seriously injurious, but the crop was injured by excessive rain and shedding in August.

Nitrate of soda, applied June 20th, proved practically of the same value as the earlier application of twice as much cotton seed meal

The only really profitable application was a mixture of acid phosphate and kainit (Plot 8), which afforded a profit of $2.20 per acre, or a profit of 71 per cent on the amount invested in fertilizer.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	80 lbs.
To acid phosphate plot	92 lbs.
To kainit plot	68 lbs.
To acid phosphate and kainit plot	16 lbs.
Average increase with cotton seed meal	**64** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	40 lbs.
To cotton seed meal plot	52 lbs.
To kainit plot	110 lbs.
To cotton seed meal and kainit plot	58 lbs.
Average increase with acid phosphate	**65** lbs.
Increase of seed cotton when kainit was added:	
To unfertilized plot	58 lbs.
To cotton seed meal plot	46 lbs.
To acid phosphate plot	128 lbs.
To cotton seed meal and acid phosphate plot	52 lbs.
Average increase with kainit	**71** lbs.

Increase from use of different quantities of kainit:
To use of 200 pounds kainit .... 52 lbs.
To use of 100 pounds kainit .... 29 lbs.

Increase from use of cotton seed meal in complete fertilizer .. 16 lbs.
Increase from use of nitrate of soda.......... .. .. 23 lbs.
Nitrate better by .... 7 lbs.

Experiments in Hale and Montgomery Counties

			Gallion			McGehees		
Plot No	Amount fertilizer per acre	Kind	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	304	80	$—.44	352	96	$ 0.07
2	240	Acid phosphate	264	40	—.40	448	192	4.46
3	000	No fertilizer	224	----	------	256	----	------
4	200	Kainit	280	58	.46	501	224	5.77
5	200 240	Cotton seed meal Acid phosphate	352	132	—.45	608	310	5.24
6	200 200	Cotton seed meal Kainit	344	126	—.37	841	521	12.27
7	000	No fertilizer	216	----	------	341	----	------
8	240 200	Acid phosphate Kainit	392	168	2.30	736	395	9.56
9	200 240 200	Cotton seed meal Acid phosphate Kainit	416	184	—.19	629	288	3.14
10	200 240 100	Cotton seed meal Acid phosphate Kainit	401	161	— 23	408	288	3.84
11	000	No fertilizer	248	----	------	120	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	416	168	.50	368	284	4.06

MONTGOMERY COUNTY, 3 MILES SOUTHEAST OF McGEHEES.

Dr. Frank McLean

Poor gray prairie soil.

This test was located on the poorest spot that could be found adjacent to the public road on Dr. McLean's plantation, eleven miles south of Montgomery. The comparatively small yields are due not alone to the thinness of the soil, but also to the late date of planting, May 6th.

The preceding crop was corn.

An inspection in August showed that the plots receiving kainit had much less rust than others, and that there was less rust where 200 pounds of kainit per acre was used than where 100 pounds was employed. However, the increase in the crop proved to be the same for 100 pounds as for 200 pounds of kainit per acre in a complete fertilizer. At the same time it was noticed that the phosphate had hastened the maturity and that on the kainit plots both bolls and plants were apparently larger than on other plots.

Every fertilizer was profitable, whether applied alone, or in pairs, or all together in a complete fertilizer.

The most profitable application was a mixture of cotton seed meal and kainit (Plot 6), which afforded a profit of $12.27 per acre, or a profit of 279 per cent on the amount invested in fertilizer.

Of the several fertilizers, kainit was the most effective, affording an average increase of 284 pounds of seed cotton per acre, as against an average increase of 192 pounds from acid phosphate, and of 170 pounds from cotton seed meal.

The stand was very uniform. Apparently Plot 9 was below the average in fertility and its results are excluded from this discussion.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	96 lbs.
To acid phosphate plot	118 lbs.
To kainit plot	297 lbs.
Average increase with cotton seed meal	**170** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	192 lbs.
To cotton seed meal plot	214 lbs.
To kainit plot	171 lbs.
Average increase with acid phosphate	**192** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	224 lbs.
To cotton seed meal plot	425 lbs.
To acid phosphate plot	203 lbs.
Average increase with kainit	**284** lbs.

PERRY COUNTY, ¼ MILE SOUTH OF HAMBURG.

J. H. Lee.

Red clay soil with red clay subsoil.

This land was pastured in 1909 and 1910. The stand was good. Some damage was done by the cotton caterpillar. The summer season was too wet. The yield was low on all plots where acid phosphate and kainit were used. Cotton seed meal gives the best yields, showing an average increase of 238 pounds of seed cotton per acre, against 77 pounds for acid phosphate, and 27 pounds for kainit. The cotton seed meal used above gave a profit of $10.57 per acre, or 352 per cent on the investment in fertilizers. See page 255.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	424 lbs.
To acid phosphate plot	44 lbs.
To kainit plot	404 lbs.
To acid phosphate and kainit plot	78 lbs.
Average increase with cotton seed meal	**238** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	160 lbs.
To cotton seed meal plot	—220 lbs.
To kainit plot	40 lbs.
To cotton seed meal and kainit plot	—286 lbs.
Average increase with acid phosphate	**—77** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	3 lbs.
To cotton seed meal plot	10 lbs.
To acid phosphate plot	—90 lbs.
To cotton seed meal and acid phosphate plot	—56 lbs.
Average increase with kainit	**—27** lbs.
Increase from use of different quantities of kainit:	
To use 200 pounds kainit	—56 lbs.
To use 100 pounds kainit	—130 lbs.
Increase from use of cotton seed meal	78 lbs.
Increase from use of nitrate of soda	204 lbs.
Nitrate better by	126 lbs.

Experiments in Perry County

Plot No.	Amount fertilizer per acre	KIND	Hamburg: Yield seed cotton per acre	Hamburg: Increase over unfertilized plot	Hamburg: Profit from fertilizer	Mario: Yield seed cotton per acre	Mario: Increase over unfertilized plot	Mario: Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	824	424	$10 57	716	268	$ 5.58
2	240	Acid phosphate	560	160	3.44	472	24	— .91
3	000	No fertilizer	400	----	------	448	----	------
4	200	Kainit	440	30	—.44	440	—2	—1.46
5	200 240	Cotton seed meal Acid phosphate	624	204	1.85	368	—68	—3.66
6	200 200	Cotton seed meal Kainit	864	434	9.19	768	338	6.42
7	000	No fertilizer	440	----	------	424	----	------
8	240 200	Acid phosphate Kainit	464	70	—.84	456	42	—1.74
9	200 240 200	Cotton seed meal Acid phosphate Kainit	496	148	—1.34	584	180	—.32
10	200 240 100	Cotton seed meal Acid phosphate Kainit	376	74	—3.01	552	158	2.88
11	000	No fertilizer	256	----	------	384	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	456	200	1.52	684	264	3.56

PERRY COUNTY, 2½ MILES SOUTH OF MARION.

GEORGE W. THOMAS.

Red sandy loam with red clay subsoil.

This land has been cleared about 80 years. The preceding crop was corn. Very little shedding was reported, and no damage from rust. There was a good stand, with the same number of plants on every plot. There was no damage reported from the cotton caterpillar. Nitrogenous fertilizers proved to be the governing factor on this soil. Kainit and acid phosphate alone or in combination were not very profitable, but complete fertilizers made good yields. The largest profit, $6.42 per acre, was afforded by a mixture of cotton seed meal and kainit. Cotton seed meal alone gave next to the highest yield, affording a profit of $5.55 per acre, against a profit of $2.88 for a complete fertilizer. The average estimated increase of seed cotton per acre was 164 pounds for cotton sead meal; there was an average loss of 104 pounds for acid phosphate, and an average gain of 84 pounds of seed cotton per acre for kainit.

Nitrate of soda applied July 10th, was more effective than cotton seed meal.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	268 lbs.
To acid phosphate plot	—92 lbs.
To kainit plot	340 lbs.
To acid phosphate and kainit plot	138 lbs.
Average increase with cotton seed meal	**164** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	24 lbs.
To cotton seed meal plot	—336 lbs.
To kainit plot	44 lbs.
To cotton seed meal and kainit plot	—158 lbs.
Average increase with acid phosphate	**—104** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—2 lbs.
To cotton seed meal plot	70 lbs.
To acid phosphate plot	18 lbs.
To cotton seed meal and acid phosphate plot	248 lbs.
Average increase with kainit	**84** lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds kainit	248 lbs.
To use of 100 pounds kainit	226 lbs.

Increase from use of cotton seed meal	138 lbs.
Increase from use of nitrate of soda	224 lbs.
Nitrate better by	**106** lbs.

DALLAS COUNTY, 6 MILES NORTH OF SELMA.

T. G. KENAN.

Chocolate colored clay loam with clay subsoil.

This land has been in cultivation for about 90 years. The preceding crop was corn. There was no damage reported from rust.

The complete fertilizers containing cotton seed meal were most profitable. Plot 10 affording a profit of $16.32 per acre, or 305 per cent on the investment in fertilizers. Apparently all three fertilizing materials were needed.

The average increase of seed cotton per acre was, for cotton seed meal 131 pounds; for acid phosphate 122 pounds; and for kainit 235 pounds.

One hundred pounds of kainit was fully as affective as 200 pounds.

Cotton seed meal gave much better results than nitrate of soda applied June 10.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	376 lbs.
To acid phosphate plot	—32 lbs.
To kainit plot	—64 lbs.
To acid phosphate and kainit plot	642 lbs.
Average increase with cotton seed meal	**231** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	424 lbs.
To cotton seed meal plot	16 lbs.
To kainit plot	—330 lbs.
To cotton seed meal and kainit plot	376 lbs.
Average increase with acid phosphate	**122** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	356 lbs.
To cotton seed meal plot	—84 lbs.
To acid phosphate plot	398 lbs.
To cotton seed meal and acid phosphate plot	276 lbs.
Average increase with kainit	**236** lbs.

Increase from use of different quantities of kainit:
To use of 200 pounds kainit .... 276 lbs.
To use of 100 pounds kainit .... 286 lbs.

Increase from use of cotton seed meal........................ 642 lbs.
Increase from use of nitrate of soda .... 316 lbs.

Nitrate better by ....—326 lbs.

Experiments in Dallas County

			Selma			Central Mills		
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	928	376	$9.03	1040	128	$ 1.10
2	240	Acid phosphate	976	424	12.17	992	80	.88
3	000	No fertilizer	552	----	------	912	----	------
4	200	Kainit	896	356	9.99	992	80	1.16
5	200 240	Cotton seed meal Acid phosphate	920	392	7.86	1024	112	—1.10
6	200 200	Cotton seed meal Kainit	808	292	4.94	968	56	—2 61
7	000	No fertilizer	504	----	------	912	----	------
8	240 200	Acid phosphate Kainit	536	26	—2.25	976	56	—1.29
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1184	668	15.30	1136	208	.58
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1200	678	16.32	1176	240	2.30
11	000	No fertilizer	528	----	------	944	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	808	352	6.38	1184	240	2.80

DALLAS COUNTY, 1 1-4 MILES FROM CENTRAL MILLS.

C. E. Shuptrine.

Black post oak bottom land, stiff clay.

This land has been cleared and cultivated in cotton for 15 years. There was a good and uniform stand.

No fertilizers gave any large net profit, the largest profit, $2.80 per acre, resulting from a complete fertilizer (on Plot

12) containing acid phosphate, nitrate of soda, and 100 pounds of kainit, per acre.

The average increase in seed cotton per acre was 72 pounds for cotton seed meal; 48 pounds for acid phosphate; and 20 pounds for kainit. However, all three of these ingredients afforded larger increases when used together in a complete fertilizer. Nitrate of soda applied June 25 was equal in effect to cotton seed meal.

The yield was greater with 100 pounds than with 200 pounds of kainit per acre.

Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	128 lbs.
To acid phosphate plot	32 lbs.
To kainit plot	—24 lbs.
To acid phosphate and kainit plot	152 lbs.
Average increase with cotton seed meal	**72** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	80 lbs.
To cotton seed meal plot	—16 lbs.
To kainit plot	—24 lbs.
To cotton seed meal and kainit plot	152 lbs.
Average increase with acid phosphate	**48** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	80 lbs.
To cotton seed meal plot	—72 lbs.
To acid phosphate plot	—24 lbs.
To cotton seed meal and acid phosphate plot	96 lbs.
Average increase with kainit	**20** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds kainit	96 lbs.
To use of 100 pounds kainit	128 lbs.
Increase from use of cotton seed meal	152 lbs.
Increase from use of nitrate of soda	152 lbs.
Nitrate better by	00 lbs.

WILCOX COUNTY, 7 MILES WEST OF CAMDEN.

G. M. Cook.

Sandy loam.

This land has been cleared for 40 years. The preceding crop for several years has been cotton. The stand was good. Complete fertilizers were profitable as were also all applications of single and paired ingredients of a complete fertilizer. The highest estimated profit was on plot 12, where a complete fertilizer containing nitrate of soda afforded a profit of $9.46 per acre, or 193 per cent on the investment in fertilizers.

