THIRTY-FIFTH ANNUAL REPORT

Fiscal Year Ending June 30, 1924

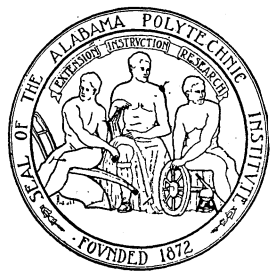
OF THE

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN



M. J. FUNCHESS, *Director*
AUBURN, ALABAMA

ALABAMA POLYTECHNIC INSTITUTE

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

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M. J. Funchess, M.S., Director of Experiment Station
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Agronomy

M. J. Funchess, M.S.	Agronomist
F. W. Parker, Ph.D.	Soils Chemist
J. T. Williamson, B.S.	Associate Agronomist
H. B. Tisdale, B.S.	Associate Plant Breeder
H. B. Helms, B.S.	Assistant in Agronomy
W. H. Appleton, B. S.	Assistant in Agronomy

Animal Industry

J. C. Grimes, M. S.	Animal Husbandman
W. H. Eaton, B.S.	Dairyman
W. D. Salmon, A.M.	Assistant Animal Husbandman

Botany and Plant Pathology

W. A. Gardner, Ph.D.	Botanist
C. C. Zeliff, M.S.	Associate Botanist
L. E. Miles, Ph.D.	Associate Plant Pathologist
Martin Palmer, B.S.	Assistant in Botany

Chemistry (Agricultural)

E. R. Miller, Ph.D.	Research Chemist
M. A. Barnes, B.S.	Assistant Research Chemist

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J. F. Duggar, M. S.	Agricultural Economist

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M. L. Nichols, M.S.	Agricultural Engineer
J. W. Randolph, M.S.	Assistant Agricultural Engineer
E. C. Easter, M.S.	Assistant Agricultural Engineer

Entomology

J. M. Robinson, M.S.	Acting Entomologist
H. G. Good, M.S.	Associate Entomologist
F. E. Guyton, M.S.	Assistant Entomologist

Horticulture

	Horticulturist
C. L. Isbell, M.S.	Associate Horticulturist
S. H. Gibbons	Assistant in Horticulture

Veterinary Science

C. A. Cary, B.S., D.V.M.	Veterinarian

CHANGES IN STATION STAFF

Appointments:

M. J. Funchess	Dean and Director of Experiment Station
J. M. Robinson	Acting Entomologist
H. G. Good	Assistant Entomologist

Resignations:

Dan T. Gray	Dean and Director of Experiment Station
W. E. Hinds	Entomologist
F. L. Thomas	Associate Entomologist
O. Brown	Assistant Horticulturist
S. H. Gibbons	Assistant Horticulturist
C. C. Zeliff	Associate Botanist
L. E. Miles	Associate Plant Pathologist

President Spright Dowell,
Auburn, Ala.

Dear Sir:

I hand you herewith the Thirty-fifth Annual Report of the Agricultural Experiment Station of the Alabama Polytechnic Institute. This report covers the work of the Experiment Station for the fiscal year ending June 30, 1924.

Yours very truly,

M. J. FUNCHESS,
Dean and Director.

Gov. W. W. Brandon,
State Capitol Building,
Montgomery, Alabama.

Dear Sir:

In accordance with Federal and state laws pertaining thereto, I hand you herewith the Thirty-fifth Annual Report of the Alabama Agricultural Experiment Station of the Alabama Polytechnic Institute.

Respectfully,

SPRIGHT DOWELL,
President.

NEW PUBLICATIONS

A Simple Mineral Mixture for Fattening Pigs, J. C. GRIMES AND W. D. SALMON (Alabama Station Bulletin 222)—This bulletin gives the results of two experiments to determine the value of adding a simple mineral mixture to a ration of corn and peanut meal. Very valuable results were obtained from the addition of the minerals.

Peanuts for Fattening Hogs in the Dry Lot, J. C. GRIMES AND W. D. SALMON (Alabama Station Bulletin 223)—The results of three experiments, comparing a ration of peanuts and mineral with the same ration to which had been added either corn, tankage, or a combination of corn and tankage, are reported. The results indicate that for hogs weighing 100 pounds or more the addition of corn or tankage alone or in combination is not an economical practice.