The average estimated increase of seed cotton per acre was 189 pounds for cotton seed meal; 129 pounds for acid phosphate; and 137 pounds for kainit.

Nitrate of soda was decidedly more effective than was cotton seed meal. The results suggest that, at least in 1911, the use of 100 pounds of kainit per acre in a complete fertilizer was more advisable than a larger amount.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	128 lbs.
To acid phosphate plot	336 lbs.
To kainit plot	248 lbs.
To acid phosphate and kainit plot	44 lbs.
Average increase with cotton seed meal	**189** lbs
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	24 lbs.
To cotton seed meal plot	232 lbs.
To kainit plot	232 lbs.
To cotton seed meal and kainit plot	28 lbs.
Average increase with acid phosphate	**129** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	76 lbs.
To cotton seed meal plot	196 lbs.
To acid phosphate plot	284 lbs.
To cotton seed meal and acid phosphate plot	—8 lbs.
Average increase with kainit	**137** lbs.
Increase from use of cotton seed meal	44 lbs.
Increase from use of nitrate of soda	146 lbs.
Nitrate better by	**102** lbs.

Experiments at Camden and Allenton

			Camden			Allenton		
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	432	128	$ 1.10	976	152	$ 1.86
2	240	Acid phosphate	328	24	—.91	896	72	.62
3	000	No fertilizer	304	----	------	824	----	----
4	200	Kainit	384	76	1.03	824	16	— .89
5	200 240	Cotton seed meal Acid phosphate	672	360	6.84	1064	272	4.02
6	200 200	Cotton seed meal Kainit	640	324	5.97	1054	279	4.53
7	000	No fertilizer	320	----	------	759	----	----
8	240 200	Acid phosphate Kainit	632	308	6.78	696	— 35	—4.20
9	200 240 200	Cotton seed meal Acid phosphate Kainit	680	352	5.18	772	68	—3.90
10	200 240 100	Cotton seed meal Acid phosphate Kainit	648	316	4.73	800	124	—1.41
11	000	No fertilizer	336	----	------	648	----	----
12	240 100 100	Acid phosphate Kainit Nitrate of soda	784	448	9.46	952	304	4.85

WILCOX COUNTY, 4 MILES NORTHWEST OF ALLENTON.

J. H. Jones, Jr.

Red clay loam.

The preceding crop for several years has been cotton. There was no rust or damage from insect attacks. The stand was poor on account of wind and hail in July. Plots 5, 6, 7, 8, 9 and 10 were the most deficient. Plot 11 had 759 plants, which was an average number for a correct stand and with this as a basis the actual yield on the plots mentioned above were corrected accordingly. Cotton seed meal gave the best results in each plot where it was used. Kainit and acid phosphate were not profitable as indicated by this test.

The average estimated increase of seed cotton from the use of cotton seed meal was 180 pounds; with acid phosphate there was an average loss of 18 pounds; and with kainit there was an average gain of 42 pounds of seed cotton per acre.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	152 lbs.
To acid phosphate plot	200 lbs.
To kainit plot	263 lbs.
To acid phosphate and kainit plot	103 lbs.
Average increase with cotton seed meal	**180** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	72 lbs.
To cotton seed meal plot	120 lbs.
To kainit plot	—51 lbs.
To cotton seed meal and kainit plot	—211 lbs.
Average increase with acid phosphate	**—18** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	16 lbs.
To cotton seed meal plot	127 lbs.
To acid phosphate plot	—107 lbs.
To cotton seed meal and acid phosphate plot	—204 lbs.
Average increase with kainit	**—42** lbs.
Increase from use of cotton seed meal	103 lbs.
Increase from use of nitrate of soda	283 lbs.
Nitrate better by	**180** lbs.

WILCOX COUNTY, 300 YARDS NORTH OF SUNNY SOUTH.

J. D. CARMICHAEL.

Gray loam upland with yellow clay subsoil.

This field has been in cultivation for about twenty years; the two preceding crops were cotton. Mr. Carmichael made no report of damage from insect or rust, but reports serious loss from unfavorable weather and from shedding in August.

The most profitable increase, $10.04 per acre, or 323 per cent on the investment in fertilizer, resulted from a mixture of acid phosphate and kainit. The mixture of cotton seed meal and acid phosphate afforded a net profit of $4.79 per acre, or 100 per cent on the investment in fertilizer.

The average increase in pounds of seed cotton per acre attributable to acid phosphate was 180 pounds; to kainit 108 pounds; and to cotton seed meal only 15 pounds.

Nitrate of soda, applied June 12th, was largely ineffective.

Increase of seed cotton when cotton seed was added:	
To unfertilized plot	00 lbs.
To acid phosphate plot	208 lbs.
To kainit plot	96 lbs.
To acid phosphate and kainit plot	—246 lbs.
Average increase with cotton seed meal	**15** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	88 lbs.
To cotton seed meal plot	296 lbs.
To kainit plot	338 lbs.
To cotton seed meal and kainit plot	—4 lbs.
Average increase with acid phosphate	**180** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	72 lbs.
To cotton seed meal plot	168 lbs.
To acid phosphate plot	322 lbs.
To cotton seed meal and acid phosphate plot	—132 lbs.
Average increase with kainit	**108** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds kainit	—132 lbs.
To use of 100 pounds kainit	—162 lbs.
Increase from use of cotton seed meal	—100 lbs.
Increase from use of nitrate of soda	— 56 lbs.
Cotton seed meal better by	**44** lbs.

Experiments in Dallas and Wilcox Counties

			Orrville			Sunny South		
Plot No.	Amount fertilizer per acre	KIND.	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per cotton	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	592	144	$ 1.61	496	000	$ 0.00
2	240	Acid phosphate	544	96	1.39	584	88	1.14
3	000	No fertilizer	448	----	-------	496	----	------
4	200	Kainit	600	118	2.38	608	72	.90
5	200 240	Cotton seed meal Acid phosphate	760	244	3.13	872	296	4.79
6	200 200	Cotton seed meal Kainit	640	90	—1.52	784	168	.98
7	000	No fertilizer	584	----	------	656	----	------
8	240 200	Acid phosphate Kainit	800	212	3.70	1064	410	10.04
9	200 240 200	Cotton seed meal Acid phosphate Kainit	904	312	3.90	816	164	—.83
10	200 240 100	Cotton seed meal Acid phosphate Kainit	840	244	2.43	784	134	---1.09
11	000	No fertilizer	600	----	------	648	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	800	200	1.52	1008	360	6.64

DALLAS COUNTY, 4 MILES SOUTH OF ORRVILLE.

B. F. Wilson.

Gray sandy land with yellowish subsoil.

This field had been cleared about forty years, but was not cultivated in 1908 and 1909. Rust was injurious, but no insect damage was reported. The stand was good.

The most profitable increase ($3.70 and $3.90) was from the complete fertilizers containing cotton seed meal (Plots 9 and 10). The average increase of seed cotton per acre was 128 pounds for acid phosphate; 91 pounds for cotton seed meal; and 62 pounds for kainit.

Cotton seed meal was superior to nitrate of soda applied June 15, by 44 pounds of seed cotton per acre.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	144 lbs.
To acid phosphate plot	148 lbs.
To kainit plot	—28 lbs.
To acid phosphate and kainit plot	100 lbs.
Average increase with cotton seed meal	91 lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	96 lbs.
To cotton seed meal	100 lbs.
To kainit plot	94 lbs.
To cotton seed meal and kainit plot	222 lbs.
Average increase with acid phosphate	128 lbs.

Increase of seed cotton when kainit was added:

To unfertilized plot	118 lbs.
To cotton seed meal plot	—54 lbs.
To acid phosphate plot	116 lbs.
To cotton seed meal and acid phosphate plot	68 lbs.
Average increase with kainit	62 lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds kainit	68 lbs.
To use of 100 pounds kainit	00 lbs.

Increase from use of cotton seed meal	100 lbs.
Increase from use of nitrate of soda	56 lbs.
Cotton seed meal better by	44 lbs.

BUTLER COUNTY, 1-3 MILE SOUTH OF McKENZIE.

J. C. ARANT.

Light sandy loam, yellowish sandy subsoil.

This land has been cleared for eleven years. The preceding crop was cotton. There was some damage from rust. The stand was good except on Plot 12, where there was some wilt. The complete fertilizers all afforded a satisfactory profit. The largest increase was 500 pounds of seed cotton per acre from a mixture of cotton seed meal and acid phosphate, which returned a profit of $11.32 per acre, or 242 per cent on the investment in fertilizers. The average estimated increase of seed cotton per acre for cotton seed meal was 185 pounds; for acid phosphate 266 pounds; while with kainit there was an average loss of 22 pounds of seed cotton.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	176 lbs.
To acid phosphate plot	372 lbs.
To kainit plot	136 lbs.
To acid phosphate and kainit plot	56 lbs.
Average increase with cotton seed meal	**185** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	128 lbs.
To cotton seed meal plot	324 lbs.
To kainit plot	346 lbs.
To cotton seed meal and kainit plot	266 lbs.
Average increase with acid phosphate	**266** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	—42 lbs.
To cotton seed meal plot	—82 lbs.
To acid phosphate plot	176 lbs.
To cotton seed meal and acid phosphate plot	—140 lbs.
Average increase with kainit	**—22** lbs.

Experiments at McKenzie and 8 Miles South of Troy

			McKENZIE			8 M. S. OF TROY		
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	464	176	$ 2.63	768	264	$ 5.45
2	240	Acid phosphate	416	128	2.42	632	128	2.42
3	000	No fertilizer	288	----	------	504	----	----
4	200	Kainit	268	—12	—2.74	904	370	10.44
5	200 240	Cotton seed meal Acid phosphate	832	500	11.32	776	212	2.10
6	200 200	Cotton seed meal Kainit	448	94	1.39	936	342	6.54
7	000	No fertilizer	376	----	----	624	----	----
8	240 200	Acid phosphate Kainit	656	304	6.65	800	186	2.87
9	200 240 200	Cotton seed meal Acid phosphate Kainit	688	360	5.44	864	260	2.24
10	200 240 100	Cotton seed meal Acid phosphate Kainit	704	400	7.42	816	222	1.72
11	000	No fertilizer	280	----	----	584	----	----
12	240 100 100	Acid phosphate Kainit Nitrate of soda	------	------	------	792	208	1.78

PIKE COUNTY, 8 MILES SOUTH OF TROY.

R. P. RHODES.

Gray land, clay subsoil.

This land has been cleared for about 20 years. The preceding crop was corn. There was no damage from rust or insect attacks. There was a good stand.

The largest profit, $10.44 per acre, or a profit of 746 per cent on the investment in fertilizers was secured on the plot receiving only kainit. The next largest profit was from using cotton seed meal and kainit. Apparently potash was the constituent chiefly needed by this soil, while cotton seed meal was also helpful.

Nitrate of soda, applied June 16 was of practically the same value as an early application of cotton seed meal.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	264 lbs.
To acid phosphate plot	84 lbs.
To kainit plot	—28 lbs.
To acid phosphate and kainit plot	74 lbs.
Average increase with cotton seed meal	**99** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	128 lbs.
To cotton seed meal plot	—52 lbs.
To kainit plot	—184 lbs.
To cotton seed meal and kainit plot	—82 lbs.
Average increase with acid phosphate	—**48** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	370 lbs.
To cotton seed meal plot	78 lbs.
To acid phosphate plot	58 lbs.
To cotton seed meal and acid phosphate plot	48 lbs.
Average increase with kainit	**138** lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds kainit	48 lbs.
To use of 100 pounds kainit	10 lbs.

Increase from use of cotton seed meal	74 lbs.
Increase from use of nitrate of soda	60 lbs.
Cotton seed meal better by	**14** lbs.

DALE COUNTY, 1 MILE SOUTH OF OZARK.

J. W. BYRD.

Light gray sandy loam, with reddish clay subsoil.

This land has been cleared for 60 years, and had been out of cultivation for 3 years prior to 1911. There was some rust on Plots 5 and 6. The stand was good. Kainit in every combination gave the largest yields. The highest estimated increase in yield was 606 pounds of seed cotton per acre with 640 pounds per acre of a complete fertilizer (Plot 9). This gave a profit of $13.31 per acre, or 219 per cent on the investment in fertilizers. The next largest profit, $10.70 per acre, or 243 per cent on the investment in fertilizers, was on Plot 6, fertilized with a mixture of cotton seed meal and kainit. The average estimated increase of seed cotton per acre was 222 pounds with cotton seed meal; 141 pounds with acid phosphate; and 254 pounds with kainit. In a complete fertilizer, nitrate of soda was very slightly less effective than cotton seed meal; 200 pounds of kainit per acre was more profitable than half this amount.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	172 lbs.
To acid phosphate plot	208 lbs.
To kainit plot	256 lbs.
To acid phosphate and kainit plot	251 lbs.
Average increase with cotton seed meal	**222** lbs

Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	128 lbs.
To cotton seed meal plot	164 lbs.
To kainit plot	139 lbs.
To cotton seed meal and kainit plot	134 lbs.
Average increase with acid phosphate	**141** lbs.