Life History and Control of the Mexican Bean Beetle (Epilachna corrupta), F. L. THOMAS (Alabama Agr. Exp. Sta. Bul. 221, 1924).—This bulletin takes up the life history of the insect. There were four generations in 1923. The number of days for each generation varied from 28 to 34 days.

Natural enemies of the beetle were found to be *Stiretrus anchorage Fab* and *Megilla maculata D. G.* Temperatures above 100° F. and strong winds are effective in reducing the number of larvae on the bean foliage. Artificial control can be obtained by mixing thoroughly one part of calcium arsenate, one part of fine dusting sulphur and four parts of hydrated lime. Apply this mixture on the under side of the dry foliage on a still day.

CONTRIBUTIONS TO SCIENTIFIC JOURNALS AND PERIODICALS

PARKER, F. W., AND TIDMORE, J. W. *A Modification of the Truog Soil Acidity Test. Soil Science* 16:75-78.—The Truog test was modified to give a quantitative measure of the hydrogen sulfide evolved. The modified test is useful in investigational work and is not intended for general use.

PARKER, F. W. *Carbon Dioxide Production of Plant Roots as a Factor in the Feeding Power of Plants. Soil Science* 17:229-247.—Four experiments were made to determine the relation between carbon dioxide production of plant roots and the feeding power of plants. Corn, cowpeas, soybeans, velvet beans, sorghum, and buckwheat were the crops studied. No relation was found between carbon dioxide production and the feeding power of plants for calcium, magnesium, phosphorus, or potassium.

NICHOLS, M. L. *An Analysis of Soil Dynamics Factors Affecting the Operation of Tillage and Tractor Machinery. American Society of Agricultural Engineers XVII;* 174-184.—Review of investigations conducted along Soil Dynamics lines by various stations and manufacturers with recommendations for further study and standardizations of methods.

AGRONOMY

Rotation Experiments. (M. J. Funchess and H. B. Tisdale). —Two rotation experiments are being conducted at the present time. The Old Rotation experiment was started in 1896. The outstanding points shown by the data obtained are: (1) the decline in cotton or corn yields on the plots continuously planted to corn and cotton; (2) the maintenance of cotton yields on plots that are in a two or three-year rotation that includes legumes.

The Cullars rotation was started in 1911 for the purpose of studying the relative value of rock and acid phosphate in a three year rotation. The rotation includes several leguminous crops that are turned under for the three major crops—cotton, corn, and oats. Rock phosphate is now giving about as good results as acid phosphate for corn and oats but not as good for cotton. The evidence, however, is conclusive that rock phosphate may be used to advantage provided a good cropping system is followed.

Three additional treatments were started in 1914 to study the value of legumes in the rotation. The results show that a large part of the nitrogen needed by cotton, corn, and oats may be supplied by working legumes into the rotation.

Acid vs. Rock Phosphate for Cotton. (M. J. Funchess and H. B. Tisdale).—The plots devoted to a study of the relative value of rock and acid phosphate have been under observation for twelve years. Six hundred and forty pounds of each phosphate has been applied each year. There are nine plots in the experiment, four receive acid phosphate, three receive rock phosphate, and two do not receive phosphate. The average yields of seed cotton for the last two years are as follows: acid phosphate 883 pounds, rock phosphate 888 pounds, no phosphate 597 pounds.

Subsoiling Experiments. (M. J. Funchess and H. B. Tisdale).—Recent data obtained in the subsoiling experiment are given in Table 2. This experiment has been in progress about twenty years. All results are in accord with the data given and show that subsoiling did not increase the yield of crops. The experiment has been discontinued.

Table 2

Subsoiling Experiments

	1920		1921		Average	
Crop	Subsoiled	Not Subsoiled	Subsoiled	Not Subsoiled	Subsoiled	Not Subsoiled
Cotton, lbs	840	785	710	762	775	773
Corn, bus.	18.4	22.7	13.0	16.9	15.7	19.8
Peas	4.1	4.8	8.8	5.4	6.4	5.1

Kudzu for Hay. (M. J. Funchess and H. B. Tisdale).—A small area has been in kudzu for a number of years. During the past three years part of the area has been cut for hay and the yields recorded in Table 3 were obtained. It is evident that the

crop may be very valuable as a hay crop or as a soiling crop. The most serious disadvantage of the crop is the difficulty of cutting and handling the hay.