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	216 lbs.
To cotton seed meal plot	300 lbs.
To acid phosphate plot	227 lbs.
To cotton seed meal and acid phosphate plot	270 lbs.
Average increase with kainit	**254** lbs.

Increase from use of different quantities of kainit:
To use of 200 pounds of kainit .... 270 lbs.
To use of 100 pounds of kainit .... 169 lbs.

Increase from use of cotton seed meal .... 251 lbs.
Increase from use of nitrate of soda .... 210 lbs.

Cotton seed meal better by .... 41 lbs.

Experiments at Ozark and Dothan

			Ozark			Dothan		
Plot No.	Amount fertilizer per acre	Kind	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	372	172	$ 2.50	656	184	$ 2.89
2	240	Acid phosphate	328	128	2.42	624	152	3.18
3	000	No fertilizer	200	----	------	472	----	------
4	200	Kainit	436	216	5.51	672	196	4.87
5	200 240	Cotton seed meal Acid phosphate	576	336	6.07	736	256	3.51
6	200 200	Cotton seed meal Kainit	732	472	10.70	824	340	6.48
7	000	No fertilizer	280	----	----	488	----	------
8	240 200	Acid phosphate Kainit	640	355	8 28	880	362	8.50
9	200 240 200	Cotton seed meal Acid phosphate Kainit	896	606	13.31	1112	564	11.97
10	200 240 100	Cotton seed meal Acid phosphate Kainit	800	505	11 78	------	----	------
11	000	No fertilizer	300	----	------	608	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	764	464	9.97	840	232	2.54

HOUSTON COUNTY, 1 MILE WEST OF DOTHAN.

T. J. Herring.

Gray sandy land, yellow clay subsoil.

This land has been cleared for 14 years. The preceding crop was corn. There was no damage from rust or from insect attacks. The stand was good. The average increase of seed cotton per acre for cotton seed meal was 159 pounds; for acid phosphate 154 pounds; and for kainit 20 pounds.

The largest profit, $11.97, or 197 per cent on the investment in fertilizers was made on Plot 9, which received 640 pounds per acre of a complete fertilizer.

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	184 lbs.
To acid phosphate plot	104 lbs.
To kainit plot	144 lbs.
To acid phosphate and kainit plot	202 lbs.
Average increase with cotton seed meal	**159** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	152 lbs.
To cotton seed meal plot	72 lbs.
To kainit plot	166 lbs.
To cotton seed meal and kainit plot	224 lbs.
Average increase with acid phosphate	**154** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	196 lbs.
To cotton seed meal plot	156 lbs.
To acid phosphate plot	210 lbs.
To cotton seed meal and acid phosphate plot	308 lbs.
Average increase with kainit	**208** lbs.

COFFEE COUNTY, 8 MILES SOUTH OF BROCKTON.

J. W. HARRY.

Red clay loam, red clay subsoil.

This land has been cultivated for about 30 years. The preceding crop was corn. There was no damage from rust or cotton caterpillars. There was a good stand. Plot 12 afforded the largest profit, $7.92, or 162 per cent on the investment in fertilizers. The average estimated increase of seed cotton per acre was 100 pounds for cotton seed meal; 97 pounds for acid phosphate; and 51 pounds for kainit.

Nitrate of soda was more effective than cotton seed meal.

Kainit was but slightly needed or in relatively small amounts, 100 pounds answering practically as well as 200 pounds per acre.

Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	—8 lbs.
To acid phosphate plot	80 lbs.
To kainit plot	128 lbs.
To acid phosphate and kainit plot	198 lbs.
Average increase with cotton seed meal	**100** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	80 lbs.
To cotton seed meal plot	168 lbs.
To kainit plot	38 lbs.
To cotton seed meal and kainit plot	108 lbs.
Average increase with acid phosphate	**99** lbs
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	8 lbs.
To cotton seed meal plot	144 lbs.
To acid phosphate plot	— 34 lbs.
To cotton seed meal and acid phosphate plot	84 lbs.
Average increase with kainit	**51** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds of kainit	84 lbs.
To use of 100 pounds of kainit	74 lbs.
Increase from use of cotton seed meal	198 lbs.
Increase from use of nitrate of soda	364 lbs.
Nitrate better by	**166 lbs.**

Experiments 8 Miles South of Brockton and 6 Miles North-West of Columbia

			8 Mi. S. of Brockton			6 Mi. N-W. of Columbia		
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	552	—8	—3.26	840	224	$ 4.17
2	240	Acid phosphate	640	80	.88	768	152	3.18
3	000	No fertilizer	560	----	------	616	----	------
4	200	Kainit	592	8	—1.14	704	92	1.36
5	200 240	Cotton seed meal Acid phosphate	768	160	.44	840	232	2.74
6	200 200	Cotton seed meal Kainit	768	136	—.05	800	196	1.87
7	00	No fertilizer	656	----	------	600	----	------
8	240 200	Acid phosphate Kainit	696	46	—1.61	752	134	1.21
9	200 240 200	Cotton seed meal Acid phosphate Kainit	888	244	1.73	904	268	2.50
10	200 240 100	Cotton seed meal Acid phosphate Kainit	872	234	2.11	984	330	5.18
11	000	No fertilizer	632	----	------	672	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	1032	400	7.92	976	304	4.85

HENRY COUNTY, 6 MILES NORTHWEST OF COLUMBIA.

F. B. Douglas.

Red land with red clay subsoil.

This field has been in cultivation for 10 years. The preceding crop was cotton. There was no rust or damage from worms. About 100 pounds of seed cotton was lost, due to late picking. The stand was very uniform. Plot 10 fertilized with a mixture of cotton seed meal, acid phosphate, and kainit, gave the largest profit, $5.18 per acre, or 96 per cent on the investment in fertilizers. Cotton seed meal was the most profitable of the fertilizers when applied singly, affording a profit of $4.17 per acre or 159 per cent on the investment in fertilizers.

The average estimated increase of seed cotton per acre was 136 pounds for cotton seed meal; 69 pounds for acid phosphate; and 21 pounds for kainit. On this red land kainit was not profitable in 1911.

Nitrate of soda was nearly as effective as cotton seed meal.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	224 lbs.
To acid phosphate plot	80 lbs.
To kainit plot	104 lbs.
To acid phosphate and kainit plot	134 lbs.
Average increase with cotton seed meal	**136** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	152 lbs.
To cotton seed meal plot	8 lbs.
To kainit plot	42 lbs.
To cotton seed meal and kainit plot	72 lbs.
Average increase with acid phosphate	**69** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	92 lbs.
To cotton seed meal plot	—28 lbs.
To acid phosphate plot	—18 lbs.
To cotton seed meal and acid phosphate plot	36 lbs.
Average increase with kainit	**21** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds kainit	36 lbs.
To use of 100 pounds kainit	98 lbs.
Increase from use of cotton seed meal	134 lbs.
Increase from use of nitrate of soda	108 lbs.
Cotton seed meal better by	**26** lbs.

MACON COUNTY, 5 MILES WEST OF NOTASULGA.

B. H. MAY.

Gray, sandy, "piney-woods" land.

This land has been cleared for 35 years. The preceding crop was corn. Plot 5 was most damaged by rust.

Every fertilizer and every combination gave a large increase in yield and in profit.

The greatest profit was on Plot 12, where a complete fertilizer containing nitrate of soda afforded a profit of $18.42 per acre, or 379 per cent on the investment in fertilizers.

The average increase attributable to cotton seed meal was 267 pounds of seed cotton per acre; to acid phosphate 144 pounds of seed cotton per acre; and to kainit 176 pounds.

Nitrate of soda gave a larger yield than did cotton seed meal.

One hundred pounds per acre of kainit was fully as effective as 200 pounds per acre.

Increase of seed cotton per acre when cotton seed meal was added:	
To unfertilized plot	508 lbs.
To acid prosphate plot	146 lbs.
To kainit plot	242 lbs.
To acid phosphate and kainit plot	170 lbs.
Average increase with cotton seed meal	**267** lbs.

Increase of seed cotton per acre when cotton seed meal was added	
To unfertilized plot	444 lbs.
To cotton seed meal plot	82 lbs.
To kainit plot	61 lbs.
To cotton seed meal and kainit plot	—11 lbs.
Average increase with acid phosphate	**144** lbs.

Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	453 lbs.
To cotton seed meal plot	87 lbs.
To acid phosphate plot	70 lbs.
To cotton seed meal and acid phosphate plot	94 lbs.
Average increase with kainit	**176** lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds kainit .... 94 lbs.

To use of 100 pounds kainit .... 112 lbs.

Increase from use of cotton seed meal.................... 170 lbs.

Increase from use of nitrate of soda...................... 196 lbs.

Nitrate better by .... **26** lbs.

Experiments at Notasulga and Ft. Davis

			NOTASULGA			FT. DAVIS		
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	632	508	$13.26	720	—24	—3.77
2	240	Acid phosphate	568	444	12.53	784	40	—.40
3	00)	No fertilizer	124	----	------	744	----	------
4	20)	Kainit	584	453	13.10	816	86	1.35
5	200 240	Cotton seed meal Acid phosphate	728	590	14.20	920	204	1.85
6	200 200	Cotton seed meal Kainit	840	695	17.84	984	282	4.62
7	000	No fertilizer	152	----	------	688	----	------
8	240 200	Acid phosphate Kainit	672	514	13.37	968	310	6.84
9	200 240 200	Cotton seed meal Acid phosphate Kainit	848	684	15.81	1128	500	9.92
10	200 240 100	Cotton seed meal Acid phosphate Kainit	872	702	17.08	1096	498	10.56
11	000	No fertilizer	176	----	------	568	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	904	728	18.42	880	312	5.10

MACON COUNTY, ½ MILE SOUTHWEST OF FT. DAVIS.

F. M. DAVIS.

White sandy "second bottom" soil with yellow clay subsoil.

This land was cleared 50 or 60 years ago. Corn was the preceding crop. The stand of cotton was uniform. Rust was worse on Plots 1, 3, 7, and 11, and least abundant on Plots 12, 6, 9, 10, and 8 in order named. This cotton was injured by hot weather in August and by cotton caterpillars in September.

The complete fertilizers, containing cotton seed meal, were most profitable, affording increased yields of 500 pounds and 498 pounds respectively, per acre; this was a profit of \$9.92 and \$10.56 per acre, or 163 and 181 per cent on the investment in fertilizers. The average increase from cotton seed meal was 133 pounds seed cotton per acre; from acid phosphate 178 pounds of seed cotton; and from kainit 240 pounds of seed cotton per acre. One hundred pounds of kainit was as effective as 200 pounds.

Nitrate of soda applied June 27th, afforded a smaller yield than did an application of cotton seed meal.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	—24 lbs.
To acid phosphate plot	164 lbs.
To kainit plot	196 lbs.
To acid phosphate and kainit plot	190 lbs.
Average increase with cotton seed meal	**133** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	40 lbs.
To cotton seed meal plot	228 lbs.
To kainit plot	224 lbs.
To cotton seed meal and kainit plot	218 lbs.
Average increase with acid phosphate	**178** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	86 lbs.
To cotton seed meal plot	306 lbs.
To acid phosphate plot	270 lbs.
To cotton seed meal and acid phosphate plot	296 lbs.
Average increase with kainit	**240** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds kainit	296 lbs.
To use of 100 pounds kainit	294 lbs.
Increase from use of cotton seed meal	190 lbs.
Increase from use of nitrate of soda	4 lbs.
Cotton seed meal better by	**186 lbs**

MONROE COUNTY, 2 MILES WEST OF MONROE.

MONROE FARM LAND CO.

Sandy, gravelly loam, yellow clay subsoil.

This land has been cleared for 30 years. The preceding crops were oats and millet. There was no damage from shedding or from rust, but some injury from the cotton caterpillar. The stand was good. All applications of fertilizers were profitable. Plot 10 afforded the greatest profit, $9.79 per acre, or 180 per cent on the investment in fertilizers. The average estimated increase of seed cotton per acre for cotton seed meal was 182 pounds; 184 pounds for kainit, and 59 pounds for acid phosphate.

Experiment in Monroe County

Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	536	152	$ 1.86
2	240	Acid phosphate	456	72	.72
3	000	No fertilizer	384	----	------
4	200	Kainit	512	148	4.34
5	200	Cotton seed meal	544	200	1.72
	240	Acid phosphate			
6	200	Cotton seed meal	704	380	7.76
	200	Kainit			
7	000	No fertilizer	304	----	------
8	240	Acid phosphate	520	214	3.77
	200	Kainit			
9	400	Cotton seed meal	736	428	7.62
	240	Acid phosphate			
	200	Kainit			
10	200	Cotton seed meal	784	474	9.79
	240	Acid phosphate			
	100	Kainit			
11	000	No fertilizer	312	----	------
12	240	Acid phosphate	608	296	4.59
	100	Kainit			
	100	Nitrate of soda			

Increase of seed when cotton seed meal was added:	
To unfertilized plot	152 lbs.
To acid phosphate plot	128 lbs.
To kainit plot	232 lbs.
To acid phosphate and kainit plot	214 lbs.
Average increase with cotton seed meal	**182** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	72 lbs.
To cotton seed meal plot	48 lbs.
To kainit plot	66 lbs.
To cotton seed meal and kainit plot	48 lbs.
Average increase with acid phosphate	**59** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	148 lbs
To cotton seed meal plot	228 lbs.
To acid phosphate plot	132 lbs.
To cotton seed meal and acid phosphate plot	228 lbs.
Average increase with kainit	184 lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds kainit	228 lbs.
To use of 100 pounds kainit	274 lbs.
Increase from use of cotton seed meal	214 lbs.
Increase from use of nitrate of soda	36 lbs.
Cotton seed meal better by	**178** lbs.

CLARKE COUNTY, 10 MILES NORTHWEST OF THOMASVILLE.

T. M. PUGH.

Sandy pine upland with clay subsoil.

The stand was good and uniform. No report was made of insect injury or severe damage by rust or other disease. All complete fertilizers were profitable, but the greatest profit was $4.69 per acre (Plot 6), or 101 per cent on the investment in fertilizer.

The average increase of seed cotton due to cotton seed meal was 199 pounds per acre; to acid phosphate, only 17 pounds; to kainit, only 49 pounds. Cotton seed meal was superior to nitrate of soda to the extent of 43 pounds of seed cotton per acre. Nitrate of soda, applied June 21st, was slightly better than cotton seed meal.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	232 lbs.
To acid phosphate plot	192 lbs.
To kainit plot	168 lbs.
To acid phosphate and kainit plot	206 lbs.
Average increase with cotton seed meal	**200** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	72 lbs.
To cotton seed meal plot	32 lbs.
To kainit plot	—38 lbs.
To cotton seed meal and kainit plot	00 lbs.
Average increase with acid phosphate	**17** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	116 lbs.
To cotton seed meal plot	52 lbs.
To acid phosphate plot	6 lbs.
To cotton seed meal and acid phosphate plot	20 lbs.
Average increase with kainit	**49** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds kainit	20 lbs.
To use of 100 pounds kainit	18 lbs.
Increase from use of cotton seed meal	206 lbs.
Increase from use of nitrate of soda	260 lbs.
Nitrate better by	**54** lbs

Experiments in Clarke and Choctaw Counties

			Bashi			Pushmataha		
Plot No.	Amount fertilizer per acre.	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		*Lbs.*	*Lbs.*		*Lbs.*	*Lbs.*	
1	200	Cotton seed meal	616	232	$ 4.42	528	112	$ 0.58
2	240	Acid phosphate	456	72	.62	520	104	1.70
3	000	No fertilizer	384	----	------	416	----	------
4	200	Kainit	544	116	2.31	536	102	1.86
5	200 240	Cotton seed meal Acid phosphate	736	264	3.77	856	404	8.28
6	200 200	Cotton seed meal Kainit	800	284	4.69	696	226	2.83
7	000	No fertilizer	560	----	------	488	----	------
8	240 200	Acid phosphate Kainit	632	78	.58	688	162	2.10
9	200 240 200	Cotton seed meal Acid phosphate Kainit	832	284	3.01	872	308	3.78
10	200 240 100	Cotton seed meal Acid phosphate Kainit	824	282	3.64	952	350	5.82
11	000	No fertilizer	536	----	------	6 40	----	----
12	240 100 100	Acid phosphate Kainit Nitrate of soda	872	336	5.87	864	224	2.83

CHOCTAW COUNTY, 20 MILES SOUTH OF CUBA.

D. O. Phillips, Pushmataha.

Dark gray sand with yellow clay subsoil.

This field has been cleared about 50 years. The preceding crop was corn. A mixture of cotton seed meal and acid phosphate (Plot 5) afforded the largest increase (404 pounds of seed cotton). This also gave the largest net profit, $8.28, or 177 per cent on the investment in fertilizers. In a complete fertilizer 100 pounds of kainit per acre was more profitable than 200 pounds.

The average increase with cotton seed meal was 171 pounds of seed cotton per acre, against 135 pounds from acid phosphate, and an average increase of only 45 pounds from the use of 200 pounds of kainit. Cotton seed meal was more profitable than nitrate of soda, applied June 13th.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	112 lbs.
To acid phosphate plot	300 lbs.
To kainit plot	124 lbs.
To acid phosphate and kainit plot	146 lbs.
Average increase with cotton seed meal	**171** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	104 lbs.
To cotton seed meal plot	292 lbs.
To kainit plot	60 lbs.
To cotton seed meal and kainit plot	82 lbs.
Average increase with acid phosphate	**135** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	102 lbs.
To cotton seed meal plot	114 lbs.
To acid phosphate plot	58 lbs.
To cotton seed meal and acid phosphate plot	—96 lbs.
Average increase with kainit	**45** lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds kainit	—96 lbs.
To use of 100 pounds kainit	—54 lbs.

Increase from use of cotton seed meal	146 lbs.
Increase from use of nitrate soda	20 lbs.
Cotton seed meal better by	**126** lbs.

WASHINGTON COUNTY, 6 MILES NORTHEAST OF CARSON.

T. LEE PORTER.

Red upland soil.

This land has been cultivated for about 40 years. The preceding crop was corn. The stand on all plots was poor. This cotton was seriously damaged by the boll weevil and the cotton caterpillar. Portions of Plots 2, 3, 5, 6 and 8 were injured by rust.

This soil needed a complete fertilizer, which in all cases afforded a profit, while all applications of chemicals singly or in pairs were of but slight value.

The average increase attributable to cotton seed meal was 90 pounds of seed cotton; to acid phosphate 94 pounds; and to kainit 118 pounds of seed cotton per acre.

Nitrate of soda applied on July 7th, was practically equal to cotton seed meal.

Increase of seed cotton when cotton seed meal was added:	
To unfertilized plot	54 lbs.
To acid phosphate plot	—30 lbs.
To kainit plot	36 lbs.
To acid phosphate and kainit plot	298 lbs.
Average increase with cotton seed meal	**90** lbs.
Increase of seed cotton per acre when acid phosphate was added:	
To unfertilized plot	50 lbs.
To cotton seed meal plot	—34 lbs.
To kainit plot	49 lbs.
To cotton seed meal and kainit plot	311 lbs.
Average increase with acid phosphate	**94** lbs.
Increase of seed cotton per acre when kainit was added:	
To unfertilized plot	41 lbs.
To cotton seed meal plot	23 lbs.
To acid phosphate plot	40 lbs.
To cotton seed meal and acid phosphate plot	368 lbs.
Average increase with kainit	**118** lbs.
Increase from use of different quantities of kainit:	
To use of 200 pounds of kainit	368 lbs.
To use of 100 pounds of kainit	314 lbs.
Increase from use of cotton seed meal	298 lbs.
Increase from use of nitrate of soda	296 lbs.
Cotton seed meal better by	**2** lbs.

Experiments at Carson and Belleville

Plot No.	Amount fertilizer per acre	KIND	CARSON: Yield seed cotton per acre	CARSON: Increase over unfertilized plot	CARSON: Profit from fertilizer	BELLEVILLE: Yield seed cotton per acre	BELLEVILLE: Increase over unfertilized plot	BELLEVILLE: Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	560	54	—1 27	556	200	$ 3.40
2	240	Acid phosphate	556	50	— 08	544	88	1.14
3	000	No fertilizer	506	----	------	456	----	------
4	200	Kainit	582	41	— 09	576	92	1.54
5	200 240	Cotton seed meal Acid phosphate	596	20	—4 64	632	120	—.84
6	200 200	Cotton seed meal Kainit	688	77	—1.94	704	164	.85
7	000	No fertilizer	646	----	------	568	----	------
8	240 200	Acid phosphate Kainit	716	90	—.20	800	232	4.34
9	200 240 200	Cotton seed meal Acid phosphate Kainit	994	388	6.34	840	272	2.62
10	200 240 100	Cotton seed meal Acid phosphate Kainit	920	334	5.31	----	----	------
11	000	No fertilizer	566	----	------	----	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	898	332	5.74	952	384	7.41

CONECUH COUNTY, BELLVILLE, 8 MILES EAST OF REPTON.

B. D. ARANT.

Light gray sandy land, yellow clay subsoil.

This land has been in cultivation for 40 or 50 years. The preceding crop was cotton. Some damage was done by cotton wilt on Plot 10; the caterpillar attacked the crop too late to do much damage. The first part of the season was too dry and the latter part too wet.

The largest profit, $7.41, was afforded by Plot 12 which received a complete fertilizer, including nitrate of soda.

The average increase in seed cotton was 86 pounds with cotton seed meal; 47 pounds with acid phosphate; and 88 pounds with kainit.

Increase of seed cotton when cotton seed meal was added:

To unfertilized plot	200 lbs.
To acid phosphate plot	32 lbs.
To kainit plot	72 lbs.
To acid phosphate and kainit plot	40 lbs.
Average increase with cotton seed meal	**86** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	88 lbs.
To cotton seed meal plot	—80 lbs.
To kainit plot	140 lbs.
To cotton seed meal and kainit plot	40 lbs.
Average increase with acid phosphate	**47** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	92 lbs.
To cotton seed meal plot	—36 lbs.
To acid phosphate plot	144 lbs.
To cotton seed meal and acid phosphate plot	152 lbs.
Average increase with kainit	**88** lbs.

MOBILE COUNTY, 6 MILES EAST OF CHUNCHULLA

W. A. Mims.

Yellow clay loam, red clay subsoil.

The preceding crop was corn. Slight damage was done by rust. There was 90 per cent of a perfect stand. On this land, capable of making about three-fourths of a bale of cotton per acre without fertilizer, every fertilizer and every combination afforded a profitable increase. The largest profit, $12.02 per acre, or 246 per cent on the investment in fertilizers, was made on Plot 12, which received a complete fertilizer containing nitrate of soda.

The average increase attributable to cotton seed meal was 116 pounds of seed cotton per acre; to acid phosphate 109 pounds; and to kainit 170 pounds. Nitrate of soda was more effective than cotton seed meal.

Experiments at Chunchulla in Mobile County

Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.	
1	200	Cotton seed meal	1128	208	$ 3.66
2	240	Acid phosphate	1024	104	1.65
3	000	No fertilizer	920	----	------
4	200	Kainit	1280	330	9.16
5	200 240	Cotton seed meal Acid phosphate	1376	396	7.99
6	200 200	Cotton seed meal Kainit	1264	254	3.73
7	000	No fertilizer	1040	----	------
8	240 200	Acid phosphate Kainit	1416	344	7.93
9	200 240 200	Cotton seed meal Acid phosphate Kainit	1488	384	6.21
10	200 240 100	Cotton seed meal Acid phosphate Kainit	1560	424	8.19
11	000	No fertilizer	1168	----	------
12	240 100 100	Acid phosphate Kainit Nitrate of soda	1696	528	12.02

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	208 lbs.
To acid phosphate plot	292 lbs.
To kainit plot	—76 lbs.
To acid phosphate and kainit plot	40 lbs.
Average increase with cotton seed meal	**116** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	104 lbs.
To cotton seed meal plot	188 lbs.
To kainit plot	14 lbs.
To cotton seed meal and kainit plot	130 lbs.
Average increase with acid phosphate	**109** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	330 lbs.
To cotton seed meal plot	46 lbs.
To acid phosphate plot	240 lbs.
To cotton seed meal and acid phosphate plot	—12 lbs.
Average increase with kainit	**170** lbs.

Increase from use of different quantities of kainit:	
To use of 200 pounds of kainit	—12 lbs.
To use of 100 pounds of kainit	—28 lbs.
From use of cotton seed meal	40 lbs.
From use of nitrate of soda	144 lbs.
Nitrate better by	**104** lbs

INCONCLUSIVE EXPERIMENTS

All the experiments recorded in the remaining pages of this bulletin were inconclusive, and hence are very briefly presented.

J. M. Alexander, at Felix, PERRY COUNTY, made a fertilizer experiment on light sandy soil with yellow clay subsoil. This proved inconclusive probably because of having only two rows per plot. However, the yields are published on page 288.

In DALLAS COUNTY, M. F. Smith, at Marion Junction, made a fertilizer experiment on prairie land. No report of yields of the separate plots was received.

In HENRY COUNTY, R. L. Williams, 3 miles northwest of Columbia, conducted a fertilizer experiment with cotton. However, his results cannot be compared with others because he did not follow instructions but applied all fertilizers at 2½ times the rate intended. The yields are shown on page 288.

RUSSELL COUNTY, 6 MILES EAST OF SEALE.

J. B. BILLUPS.

Gray sandy loam with light yellow subsoil.

This land has been continuously in cotton for the past 28 years. Cotton wilt so reduced the stand on Plots 2, 9, and 10 as to make the experiment inconclusive. See page 290.

MONROE COUNTY, 12 MILES WEST OF REPTON.

A. L. HARRISON.

Red pine land.

This experiment was inconclusive by reason of greater fertility of that part of the field adjacent to Plot 11. See p. 290. However, at least this conclusion may be safely drawn, namely, that acid phosphate was highly profitable on this land.