Table 3
Yields of Kudzu Hay

Cut once in 1920	5114 pounds hay
Cut twice in 1921	5410 pounds hay
Cut twice in 1922	5240 pounds hay
Cut twice in 1923	5665 pounds hay

Silage Crops. (H. B. Tisdale).—Corn and sorghum have been compared for the past three years as silage crops. The results show that some of the larger-growing sorghums will make more than double the tonnage made by corn. As a three-year average, Texas Seeded Ribbon cane gave a yield of 22,008 pounds per acre while corn gave a two-year average yield of only 10,738 pounds.

Peanut Spacing Test. (M. J. Funchess and H. B. Tisdale).—Experiments have been conducted for a period of five years to determine the influence of spacing on the yield of peanuts. Table 4 gives the results for the last year of the test together with the average results for the five year period.

Table 4
Spacing Experiment with Peanuts

Spacing	1921	Five-Year Average
18 inches x 4 inches	62.0	59.5
24 inches x 4 inches	57.9	52.7
30 inches x 4 inches	49.6	43.6
36 inches x 4 inches	40.4	43.3
18 inches x 8 inches	41.2	44.1
24 inches x 8 inches	49.5	39.0
30 inches x 8 inches	40.1	38.2
36 inches x 8 inches	33.0	27.1
18 inches x 12 inches	46.8	47.9
24 inches x 12 inches	41.1	38.6
30 inches x 12 inches	36.0	33.4
36 inches x 12 inches	40.6	27.1

Summarizing all of the above data, and combining certain plots, the following table shows the results compared on the basis of yield per acre when each plant has a given number of square inches of space.

Table 5

Square Inch Space Per Plant	Bus. Per Acre	Square Inch Space Per Plant	Bus. Per Acre
72	59.5	216	47.9
96	52.7	240	38.2
120	43.6	288	32.8
144	43.7	360	33.4
192	39.0	432	27.1

These results show conclusively that Spanish peanuts must be planted thick for large yields. The extremes are 59.5 bushels for a spacing of 18 x 4 inches, and 27.1 bushels for a spacing of 36 x 12 inches, a spacing that is used frequently in farm practice.

Varieties of Small Grain. (H. B. Tisdale).—Oat variety tests conducted the past several years show that the earlier varieties usually are the highest yielding varieties. Fulghum, Red Rust Proof (fall strain), and Red Rust Proof 1007 have been among the leading varieties in recent tests.

Wheat variety tests show that Alabama Blue Stem is very much better for our conditions that any other variety. As a three year average it gave a yield of 16.3 bushels as compared with 10.9 bushels for the second best variety.

Abruzzi rye and a local variety, known as Tuscaloosa, are the two best varieties of rye according to the results of experiments made during the past three years.

Fall vs. Spring Planted Oats. (H. B. Tisdale).—For many years a comparison has been made of fall and spring planted oats. As an average of 19 years the fall planted oats have yielded 37.8 bushels as compared with 15.9 bushels when spring planted. The test is being continued since it appears that a wide difference has developed in the same variety of oats continuously fall-planted as compared with the continuously spring-planted.

Soil Acidity Methods.—(F. W. Parker and J. W. Tidmore).—The Truog soil acidity test has been modified for use in research work. The modification consists of absorbing the hydrogen sulfide evolved in a test in dilute ammonia. An excess of standard iodine solution is added, the solution acidified and the excess iodine is titrated with standard sodium thiosulfate of the same normality. The results of the test are recorded as milligrams of hydrogen sulfide evolved.

The strength of the acids in twenty-five soils was determined by the Truog avidity method, the sugar inversion method, and by the hydrogen-ion concentration. The last two methods were modified so that the same amount of acid was used in the determination for all soils. The results of the three methods correlate well and this is considered as an indication that the hydrogen-ion concentration of the soil solution is largely determined by the acidity of the acid silicates of the soil.