Inconclusive fertilzer experiments at Felix, Columbia and Letohatchie

			FELIX		COLUMBIA		LETOHATCHIE	
Plot No.	Amount fertilizer per acre	KIND	Yield seedcotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	880	216	700	100	752	168
2	240	Acid phosphate	624	—40	660	60	624	40
3	000	No fertilizer	664	------	600	----	584	----
4	200	Kainit	392	—204	600	25	872	234
5	200 240	Cotton seed meal Acid phosphate	608	88	800	250	960	268
6	200 200	Cotton seed meal Kainit	912	464	860	335	1056	310
7	000	No fertilizer	376	------	500	----	800	----
8	240 200	Acid phosphate Kainit	480	84	800	295	1192	488
9	200 240 200	Cotton seed meal Acid phosphate Kainit	704	288	1080	570	1232	624
10	200 240 100	Cotton seed meal Acid phosphate Kainit	784	348	1420	905	952	440
11	000	No fertilizer	456	------	520	----	416	----
12	240 100 100	Acid phosphate Kainit Nitrate of soda	952	496	1060	540	504	88

CLARKE COUNTY, 8 MILES WEST OF WHATLEY.

J. W. CALHOUN.

Gray sandy upland with clay subsoil.

This field had been cleared 5 years. The original forest trees were oak and long leaf pine. The preceding crop was cotton. All plots were damaged by a severe windstorm in August. The results are inconclusive, partly because of variations in the fertility of different plots, and possibly because of unequal damage to the different plots by the storm. See page 290.

In PIKE COUNTY, near Brundidge, J. N. Colley conducted an experiment which was damaged so much by wilt and rust that no conclusion can be drawn. Hence the figures are not published.

LOWNDES COUNTY, ¼ MILE SOUTH OF LETOHATCHIE.

J. B. MITCHELL, JR.

Black prairie upland with reddish subsoil.

The best yields were obtained from complete fertilizer, giving a profit of $13.99 per acre, or 230 per cent on the investment in fertilizer. See page 288.

The land was so variable in fertility (see yields of Plots 3, 7 and 11) that no positive conclusions can be drawn. However, the indications are that kainit and cotton seed meal, each alone and in combination, was profitable, and that probably acid phosphate was helpful when used in a complete fertilizer.

In BARBOUR COUNTY, J. A. Richards, at Louisville, conducted a fertilizer experiment but the crop was ruined by wilt and by a hail storm on the 30th of June.

CRENSHAW COUNTY, 1 MILE EAST OF LUVERNE.

F. L. HAWKINS.

Gray sandy upland; red clay subsoil.

This cotton was grown on land that had been cleared for about 55 years. There was no damage from plant disease or from insects. This experiment was inconclusive because the land was not uniform in fertility. See page 290.

BULLOCK COUNTY, 1 MILE EAST OF INVERNESS

R. F. HOOKS conducted an experiment on gray soil with yellow subsoil, which proved inconclusive because of a defective stand on certain plots. See page 290.

In BULLOCK COUNTY, 2½ miles south of Union Springs, E. H. Cope conducted an experiment. However, the results are inconclusive because the different plots were not uniform in fertility. See page 290.

Inconclusive fertilizer experiments at Luverne, Inverness, Union Springs, Seale, Repton and Whatley

			LUVERNE		INVERNESS		UNION SPRINGS		SEALE		REPTON		WHATLEY	
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	824	392	----	----	968	232	754	390	920	80	864	104
2	240	Acid phosphate	712	280	----	----	880	144	460	96	1040	200	888	128
3	000	No fertilizer	432	----	656	----	736	------	364	----	840	----	760	----
4	200	Kainit	592	52	784	186	728	10	436	67	1000	180	840	42
5	200 240	Cotton seed meal Acid phosphate	904	256	824	284	912	212	472	98	1200	400	992	156
6	200 200	Cotton seed meal Kainit	928	172	744	262	816	134	584	205	960	180	1120	246
7	000	No fertilizer	864	----	424	----	664	------	384	----	760	----	912	----
8	240 200	Acid phosphate Kainit	840	12	760	352	616	— 168	536	150	1120	290	1008	110
9	200 240 200	Cotton seed meal Acid phosphate Kainit	952	112	760	368	736	—48	696	308	1200	300	992	108
10	200 240 100	Cotton seed meal Acid phosphate Kainit	848	20	608	232	816	32	768	378	1160	190	1024	154
11	000	No fertilizer	816	----	360	----	784	------	392	----	1040	----	856	----
12	240 100 100	Acid phosphate Kainit Nitrate of soda	1048	233	872	512	904	120	704	312	1160	120	1040	184

GENEVA COUNTY, 2 MILES NORTH OF SLOCOMB.

J. G. Lewis.

Gray, "piney-woods" sandy loam, with yellow clay subsoil.

This land has been cleared for 7 years. The preceding crop was corn. The stand was good, except plot 7. There was no damage reported from rust or insect attacks. By error the plots were made smaller and the rate of fertilization higher than directed. Hence the results from this experiment cannot well be compared with those from other experiments.

All of the fertilizers were profitable. The largest increase in yield was made on plot 10, which showed a profit of $13.03 per acre. or 161 per cent on the investment in fertilizers. The highest yield from the fertilizer applied singly was acid phosphate $7.12 per acre, or 263 per cent on the investment in fertilizers. The average estimated increase of seed cotton per acre, due to the use of cotton seed meal was 206 pounds; to acid phosphate 150 pounds; and to kainit 22 pounds.

Nitrate of soda was applied June 6th.

Experiment at Slocomb in Geneva County.

Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Profit from fertilizer
	Lbs.		Lbs.	Lbs.	
1	325	Cotton seed meal	1179	307	$ 4.96
2	385	Acid phosphate	1149	307	7.12
3	000	No fertilizer	872	----	------
4	325	Kainit	1051	179	3.48
5	325 385	Cotton seed meal Acid phosphate	1346	474	7.61
6	325 325	Cotton seed meal Kainit	1218	346	3.93
7	000	No fertilizer	872	----	------
8	385 325	Acid phosphate Kainit	1103	234	2.51
9	325 385 325	Cotton seed meal Acid phosphate Kainit	1282	416	3.47
10	325 385 163	Cotton seed meal Acid phosphate Kainit	1538	676	13.03
11	000	No fertilizer	859	----	------
12	385 163 163	Acid phosphate Kainit Nitrate of soda	1513	654	13.01

Increase of seed cotton per acre when cotton seed meal was added:

To unfertilized plot	307 lbs.
To acid phosphate plot	167 lbs.
To kainit plot	167 lbs.
To acid phosphate and kainit plot	182 lbs.
Average increase with cotton seed meal	**206** lbs.

Increase of seed cotton per acre when acid phosphate was added:

To unfertilized plot	307 lbs.
To cotton seed meal plot	167 lbs.
To kainit plot	55 lbs.
To cotton seed meal and kainit plot	70 lbs.
Average increase with acid phosphate	**150** lbs.

Increase of seed cotton per acre when kainit was added:

To unfertilized plot	179 lbs.
To cotton seed meal plot	39 lbs.
To acid phosphate plot	—73 lbs.
To cotton seed meal and acid phosphate plot	—58 lbs.
Average increase with kainit	**22** lbs.

Increase from use of different quantities of kainit:

To use of 200 pounds of kainit	58 lbs.
To use of 100 pounds of kainit	202 lbs.

Increase from use of cotton seed meal	182 lbs.
Increase from use of nitrate of soda	160 lbs.
Cotton seed meal better by	**22** lbs

DALE COUNTY, 1 MILE SOUTH OF PINCKARD.

T. W. BARRINEAU.

Light clay loam with red clay subsoil.

This land has been in cultivation for 40 years. The preceding crop was corn. There was no damage from rust or insects. The plots of this experiment were not full size being only .115 of an acre each, instead of ⅛ acre as was intended, thus making the rate of fertilization higher than it should have been on the ordinary plots. The experiment is inconclusive because of wilt on plots 9 and 10 and because plots 1 and 12 were apparently more fertile than the others.

Inconclusive experiment at Pinckard

Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.
1	217	Cotton seed meal	1018	348
2	260	Acid Phosphate	600	—70
3	000	No fertilizer	670	----
4	217	Kainit	626	—18
5	217 260	Cotton seed meal Acid Phosphate	1043	426
6	217 217	Cotton seed meal Kainit	765	174
7	000	No fertilizer	564	----
8	260 217	Acid Phosphate Kainit	1096	532
9	217 260 217	Cotton seed meal Acid Phosphate Kainit	1200	636
10	217 260 108	Cotton seed meal Acid Phosphate Kainit	1043	478
11	000	No fertilizer	565	----
12	260 108 108	Acid Phosphate Kainit Nitrate of soda	1443	878

HENRY COUNTY, 1 1-4 MILES NORTHWEST OF HEADLAND.

J. T. Knowles.

Dark clay loam with red clay subsoil.

This land has been cleared for ten years. The yields were so irregular that no conclusion could be drawn. This was probably due to having the plots too narrow; moreover, the plots were too small, being only .093 of an acre, making the fertilization heavier than was intended. The figures are not published.

ESCAMBIA COUNTY, 1 1-2 MILES NORTH OF ATMORE.

J. W. JONES.

Gray sandy loam, yellow clay subsoil.

This land has been cultivated for about 5 years. Irregularity in the stand on the different plots and injury by caterpillars rendered this experiment inconclusive.

(For yields, etc., see page 296.)

ESCAMBIA COUNTY, 2 MILES NORTH OF BREWTON.

G. W. BROWN.

Gray sandy upland with yellow clay subsoil.

This land has been cultivated for about 5 years. The preceding crop was corn. There was no damage from rust. A heavy rain and wind about July 20th did considerable damage. This cotton was seriously damaged in August by the caterpillar. There was a uniform stand. See page 296.

Nitrate of soda was applied June 27th.

CRENSHAW COUNTY, 1-2 MILE NORTH OF BRANTLEY.

J. W. ELLIS.

Gray sandy loam, yellow clay subsoil.

This land, already rich, has been cultivated for 22 years. The preceding crop was corn. The results are inconclusive. See page 296.

HENRY COUNTY, 5 MILES WEST OF HEADLAND.

R. W. WARD.

Gray loam with red clay subsoil.

This land has been in cultivation for 17 years. The preceding crop was cotton. This experiment was inconclusive because of failure to make the last picking and because the plots were too narrow.

The chief need of this soil was phosphate, which gave a profit when used alone of $3.70 per acre or 280 per cent on the investment in fertilizer. See page 296.

COVINGTON COUNTY, 2 MILES EAST OF ANDALUSIA.

W. E. BAGLEY.

Sandy loam with stiff clay subsoil.

This land has been cleared for about 35 years. The preceding crop was sorghum. The results are inconclusive except in showing that cotton seed meal was uniformly effective. See page 296.

COVINGTON COUNTY, 1-2 MILE SOUTH OF OPP.

W. A. MALOY.

This experiment was inconclusive by the failure of the experimenter to carry out the written plan, which called for three unfertilized plots, so as to determine whether the different parts of the field were uniform in fertility. The figures are not published.

In GREENE COUNTY, 15 miles South of Eutaw, W. W. Morgan made a fertilizer experiment with cotton. The results were inconclusive, and are not published.

Inconclusive fertilizer experiments at Atmore, Brewton, Brantley, Headland, Andalusia

			Atmore		**Brewton**		**Brantley**		**Headland** *1 pickiug only*		**Andalusia**	
Plot No.	Amount fertilizer per acre	KIND	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot	Yield seed cotton per acre	Increase over unfertilized plot
	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1	200	Cotton seed meal	1060	504	720	88	1608	480	296	56	632	192
2	240	Acid phosphate	728	168	696	64	1104	—24	408	168	536	96
3	000	No fertilizer	560	----	632	----	1128	----	240	----	440	----
4	200	Kainit	648	96	816	194	1312	200	224	—16	608	126
5	200 240	Cotton seed meal Acid phosphate	648	104	656	34	1248	152	408	168	768	244
6	200 200	Cotton seed meal Kainit	648	112	696	94	1384	304	296	56	760	194
7	000	No fertilizer	528	----	592	----	1064	----	240	----	608	----
8	240 200	Acid phosphate Kainit	712	190	696	92	1176	92	368	132	552	—38
9	200 240 200	Cotton seed meal Acid phosphate Kainit	752	236	864	248	1192	88	448	216	752	180
10	200 240 100	Cotton seed meal Acid phosphate Kainit	704	194	816	188	1160	36	464	236	792	238
11	000	No fertilizer	504	----	640	----	1144	----	224	----	536	----
12	240 100 100	Acid phosphate Kainit Nitrate of soda	752	248	840	200	1288	144	432	208	736	200

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AUBURN

LIME FOR ALABAMA SOILS

BY

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LIME FOR ALABAMA SOILS

By J. F. Duggar and M. J. Funchess

How Lime Acts.

Soils that are deficient in available lime compounds, may be greatly benefited by the application of lime. Whatever favorable results follow the use of lime may be due to one or more of its several beneficial effects. Lime may increase the productiveness of a soil by any of the following means:

(1) By overcoming a sour condition in acid soil.

(2) By making more available the mineral plant food in the soil.

(3) By improving the physical condition, or texture, of the soil.

(4) By serving as a plant food.

Correcting the acidity of the soil. Practically all farm crops are less thrifty in a sour or acid soil, and make their best growth in one that is neutral or slightly alkaline. In case the plant itself is not directly injured by this acidity it may be indirectly affected unfavorably by an acid condition. Hence, the prime object in liming a soil is to overcome or prevent an acid or sour condition in that soil. Examples of plants which are affected both directly and indirectly by lime are most leguminous or soil-improving plants. Most of these are very sensitive to acidity, and make a very poor growth in sour soils. While these plants themselves are so greatly affected by this acidity, the bacteria that form beneficial enlargements on their roots are probably still more sensitive to this harmful condition. Under favorable conditions the bacteria attack root hairs of the legumes, forming nodules or tubercles; and through the action of these nodule-forming bacteria this type of plant is able to make use of the free nitrogen of the air. The growth of the legume, then, is one great factor in the building up of the soil, especially in maintaining the supply of nitrogen. Now, if the legumes and their co-operating bacteria are both so much injured by a sour condition, this acidity should certainly be overcome or prevented by the use of lime in some form.

There is a second very important group of bacteria living in the soil, the development of which is greatly retarded by acids. When cotton seed meal, dried blood, tankage, barnyard manure, and pea vines are plowed into the soil, they must first be fermented, or decomposed, before their contained nitrogen is made available to plants. This fermentation is caused by a number of groups of bacteria in the soil. In the presence of small amounts of acid, their desirable activity is retarded or even stopped. Hence, if the farmer is to get full returns for his organic fertilizers or barnyard manure, the soil to which these are added must not be sour. If it is sour, the evil must first be remedied by the use of some form of lime.

Still a third more or less important group of soil bacteria is also affected by the reaction of the soil. This is the type of nitrogen-fixing bacteria, which, unlike the legume bacteria, do not need any host plant. If supplied the necessary food and the proper conditions for growth, these bacteria have the power of using the free nitrogen of the air, thereby actually increasing, to at least a slight extent, the store of nitrogen in the soil. In the absence of lime compounds to neutralize acidity, if present, these organisms fails to grow, and they are even absent from soil that is strongly acid.

Rendering mineral compound more available. Aside from the effect of lime in overcoming acidity, it has an important bearing on the availability of the mineral plant food of the soil. Many of the complex soil-forming minerals contain potash, locked in unavailable or insoluble form. Soluble lime salts react with these complex minerals, taking the place of the potash in the mineral, while the potash is set free in the soil in available form. Where there is a large supply of potash in the soil, but in unavailable form, it is good practice to make use of lime in this way; but if the soil be deficient in potash, it would be dangerous to rely solely on the lime to supply the potash needed for the crop, since this stimulation would soon bring about soil exhaustion. In the latter case, it would be advisable to replace at least a part of the potash removed by crops.

Lime also has considerable effect on the availability of phosphates in the soil. If the soil is deficient in lime, most of the phosphate in it is in the form of insoluble phosphate of iron and aluminum. In such soil, lime reacts with these iron and aluminum phosphates, forming phosphate of lime, a more available phosphate. The acid or soluble phosphate found in most fertilizers, when added to a soil, "reverts," or goes back, to a more insoluble form soon after it is applied. If there be a deficient amount of carbonate of lime in the soil the reversion will be largely to the most unavailable forms, namely phosphates of iron and aluminum. However, if there is a sufficiency of lime, the reverted product will be largely the more available compound, namely, dicalcium phosphate.

Improving the texture of the soil. Besides its action in neutralizing acidity, and in making more available the plant food in soil, lime may have a very good effect on the texture, or "workableness" of certain heavy soils. Soils containing a high percentage of clay, and that are at the same time deficient in lime, may be very hard to cultivate; such soils are very sticky and heavy when wet, and bake and crack badly on drying. The addition of lime to such a soil causes the very small clay particles to group themselves together into clusters, each of which acts somewhat like a single grain of sand, making the soil more porous, less retentive of water, and less liable to baking and cracking.

Lime has quite a different effect on light porous soil. In this case, the larger particles or sand grains are cemented to each other to a certain extent, thus rendering a sandy soil more compact.

Lime as a plant food. Plants require lime as well as potash, nitrogen, and a number of other elements or compounds. However, most soils contain enough lime to supply that actually used as food by ordinary crops, but often not enough to bring about the indirect beneficial effects previously discussed. The indirect effects of lime on the plant in neutralizing the acidity of the soil, in permitting the soil to become more abundantly stocked with helpful bacteria, and in causing the soil minerals to become more available, are all more important than is the supplying of lime to be taken in by the plant.

Need for Lime in Alabama Soil.

Among the numerous soils of Alabama there are many that contain only small amounts of lime, less than is needed for the successful growth of lime-loving plants. But there are regions, the soils of which are comparatively well supplied with lime. The most extensive of these lime areas are the following:

(1) The Central Prairie Region, which is a rather narrow belt extending from near Union Springs westward into Mississippi, passing near or through Montgomery, Selma, Marion Junction, Demopolis, Livingston, and Geiger.

(2) Parts of the Tennessee Valley Region in northern Alabama.

(3) Several very narrow valleys in the northeastern part of the State.

(4) Very small detached areas of so-called lime hills in Clark county.

(5) Probably parts of the flat-woods soils in the northeastern part of Alabama.

On the soils just mentioned there is usually no decided need for lime, except possibly in growing alfalfa, for which plant it may sometimes be needed even in these soils, except in the Central Prairie Region.

During the past fifteen years the agriculturist of this Station, while traveling over the State, has made a number of simple tests by using litmus paper to determine whether the soils examined are acid. As a rule these tests have shown that a large proportion of the sandy soils in the southern part of the State are acid; that much of the sandy upland soils in the northeastern plateau or mineral region is acid; and that at least the lighter colored and more poorly drained spots in the Tennessee valley show acidity.

How to Determine Whether a Soil is Acid.

A very simple and inexpensive test can be made by any one to determine whether a soil is sour. Have your local druggist order from a wholesale druggist a small bottle of blue litmus paper, which will usually retail at 15 to 25 cents per bottle. This contains enough for testing a large number of samples. In the soil to be tested dig down to moist earth and then with a knife, or otherwise, make a slit in the moist soil; take a slip of blue litmus paper and touching it at only one end, thrust it into the slit in the soil and press the damp soil tightly against both sides of the paper, leaving the paper and moist soil in contact for five minutes. Then take out the paper and dry it. If the color has changed from a blue to a pinkish tint, the soil may be regarded as slightly acid. If the change is to a deeper reddish color, the soil is quite acid and probably needs lime for most crops.

In making the litmus paper test, be careful not to mistake for an evidence of acidity in the soil the reddish coloring brought about by the perspiration from the fingers that touched on the end of the paper which has been handled.

The litmus paper test simply determines (1) that the soil is more or less acid; or (2) that it has the opposite property of being alkaline, which might be due to the presence of lime; or (3) that it is neutral, that is, neither acid nor alkaline.

Whether it will pay to use lime on neutral or on a very slightly acid soil will depend largely upon the crop that is to be grown.

Lime-Loving Crops.

Alfalfa and red clover are extreme examples of lime-loving plants. These require for their best growth a soil that is naturally alkaline, or made so by the application of liberal amounts of some form of lime. Indeed, it is generally true that most of the leguminous plants, such as peanuts, clover, vetches, etc., are unthrifty on acid soils and pay well for the application of lime. Among other such lime-loving plants are sweet clover, or mellilotus, crimson clover, bur clover ,and the vetches.

On the other hand, cow peas and lespedeza (commonly called Japan clover) are able to grow successfully on either slightly acid or lime soil. Among the weeds that are especially partial to acid soil—are sorrel (*Rumex acetosella*) ; bluets (*Houstonia coerulea*), rushes, and sedges.

Wheat and barley require considerable lime in soil or fertilizer, while oats are less particular. Corn, and indeed most grass-like plants, are usually helped by lime on acid soils. However, red top grass is an exception, preferring acid soil; and hence this grass is especially suitable for growing on poorly drained, acid soils. The cotton plant, though often helped by lime, is able to make thrifty growth in slightly acid soil. Among the crops which have been found to thrive on acid soils are watermelons. The use of lime is not generally advised for Irish potatoes because lime favors the growth of potato scab, which is one of the most common and troublesome diseases of the Irish potato.

Many of the garden vegetables are especially helped by liberal applications of lime; for example, beets, onions, lettuce, turnips and cabbage, and other members of the mustard family, which includes also Dwarf Essex rape.

A more extended list of the plants which have been found to respond to or to be indifferent to lime may be had by applying to the U. S. Department of Agriculture at Washington for Farmers' Bulletin No. 77.

Sources of Lime.

At present most of the lime offered for agricultural uses in Alabama is in the form of quick or builders' lime. A few of the lime manufacturers have also offered hydrated lime, that is, lime slacked at the kiln. But little, if any, crushed limestone or calcium carbonate has been manufactured within the limits of Alabama; though in recent months this article has been advertised for sale by a few companies. The advertisers of crushed limestone in localities easily accessible to Alabama farmers, which have been brought to our attention, are the following:

Manufacturers of Ground Limestone

Southern Lime and Phosphate Co., 927 Woodward Building Birmingham, Ala.
Foster Creighton Gould Co., Rockwood, Franklin Co., Ala.
Keystone Lime Co., Keystone, Shelby County, Ala.
Banks & Parson, Nashville, Tenn.

Most of the lime now manufactured in Alabama is from the hard limestone of the Calera and Anniston regions. This limestone has usually a purity of about 97 per cent. Limestone, of similar quality, and probably equally as suitable for the manufacture of any grade of lime, occurs also in other localities in the northern part of the State. Doubtless the State

Geologist, Dr. E. A. Smith, Tuscaloosa, Ala., would furnish to inquirers full information as to the localities in which other outcrops of pure limestone may be found.

The following is a list, doubtless incomplete, of all the Alabama manufacturers of quick lime, whose addresses the writers have been able to obtain:

MANUFACTURERS OF QUICK LIME.

Longview Lime Works, Longview, Shelby County, Alabama.

Keystone Lime Works, Keystone, Shelby County, Alabama.

O'Neal Lime Works, Calera, Shelby County, Alabama.

Saginaw Lime & Lumber Co., Saginaw, Shelby County, Alabama.

Bowdon Lime Works, Saginaw, Shelby County, Alabama.

Calcis Lime Works, Calcis, Alabama.

Anniston, Lime Works, Anniston, Ala.

A source of crushed limestone that has thus far been unused commercially is the rotten limestone underlying all of the Central Prairie Region in central Alabama. This rotten limestone, also called "the Selma chalk," varies considerably in composition and usually contains too much impurity to be burned for builders' lime. Rotten limestone usually consists of about 60 to 90 per cent of calcium carbonate. Theoretically every pound of lime (CaO) contained in it should be as valuable as that in the somewhat purer limestone of the Calera and Anniston regions. Doubtless the cost of crushing the softer rotten limestone would be less than in crushing the hard limestone of the regions just mentioned.

The value of limestone is practically in proportion to the fineness of the grinding.

A third source of lime for agricultural purposes consist of oyster shells. These may be either burned, so as to make quicklime; or finely crushed. so as to form calcium carbonate. a material practically identical with crushed limestone. However, adhering dried mud makes oyster shell lime somewhat less pure than other kinds.

A fourth source of lime consist of wood ashes. Wood ashes usually contains from 10 to 50 per cent of lime. Their composition is quite variable; the ashes from pine are usually less rich in lime, as well as in potash, than the ashes from hard-wood trees.

A fifth source of lime consist of marls, beds of which are occasionally found in South Alabama. Marls contain a very low percentage of lime, often one to twenty per cent, which usually restricts their usefulness to the fields immediately around such beds.

Several commercial fertilizers may be mentioned as containing small amounts of lime. However, in most of these fertilizers, the lime is in a form in which it cannot neutralize acidity, though capable of supplying lime as plant food and of making certain other mineral compounds of the soil more available. Among these fertilizers are ground phosphate rock, acid phosphate, and land plaster, in which latter the lime may constitute 20 per cent or more of the total weight.

None of these are ordinarily advisable as sources of lime because of the form in which the lime exists, the small amount of lime, and the cost of most of these fertilizers.

Basic slag or Thomas phosphate is a common phosphatic fertilizer in Europe and is imported to some extent into the United States to be used for the same purposes as acid phosphate.

About half of the weight of basic slag consists of lime, only 2 to 10 per cent of which is in the free form, that is, in condition to netralize acidity most effectively.

While the composition of all sources of lime varies considerably, the following figures represent their most usual approximate composition.

Percentage of Lime (calculated as CaO) in Different Sources of Lime and in Certain Commercial Fertilizers.

Important Sources of Active Lime.	*Approximate % of lime (CaO).*
Quick lime (97% purity)	97
Slacked lime (97% purity)	70-73
Ground limestone (97% purity)	54
Rotten limestone, or Selma chalk	35-45
Oyster shells (90% purity)	50
Wood ashes	30

Fertilizers Containing Some Lime, Mostly Inactive.