A study was made of the relative importance of the strength and amount of soil acids as factors influencing the Truog soil acidity test. The amount of acid was determined by Truog's method for "active acidity." The strength of the acids was determined by the Truog acidity method. An excellent correlation, 909-.025, was found between the results of the modified Truog test and the relative acidity of the twenty-five soils determined by multiplying the amount of acids by the strength of the acids.

An experiment was made to determine the effect of the presence of different amounts of soil on the rate of sugar inversion when the specific resistance and hydrogen-ion concentration of

the soil suspensions were constant. The presence of the acid soil greatly increased the rate of sugar hydrolysis as is shown by the data in Table 6.

TABLE 6

The Sugar Hydrolysis Velocity Constant, Hydrogen-ion Concentration, and Specific Resistance of Soil Suspensions Having Different Soil-soil Solution Ratios.

Quantity of Soil per 100 cc. of soil solution	Hydrogen-ion concentration	Specific resistance	Sugar inverted	Velocity constant K
gm.	pH	ohms	gm.	
None	4.0	650	0.189	0.0003207
0.25	4.0	694	0.299	0.0005231
0.50	4.0	710	0.357	0.0006159
1.00	4.0	701	0.438	0.0008454
2.00	4.0	720	0.625	0.0011068
4.00	4.0	717	0.770	0.0013918
8.00	4.0	701	0.990	0.0018361
16.00	4.0	710	1.143	0.0021602
32.00	4.0	694	1.219	0.0023265
128.00	4.0	650	1.390	0.0027110

The explanation of the influence of the solid phase is not known. It may be due to a higher concentration of hydrogen-ions at the surface of the soil particles than in the solution.

Carbon Dioxide Production of Plant Roots as a Factor in the Feeding Power of Plants. (F. W. Parker).—Four experiments were conducted in which a study was made of the relation between the carbon dioxide production of plant roots and the feeding power of the plant. In the experiments 1 and 2 carbon dioxide production was studied by determining the influence of the crop on the carbon dioxide content of the soil air at intervals during the growing period. The feeding power of the plants was studied by determining the composition of the plants and also by considering the total amount of the different elements absorbed.

In the second experiment a study was made of the effect of continuous aspiration of the cultures on the feeding power of the plants as indicated by their composition. Aspiration was continuous during the growing period and was at the rate of about twenty-five liters per hour. In this manner the carbon dioxide content of the air was reduced to 0.20 per cent or less.

The total amount of carbon dioxide excreted from the plant roots was determined in the third experiment. After determining the amount of absorption, the amount of the different elements absorbed per gram of carbon dioxide excreted was calculated for sorghum, cowpeas, buckwheat and soybeans.

In the last experiment absorption from a nutrient solution was determined.

A summary of the results obtained in these experiments follows:

More carbon dioxide was excreted from the roots of cowpeas than from the roots of any other plant used in the experiments.

Buckwheat roots gave off very little carbon dioxide.

Sorghum, soybeans and cotton are very similar in carbon dioxide production, producing much more carbn dioxide than buckwheat.

Buckwheat has the greatest feeding power of any of the plants used in the experiments. Cotton ranks second in feeding power of all the plants used.

No relation was found between carbon dioxide production and the feeding power of the plants for calcium, magnesium, phosphorus, or potassium in a rather poor sandy soil.

The removal of carbon dioxide by continuous, rapid aspiration did not influence the composition of the plants.

Different plants absorb widely different amounts of calcium, magnesium, and phosphorus per gram of carbon dioxide excreted from the plant roots. For each gram of carbon dioxide excreted by the roots, buckwheat absorbed 41.5 mgm. of calcium; sorghum, cowpeas, and soybeans absorbed 5.0, 12.7, and 21.2 mgm., respectively.

Cowpeas, velvet beans, and sorghum grown in sand cultures absorbed different amounts of calcium, magnesium, and nitrogen. The legumes contained much higher percentages of these elements than did the sorghum.