Thomas phosphate, or basic slag...........32-40
Ground rock phosphate (72% purity) 38-42
Acid phosphate (15% available)...........19-22
Land Plaster (commercial) 20-25

Effect of Lime on Organic Matter.

Under another heading, it has been shown that lime hastens the decomposition of organic matter, humus, in the soil, by overcoming acidity, thus favoring bacterial action. The store of humus in the soil may be excessively exhausted by the addition of quick or freshly slacked lime, on account of its caustic action. Besides overcoming the acidity, lime in these forms has a marked effect on the humus by purely chemical action, that is, it "burns out" the humus. So that *where much caustic or quicklime is used ample return of organic matter in the form of stable manure, green manure, or crop residue must be made* if soil exhaustion is to be prevented.

Crushed lime, or calcium carbonate, has not this bad effect, since it is not caustic and has no exhausting effect on the humus. For this reason it should be used instead of the caustic lime where it can be cheaply obtained. Moreover, crushed limestone is not so disagreeable to handle as is the caustic lime.

Quicklime Equivalents.

Where the crushed limestone cannot be had cheaply and other forms of lime must be bought, the buyer should consider the following relations in determining what is the most economical form of lime for him to use:

100 pounds of chemically pure, freshly burned lime (CaO) is equivalent to 132 pounds of fresh slacked lime ($Ca(OH)_2$).

100 pounds of quicklime is equivalent to 178 pounds of crushed limestone ($CaCO_3$).

132 pounds of slacked lime is equivalent to 178 pounds of crushed limestone.

The relative values of equal amounts of the above forms of lime for overcoming acidity are, in terms of dollars and cents, when quicklime costs $10.00 per ton, (about 80 cents per barrel), about as follows:

Slacked lime, about $7.60.

Crushed limestone, about $5.60.

It is doubtful whether the use of lime will ever become general in Alabama until crushed limsetone can be delivered at the farmers' depot at a price around two or three dollars per ton.

In the absence of cheap crushed limestone, it is cheaper and more economical to buy the quicklime and slack it on the farm than to buy lime already slacked, or hydrated lime. In the first case the cost of freight is less, and the farmer can slack the lime cheaper on the land than the manufacturer can at the kiln. If a farmer buys hydrated lime he must pay the freight on 2640 pounds of slacked lime instead of on 2,000 pounds of quicklime, the difference being water. Quicklime or any kind of lime for agricultural purposes ought to be bought on a written statement showing what per cent of it consist of pure calcium oxide (CaO).

Slacking Lime.

Probably the easiest and best way to slack quicklime is to haul it directly to the field and pile it in small piles over the area to be limed. Then cover these piles with a layer of moist soil two or three inches thick, letting it stand so for several weeks. At the end of that time the lime will usually be found in the form of a fine white powder, thoroughly slacked. The slacked lime from the piles may then be scattered over the fields. If the farmer be pressed for time and cannot wait for this slow process of slacking, water may be hauled and a little may be added to each pile of lime to hasten the process. But care must be taken not to add too much water, or a paste will result instead of the fine dry powder desired.

Applying Powdered Lime.

Where the lime is slacked in the field it is most conveniently applied to the land by shovels. After slacking, the piles are torn down and the lime scattered over the surrounding area. If it is desired to put one-half of a ton of quicklime per acre, 25 pounds of lime in a pile every thirty-three feet each way will give the desired distribution. A man can easily throw the powder sixteen or eighteen feet with a long-handle shovel.

This is rather disagreeable work, for the caustic lime burns and irritates the skin. Therefore, lime is best distributed early in the morning when there is little wind blowing and when dew is on the ground.

If the lime be bought in crushed or powdered form in car lots, it is best to distribute the lime directly from the wagon as it is hauled from the car. The wagon is driven to the field to be limed, and the lime is thrown out by shovels, as in the case of field-slacked lime.

Lime-spreading machines can be had on the market, that do satisfactory work; besides, it is much less disagreeable to spread by machines than by hand, since the laborer is not so much troubled by the flying lime dust. Several farmers might buy such a machine on the co-operative plan, thereby reducing the expense. Machine spreaders are advertised by the following manufacturers:

Belcher & Taylor, A. T. Co., Chicopee Falls, Mass.
Empire Drill Co., Shortsville, N. Y.
Hench & Dramgold Co., York, Pa.
International Harvester Co., Springfield, Ohio.
Ontario Drill Co., Deposit, N. Y.
Spangle Manufacturing Co., York, Pa.

Lime should never be plowed deeply into the soil, since its tendency is to work downward. The soil should first be well turned, the lime then scattered and harrowed or disked into the top three inches of soil. The harrowing should be thorough so as to get the lime well mixed with the soil.

Time to Apply Lime.

There is probably no "best" time to apply lime. The kind of rotation followed, the crops that are to follow the liming, labor conditions, etc., all bear on this point. Generally it is best to apply lime broadcast on land that has recently been fallowed, or "plowed flushed" or broadcast.

Lime should not be used in immediate contact with acid phosphate, since it hastens the reversion of the phosphate to a less available form. Nor should lime be mixed with stable manure, cotton seed meal, and other organic manure, nor with sulphate of ammonia, because of the chemical action of lime, by which it tends to liberate some of the nitrogen in these manures and fertilizers. Apply the lime alone on the plowed land, and disk it well into the soil before adding manure and fertilizer.

Amount of Lime to Apply.

On soils that are not markedly sour, one thousand pounds of quicklime, or two thousand pounds of crushed limestone thoroughly incorporated with the surface soil will usually be sufficient. However, many soils may be found in which the above amounts would be insufficient to overcome the acidity in the surface foot of soil. Very good results may be obtained, however, by these comparatively small amounts, which may be sufficient to neutralize the acidity in the upper three or four inches, even though these light applications may leave the subsoil still sour.

On ordinary soils, one to two tons of lime should be sufficient to last three or four years. It would be unsafe to use large amounts of quicklime on the lighter, sandier grades of soil, on account of its "burning out" the organic matter. On the other hand, large applications of the crushed limestone may be made without harmful effect, and with beneficial results extending through a number of years.

RESULTS OF EXPERIMENTS WITH LIME IN ALABAMA.

Lime Experiments at Auburn.

With the exception of two tracts of bottom land, the soils of the Experiment Station farm at Auburn are not acid; hence, but few experiments with lime have been conducted at Auburn. The table below shows that on one of the tracts of sour bottom land the increase in the corn crop or the limed plot by using 1,760 pounds of slacked lime per acre was in one experiment 41 per cent and in another experiment the same year 10 per cent.

Table I. Lime experiments, sour bottom land, on Experiment Station Farm at Auburn

	AUBURN, '08 Bottom, no cover crop		AUBURN, '08 Bottom, after cr. clover, uncut.	
	Crop per acre	Increase, %	Crop per acre	Increase, %
Corn, yield bushels, limed	43.4		48.6	
Corn, yield bushels, not limed	30.7		44.0	
Corn, gain from liming	**12.7**	**41**	**4.6**	**10**

Attention is here called to the increase attributable to the crimson clover plowed under in April. This increase in the corn crop was, in the case of the limed plot 5.2 bushels, and on the plot not limed 13.3 bushels attributable to clover.

The same year slacked lime at the rate of about one ton per acre was applied to cotton by scattering the lime over a luxuriant growth of crimson clover just before the latter was plowed under in preparation for cotton, on April 8. This was done to ascertain whether on neutral sandy upland soil the rotting of a large mass of green crimson clover would produce enough acidity to require the correcting effects of lime. Evidently the plowing under of green clover on April 8, did not have an injurious effect nor make necessary the use of lime, as shown by the fact that on the limed plots the increase in the cotton crop was only 2 per cent.

For several years the Alabama Experiment Station has had conducted lime experiments in parts of the State where it was believed that the soil was more or less acid. The results of these earlier co-operative experiments, together with the results of local lime experiments made in 1911 under the State appropriation made for local experimental work, are presented below. While the amount of slacked lime varied slightly it is as a rule one ton per acre.

All of the soils on which the experiments reported in Table II were conducted are sandy and tests made on other similar soils in the same neighborhood indicated acidity. The soils in the experiments at Dothan showed an acid reaction to litmus paper and it is believed that the other soils were also acid.

Table II. Yields and increases in pounds per acre from use of slacked lime for corn, corn stover, cotton, peanuts, cowpeas, sweet potatoes, sorghum and soy beans.

CROP	DOTHAN '06		BREWTON '06		BREWTON '07		ELBA '11		DALEVILLE '09	
	Per acre	Increase, %	Per acre	Increase, %	Per acre	Increase, %	Per acre	Increase, %	Per acre	Increase %
Corn, yield bushels, limed			*20.7						*13.1	
Corn, yield bushels, not limed			*19.1						*14.1	
Corn, gain from liming			*** 1.6**	**8**					***—1.0**	**—8**
Corn (forage), limed					4400					
Corn (forage), not limed					3440					
Corn (forage) gain from liming					**960**	**28**				
Cotton, seed cotton, limed	416		1024		552				592	
Cotton, seed cotton, not limed	608		928		408				592	
Cotton, seed cotton, gain from liming	**192**	**31**	**96**	**10**	**147**	**36**			**0**	**0**
Peanuts, nuts, limed			576		1056		2048			
Peanuts, nuts, not limed			576		864		1408			
Peanuts, nuts, gain from liming			**0**	**00**	**192**	**22**	**640**	**45**		
Cowpeas, seed, limed			1224		532		2048			
Cowpeas, seed, not limed			1056		782		1504			
Cowpeas, seed, gain from liming			**168**	**16**	**—250**	**—32**	**544**	**36**		
Sweet potatoes, limed			6144		3946				5888	
Sweet potatoes, not limed			6336		5616				5888	
Sweet potatoes, gain from liming			**—192**	**—3**	**—1670**	**—30**			**0**	**0**
Sorghum hay, limed					4080					
Sorghum hay, not limed					2992					
Sorghum hay, gain from liming					**1088**	**36**				
Soy beans, seed, limed					828					
Soy beans, seed, not limed					610					
Soy beans, seed, gain from liming					**218**	**36**				

*Bushels.

The test at Brewton, Escambia county, was made by I. E. Watson. On his soil, lime afforded notable increases in the yield of corn forage, cotton, peanuts (in 1907), sorghum hay, and soybeans, but a loss with cowpeas (in 1907), and with sweet potatoes. In the case of the cowpeas this loss seemed due to the caustic effect of the lime which injured the young cowpea plants, many of which were killed and others turned yellow, though later they recovered. This injurious effect was noted from the application of 2,000 pounds of slacked lime applied two or three days before planting.

The experiment at Dothan, Houston county, was conducted by E. J. Whidden, on a slightly acid soil. Here the yield of cotton was less on the limed plot.

The experiment at Daleville, Dale county, was conducted by E. A. Thompson. Here limed and unlimed plots afforded practically the same yields for all crops.

In the experiment made at Elba, Coffee county, by M. V. B. Farris, on soil which was very slightly if at all acid, the limed plots of peanuts and cowpeas afforded much the larger yields.

Lime Experiments at Wetumpka and Tallassee, Elmore County.

The experiment at Wetumpka, Elmore county, was made by Prof. B. W. Scheib, on the farm of the Fifth District Agricultural School, having an acid soil. Here lime afforded an increase with all crops, namely, cotton, soybeans, peanuts, corn, cowpeas, German millet, and sorghum.

Table III. Yields and increases in pounds per acre from use of slacked lime for corn, cotton, peanuts, cowpeas, sorghum hay, soy beans and German millet hay

CROP	Wetumpka '07 Per acre	Wetumpka '07 Increase, %	Wetumpka '10 Per acre	Wetumpka '10 Increase, %	Tallassee '11 Per acre	Tallassee '11 Increase, %
Corn, yield, bushels, limed			331		* 51.4	
Corn, yield, bushels, not limed			252		* 55.7	
Corn, gain from liming			**79**	**36**	*—3.7	**—7**
Cotton, seed cotton, limed			960		1065	
Cotton, seed cotton, not limed			420		1018	
Cotton, seed cotton; gain from liming			**540**	**129**	**47**	**5**
Peanuts, Spanish, nuts, limed			3160			
Peanuts, Spanish, nuts, not limed			2280			
Peanuts, Spanish, nuts, gain from liming			**880**	**39**		
Cowpea, seed, limed			1460			
Cowpea, seed, not limed			1220			
Cowpea, seed, gain from liming			**240**	**20**		
Sorghum hay, limed	8780		1140			
Sorghum hay, not limed	6316		1080			
Sorghum hay, gain from liming	**2464**	**39**	**60**	**6**		
Soy beans, seed, limed			240			
Soy beans, seed, not limed			140			
Soy bean seed, gain from liming			**100**	**71**		
German millet hay, limed			2600			
German millet hay, not limed			2340			
German millet hay, gain from liming			**260**	**11**		
Peanuts, (N. C.) nuts, limed			1760			
Peanuts, (N. C.) nuts, not limed			1100			
Peanuts, (N. C.) nuts, gain from liming			**660**	**60**		

*Bushels.

The experiment at Tallassee, Elmore county, was made by W. E. Sistrunk, on second bottom reddish clay loam soil which was not acid. There was no decided effect of lime on either cotton or corn.