ANIMAL INDUSTRY

Minerals For Dairy Heifers. (W. D. Salmon, W. H. Eaton).—The experiment to determine the effect of feeding bone meal to dairy heifers has been continued. At the end of the first 17 months the group that received the bone meal had made an average gain per animal of 371 pounds compared with 330 pounds per animal in the group that did not receive bone meal. Whether this difference can be considered significant or not will depend on the confirmation of the results by the offspring of the experimental animals.

There were no significant differences in measurements of the two groups.

Minerals In The Dairy Ration. (W. D. Salmon, W. H. Eaton).—This experiment was begun in June 1923. The purpose was to determine the practical value of adding mineral supplements to good milk producing rations. Due to the small number of cows available for the study it will be several years before a report can be made on the results.

Peanut Meal With Supplementary Feeds For Hogs. (W. D. Salmon).—This is a continuation of the cooperative soft pork project. The object of the test this year was to determine the effect of various mineral supplements on the rate and economy of gain and on the quality of pork. The basal ration which con-

sisted of 5 parts of ground corn and 1 part of high grade peanut meal was the same for all lots. The only difference in the rations of the various lots was in the mineral supplements used. Table 1 shows a summary of the feeding data. All feeds were self-fed.

Table 1
Mineral Supplements For Hogs

	Lot 1 No mineral	Lot 2 Charcoal 1 Lb. Marble dust 1 Lb. Salt 1 Lb Free-access	Lot 3 Marble dust 2 Lbs. Acid phosphate 1 Lb. Salt 1 Lb. Free-access	Lot 4 Marble dust 2 Lbs. Bone meal 1 Lb. Salt 1 Lb. Free-access	Lot 5 Marble dust 2 Lbs. Bone meal 2 Lbs. Salt 1 Lb. Tankage 1 Lb. Free-access
No. Hogs in Lot	12	12	12	12	12
No. days fed	68	68	68	68	68
Average initial weight, lbs.	78.5	79.6	78.6	78.5	78.9
Average daily gain, lbs.	1.07	1.79	1.68	1.70	1.71
Feed for 100 lbs. gain					
Corn, lbs.	317	285.8	289.0	279.0	283.9
Peanut Meal, lbs.	63.4	57.1	57.0	56.0	56.8
Mineral Mixture, lbs.	—	8.7	7.3	5.5	7.4
Total	380.4	351.6	354.1	341.4	348.1

The 4 lots that received a mineral supplement made an average of 60.7 per cent larger gains and required 8.2 per cent less feed for a unit of gain than the lot which did not receive a mineral supplement. There were no marked differences in the effects of the various mineral mixtures. The acid phosphate mixture seemed to be slightly less efficient than the other mixtures but the difference could hardly be considered significant. The carcasses were of about the same firmness as would have been obtained from corn and tankage feeding. All the hogs that weighed 200 pounds or more at slaughter were commercially hard. The minerals affected the quality of the carcasses only indirectly through their influence on the finish carried by the hogs.

The Influence of Mineral Matter Upon Growth and Reproduction. (W. D. Salmon).—White rats made very little growth on a diet of 2 parts of yellow corn and 1 part of peanut meal. Another group of rats that received the same diet to which had been added 1 per cent of common salt made slight gains for 2 or 3 months. After this the females maintained approximately their weight and the males declined in weight. The rats in both groups developed beading of the ribs which is associated with a rachitic condition.

When calcium carbonate, or bone meal, was added in addition to the common salt the diet supported normal growth. When acid phosphate was used the rate of growth was slightly below normal.

None of the females on the basal diet or on the basal diet plus salt littered young. When salt and bone meal were added

large litters of young were raised successfully. Reproduction continued to the fourth generation on this diet. When salt and calcium carbonate were added the second generation was reared successfully but the third generation was a failure. When salt and acid phosphate were added to the basal diet none of the young was raised to maturity. The females littered fairly regularly but the young were weak, low in vitality, and usually died within a few days after birth.

Vitamin B In The Velvet Bean. (W. D. Salmon, E. R. Miller).—Tests with rats and pigeons have shown that the seed of the velvet bean contains vitamin B. The tests on pigeons indicate that the bean contains nearly as much of the antineuritic substance as is found in other common seeds. The velvet bean has a harmful effect, however, and rats cannot make normal growth when the bean is used as the sole source of vitamin B. Cooking or autoclaving the beans greatly lessens but does not entirely overcome their harmful effect.

Vitamins In The Pecan Nut. (W. D. Salmon, Clare W. Livingston).—The pecan nut was found to contain appreciable amounts of vitamin A. The nut also contains considerable vitamin B but our experiments indicate that it is not as rich a source of this factor as had been reported previously by Cajori. The fact that our rats did not have access to their excreta might have caused the difference in results. We have not yet been able to determine whether vitamin C is present or not.

BOTANY

Soil Toxin Investigations. (W. A. Gardner).—The addition of calcium sulphate improves Robbins' solution for the growth of soil organisms. Solutions but slightly acid to phenolphthalein yield the most abundant growth of a majority of soil organisms. Seven toxins have been added to the list of those decomposed by soil organisms,—namely, resorcinol, cinnamic acid, quinone, hydroquinone, caffein, piperidine, and benzidine.

Physiology Of Sweet Potatoes. (W. A. Gardner).—There was a marked decrease in percentage of moisture during the latter stages of growth of Porto Rico sweet potatoes. The starch content nearly doubled between August 16th and October 25th. The sucrose in Porto Rico sweet potatoes increased sixfold during the same period.

The harvesting and curing resulted in a decrease in percentage of water and corresponding increase in sugars and starches. While the reducing sugar is never present in large amounts, it more than doubled during the month following harvesting. Once the potatoes have been cured there is very little fluctuation in the percentage of reducing sugar.

The sucrose in sweet potatoes cured after harvest gradually increased from 3.3 per cent October 17, to 6.4 per cent February 21. The percentage of sucrose of sweet potatoes stored

without curing increased quite rapidly for the first week, then more slowly, and gradually decreased until February 21. A slight increase occurred from February 21 to March 20. The sucrose of the potatoes whether cured or not cured, but stored in the bank gradually increased from 2.7 per cent at harvest time to more than 8 per cent February 21, and then decreased to slightly less than 8 per cent by March 20. Under most conditions of storage a change in starch is accompanied by a reciprocal change in sucrose content. Similar results were obtained with Triumph sweet potatoes.

The results of the year's work indicate that during the maturation period of sweet potatoes the percentage of sugar and starch increases but the percentage of moisture decreases. Immediately after harvesting—whether cured or not—the potatoes lose moisture, and the percentage of sugar and starch increases. The rate of increase depends upon the conditions of storage.

Decomposition Of Chlorophyll. (W. A. Gardner).—Results obtained during the past year indicate that acetylene as well as ethylene can be substituted for motor exhaust, and that the hydrocarbon is accessory to the decomposition of the chlorophyll in the coloring of satsuma oranges. Nitrogen and carbon dioxide were entirely ineffective in the destruction of the green pigment.

AGRICULTURAL CHEMISTRY

The Enzymes Of The Velvet Bean. An Insoluble Tyrosinase. (Emerson R. Miller).—When velvet bean seed are finely powdered and mixed with water a pink colored substance is formed very quickly—sometimes within half a minute. This color passes through several shades of red and brown and finally becomes black.

If the seed coats are completely removed and the powdered interiors mixed with water no coloration occurs for a very long time. Neither do the seed coats when mixed alone with water show any color formations; but the interior of any variety of velvet bean when mixed with water in the presence of some seed coat of the same or of any other variety shows this color formation. However, the reaction is much slower when the seed coats of the black Tracy variety are used.

Aqueous solutions obtained by extracting velvet bean interiors with water and aqueous solutions of a white powder obtained from velvet beans by extraction with strong alcohol show practically the same behavior in the presence of velvet bean seed coat. Tyrosine also shows about the same behavior.

Aqueous solution prepared from Irish potatoes and from the petals of *Magnolia grandiflora* very quickly produce this color formation with velvet bean interiors. The tyrosinase from these sources, however, must be different from that of the velvet bean seed coat, since the latter can not be removed from the velvet bean seed coats by triturating with clean sand in the presence of

water, dilute gylcerin, dilute alcohol, or dilute salt solution, either at ordinary temperature or at slightly elevated temperature.