Lime Experiments in Butler and Conecuh Counties.

The experiment at Georgiana, Butler county, was made by J. C. Lee, on gray sandy soil, found to be slightly acid. With lime there was an increase in the crop of peanuts, cotton and soybeans, but no increase in case of the chufas.

Table IV. Yields and increases in pounds per acre from use of slacked lime for peanuts, soy beans, cotton, corn, cowpeas and chufas

CROP	Georgiana 1911 Per acre	Georgiana 1911 Increase, %	Castleberry, 1911 (Davis) Per acre	Castleberry, 1911 (Davis) Increase, %	Castleberry, 1911 (Green) Per acre	Castleberry, 1911 (Green) Increase, %
Peanuts, yield limed	2688		3712		1024	
Peanuts, yield not limed	2474		3392		889	
Peanuts, gain from liming	**214**	**9**	**320**	**9**	**135**	**15**
Soy beans, yield hay, limed	6368					
Soy beans, yield hay, not limed	4480					
Soy beans, gain from liming	**1888**	**42**				
Cotton, yield seed cotton, limed	744		554			
Cotton, yield seed cotton, not limed	672		469			
Cotton gain from liming	**72**	**11**	**85**	**18**		
Corn, yield bushels, limed			* 38.4			
Corn, yield bushels, not limed			* 33 3			
Corn, gain from liming			* **5.1**	**13**		
Cowpeas in hull, limed					928	
Cowpeas in hull, not limed					889	
Cowpeas, gain from liming					**39**	**4**
Chufas, limed	2112					
Chufas, not limed	2112					
Chufas gain from liming	**0**	**0**				

*Bushels.

In the experiment made by J. B. Davis, Castleberry, Conecuh county on acid soil, there was an increased yield of peanuts, cotton, and corn on the limed plots.

In the experiment made by J. R. Green, at Castleberry, Conecuh county, on soil that was distinctly acid, the yield of peanuts and cowpeas was greater on the limed plots.

Lime Experiments in Mobile County.

At Irvington, Mobile county, the experiment was made by the Irvington Land Company, on reddish sandy loam soil, close to the depot, on land that apparently had been long in cultivation.

Table V. Yields and increases, in pounds per acre, in Mobile County from applying slacked lime for peanuts, cotton, corn, cowpeas, sweet potatoes and velvet beans

CROP	Irvington 1911 Per acre	Irvington 1911 Increase, %	Mobile 1911 Per acre	Mobile 1911 Increase, %
Peanuts, yield, limed	53.7		1008	
Peanuts, yield, not limed	50.3		780	
Peanuts, gain from liming	**3.4**	**7**	**228**	**29**
Cotton, yield, seed cotton limed	800		248	
Cotton, yield, seed cotton, not limed	592		288	
Cotton, gain from liming	**208**	**35**	**—40**	**—14**
Corn, yield bushels, limed			20.2	
Corn, yield bushels, not limed			29.8	
Corn, gain from liming			**—9.6**	**—32**
Cowpea hay, limed	2048		896	
Cowpea hay, not limed	1920		816	
Cowpea hay, gain from liming	**128**	**7**	**80**	**10**
Cowpeas, seed, limed			344	
Cowpeas, seed, not limed			256	
Cowpeas, seed, gain from liming			**88**	**34**
Sweet potatoes, yield bushels, limed	96.4			
Sweet potatoes, yield bushels, not limed	186.8			
Sweet potatoes, loss from liming	**90.4**	**94**		
Velvet bean hay, limed	5184		4800	
Velvet bean hay, not limed	4112		3216	
Velvet bean hay, gain from liming	**1072**	**21**	**1584**	**49**

*Bushels

On the limed plots, there was an increase of 35 per cent in the cotton crop, of 21 per cent with velvet bean hay, and of only 7 per cent with peanuts and cowpeas The very large apparent decrease on the limed plots of sweet potatoes is not understood.

The experiment on the property of the Mobile Farm Land Company, was on land recently cleared and stumped. The limed plots afforded an increase of 49 per cent with velvet bean hay, 34 per cent with cowpea seed, 29 per cent with peanuts, 10 per cent with cowpea hay, and a loss with corn and cotton.

Lime Experiments at Abbeville, Henry County.

In 1906, Prof. J. B. Espy began, in co-operation with the Alabama Experiment Station, co-operative lime experiments on the farm of the Third District Agricultural School at Abbeville, Ala., using each year 2,000 pounds of slacked lime per acre in addition to commercial fertilizer, the latter usually consisting of 400 pounds per acre of a complete fertilizer. The sandy loam soil was originally acid; slacked lime at the rate of 2,000 pounds per acre was applied annually to the same plots. The results have been as follows:

Table VI. Results of lime experiments on farm of Third District Agricultural School, Abbeville, Ala.

	1906 Increase		1907 Increase		1908 Increase		1909 Loss	
	Amt.	%	Amt.	%	Amt.	%	Amt.	%
Seed cotton, pounds	124	22	476	48	300	40	366	26
Corn, bushels	2.2	21					25	10
Soy bean hay, pounds	1210	30	2184	51	4890	120		
Sweet potatoes, bushels	3	4	21	13			15	10
Sorghum hay, pounds	1110	46						
Cowpea hay, pounds	926	31						
Peanuts, bushels			4.1	29				

In these tests cotton, corn, sorghum, sweet potatoes, soybeans, cowpeas and peanuts, were all largely increased by the use of lime except that in the fourth year, 1909, there was a decrease with all crops on the limed plots. Possibly this unfavorable effect after the application of a total of 8,000 pounds of slacked lime per acre may have been due to the exhaustion of the humus in the soil.

Results of Lime Tests in Alabama, Arranged by Crops.

The discussions below are based on results of experiments the details of which are presented in Tables I to VI. These tests were in most cases made on soils more or less acid and the usual amount of slacked lime per acre was 2,000 pounds.

Cotton	Increase, per cent.	Loss, per cent.
Auburn (neutral, sandy upland)	2	...
Tallassee (neutral, sandy loam)	5	...
Brewton, 1906 (sandy)	10	...
Brewton, 1907 (sandy)	36	...
Dothan (sandy, acid)	31	...
Daleville (sandy)	0	...
Wetumpka (acid)	129	...
Georgiana (barely acid)	11	...
Castleberry (acid)	18	...
Irvington	35	...
Mobile	...	14
Abbeville, 1906	22	...
Abbeville, 1907	48	...
Abbeville, 1908	40	...
Abbeville, 1909	...	26
Average increase	23	

In the majority of cases the crop of cotton was notably increased by the use of lime. Indeed, in every case where there was positive proof that the soil was acid there was a large increase in the cotton crop on the limed plots. The average increase in all tests, including several on neutral soil, was 23 per cent.

Corn	Increase, per cent.	Loss, per cent.
Auburn (bottom land, acid)	41	...
Auburn (bottom land, after clover)	10	...
Tallassee (neutral, sandy loam)	...	7
Brewton, 1906 (sandy), grain	8	...
Brewton, 1907 (sandy), forage	28	...
Daleville (sandy)	8	...
Wetumpka (acid)	36	...
Castleberry (acid)	13	...
Mobile	...	32
Abbeville, 1906	21	...
Abbeville, 1909	...	10
Average increase	11	

In all but three experiments the use of lime increased the crop. The average increase was 11 per cent, or less than with cotton.

Cowpeas	*Increase, per cent.*	*Loss, per cent.*
Seed; Brewton, 1906	16	...
Seed; Brewton, 1907	...	32
Seed; Wetumpka	20	...
Seed; Elba	36	...
Seed; Castleberry	4	...
Seed; Mobile	34	...
Hay; Mobile	10	...
Hay; Irvington	7	...
Hay; Abbeville	31	...
Average increase	**14**	

The increase was only 14 per cent in spite of the fact that the greater proportion of the soils where these tests were made were acid.

Peanuts	*Increase. per cent.*
Brewton, 1906 (sandy)	0
Brewton, 1907 (sandy)	22
Wetumpka (Spanish) (acid)	39
Wetumpka (N. C.) (acid)	60
Elba (sandy)	45
Georgiana (barely acid)	9
Castleberry, Davis (acid)	9
Castleberry, Green, (acid)	15
Irvington	7
Mobile	29
Abbeville	29
Average increase	**24**

In all tests except one lime increased the yield of peanuts, the average increase being 24 per cent.

The use of lime is considered especially important in the case of the running peanuts, tending to reduce the percentage of pops. It should be noted that at Wetumpka, on acid soil, the increase with the North Carolina running peanuts was 60 per cent as the result of liming.

Sweet Potatoes	*Increase, per cent.*	*Loss, per cent.*
Brewton, 1906	...	3
Brewton, 1907	...	30
Daleville, 1909	...	...
Irvington, 1911	...	94
Abbeville, 1906	4	---
Abbeville, 1907	13	---
Abbeville, 1909		10
Average loss	...	**17**

In two of these tests sweet potatoes showed a notable decrease in yield where lime was employed. In two other tests lime was practically without effect on the yield, and in only one test there was a moderate increase. Apparently, sweet potatoes are not very responsive to lime.

Velvet Bean Hay	*Increase. per cent.*
Irvington, 1911	21
Mobile, 1911	49
Average increase	**35**

This plant was notably improved by the use of lime.

German Millet Hay	*Increase. per cent.*
Wetumpka, 1909	11
Chufas	
Georgiana, 1911	0
Soy Bean	
Seed; Brewton	36
Seed: Wetumpka	71
Hay; Georgiana	42
Hay; Abbeville	46
Average increase	**49**

The yield of soybeans was in every case greatly increased by liming.

Sorghum hay	*Increase. per cent.*
Brewton, 1907	36
Wetumpka, 1907	39
Wetumpka, 1909	6
Abbeville, 1906	30
Abbeville, 1907	51
Abbeville, 1908	120
Average increase	**47**

The yield of sorghum hay was considerably increased by liming.

SUMMARY.

(1) Lime increases the yield of crops on many soils.

(2) The beneficial effects of lime may be due to any of the following:

- (a) To its correcting or neutralizing an acid condition in the soil;
- (b) To its effect in hastening the fermentation of organic matter;
- (c) To its action in making conditions in the soil more favorable for the growth of nitrogen-fixing bacteria and other beneficial bacteria;
- (d) To its indirect action in making certain mineral ingredients of the soil more available; and,
- (e) To its power of improving the texture of the soil.

(3) In Alabama there are large areas of acid soils, the exact extent of which has not been determined; however, these acid soils are especially abundant and extensive in the Southern part of the State. On most acid soils, as well as on some other soils, the use of lime generally increases the yield of most crops.

(4) Any one can determine whether his soil is acid by the simple test described on page 304.

(5) Among the plants that most need lime are alfalfa, red clover and wheat. Indeed most of the leguminous or soil improving plants are especially helped by lime; among other lime-loving plants are the cabbage, turnip, and other members of the mustard family, beets, onions, lettuce and many others.

In the lime tests made in various parts of Alabama the average increase in yield attributable to the use of lime were as follows:

Cotton	23 per cent.
Corn	11 per cent.
Cowpeas (seed and hay)	14 per cent.
Peanuts	24 per cent.
Velvet bean hay	35 per cent.
Soy beans (seed and hay)	49 per cent.
German millet hay	11 per cent.
Sorghum hay	47 per cent.
Chufas	0 per cent.
Sweet potatoes, loss	17 per cent.

(6) Alabama is rich in limestone, suitable either for burning or for crushing. Notable among these limestones

are those occurring at Calera and Anniston, and the rotten limestone, or Selma chalk, underlying the central prairie region. The latter has not been utilized commercially in agriculture. Other materials rich in lime are oyster shells and wood ashes.

(7) Slacked lime has heretofore been the form in which lime has been chiefly used in agriculture in Alabama. However, crushed limestone used in large amounts has the advantage of not causing such rapid disappearance of the organic matter of the soil.

(8) Different forms of lime are valuable in agriculture about in the proportions in which they contain calcium and magnesium oxides. Classed in this way, one ton of quick lime is theoretically equivalent to 2,680 pounds of slacked lime or 3,560 pounds of crushed limestone.

(9) When quick or builders' lime sell at $10.00 per ton delivered, farmers could just as well afford to pay about $7.60 per ton for slacked lime, or about $5.60 for crushed limestone, provided all were made from the same limestone and so prepared as to be of equal firmness. But all of these places are so high as to prohibit the general use of lime in agriculture.

(10) Methods of slacking and distributing lime are described on page 310.

(11) Lime should be applied at least several weeks before the time of planting and preferably harrowed in rather than plowed in.

(12) Do not let lime come in immediate contact with most commercial fertilizers. However, the use of lime should not cause any one to fail to apply either manure or fertilizer. Lime is not a substitute for fertilizers, but rather increases the need for fertilizers. A light application of lime is 1,000 pounds of slacked lime per acre or one ton of crushed limestone. Much larger amounts of crushed limestone may be used with entire safety. It is usually sufficient to apply any form of lime once every three or five years.

(13) At Auburn, on acid bottom land, lime increased the yield of corn; however, on neutral, sandy, upland soil, in good condition, the yield of cotton was not increased by lime.