When seed coats were treated in water in a boiling water bath for 15 minutes and then mixed with bean interiors in the presence of water no color appeared within ten minutes.

Heating the dry coats to 105° C. for two hours retarded the formation of color but did not render them inactive.

Velvet Bean Rations For Brood Sows. (Emerson R. Miller, W. D. Salmon).—In previous reports we have shown that brood sows on a ration of velvet beans alone or velvet beans supplemented by the addition of sodium chloride and calcium carbonate farrowed undersized pigs of low vitality and generally had little or no milk. With such a ration the pigs, as a rule, were all dead within a few days.

Two sows which twice failed to raise pigs on a velvet bean ration were changed to a normal ration with good results in both cases.

When sows were fed for the first 100 days on a ration of velvet beans with the addition of mineral matter and then changed to a normal ration pigs somewhat below the average were raised. When the period of feeding the velvet beans was reduced to 75 days the results were much better. The addition of alfalfa meal to the ration fed for the first 75 days showed no improvement.

This year the ration of velvet beans and mineral matter has been supplemented by the addition of cod-liver oil and yeast. With the addition of cod-liver oil alone to the ration a slight improvement was noticed, but the sow was not able to raise the pigs. The addition of both cod-liver oil and yeast produced a marked improvement. Of a litter of ten the sow raised six pigs which averaged 20.6 lbs. at the age of eight weeks.

With a ration composed of velvet beans 45 per cent, corn 50 per cent and tankage 5 per cent, with access to a simple mineral mixture, apparently normal litters were farrowed but the pigs did not develop well.

Fair results were obtained with a ration consisting of 25 per cent of velvet beans and 75 per cent of a mixture composed of corn, shorts, tankage, alfalfa meal, and mineral matter.

Velvet Beans In The Ration For Pigs. (Emerson R. Miller, W. D. Salmon).—Continuing the experiments in the feeding of velvet beans we found that the use of 25 per cent of raw velvet beans in the ration for weanling pigs was very unsatisfactory. As a rule, the pigs barely maintained their weight on this ration. The limiting factor seems to be the unpalatability of the ration. By the use of a 25 per cent cooked velvet bean ration there was marked improvement.

AGRICULTURAL ENGINEERING

A Study Of The Fundamental Factors Influencing The Traction Of Wheel Tractors. (J. W. Randolph and M. L. Nichols).—At the request of the Gulf Coast Horticultural Society, work was started to find the best lug equipment for tractors in sandy soils of the southern part of Alabama.

Preliminary study of tractors in the field and factors entering into traction of wheel tractor indicated that the problem of traction could be studied best one factor at a time. Testing equipment and methods were developed having a direct relation to the tractor's driving wheels and lugs. The lug and wheel testing equipment consisted essentially of a wheel mounted so that the input, output, weight, and various other factors could be measured accurately by means of calibrated scales. The following factors of the tractor could be varied at will: weight of wheel, width of rim, and size, shape, etc., of lug.

It was found that the factors influencing traction had the following order of importance in Norfolk sand: The weight upon the wheel, the depth of lug, width of lug, and the angle of lug across the rim.

All known methods of measuring force distribution in the soil were tried but none found satisfactory. A new method of measuring soil stresses was devised which is called the Plaster Cast Method. This method consists of arranging the soil to be tested in a box in layers, separated by thin sheets of fragile paper. A wheel and lug were tested on this soil through any desired distance. With the wheel removed the distortions of the sheets of paper were studied and cast in plaster of Paris for future study. A report of this method is given in the *Journal of American Society of Agricultural Engineers,* Trans. 6 (1925) pp. 134-135.

ENTOMOLOGY

Belted Bean Beetle, *Diabrotica balteata.* (J. M. Robinson).—This insect has long been known in Mexico as doing damage to beans, cotton, and various cucurbitaceous plants. It was recorded as doing damage to beans, okra, and cucumbers in various places in Texas in 1905. In Alabama *Diabrotica balteata* has become established as far north as Tallapoosa County and is rather evenly distributed over the counties south of Lee and Perry. Damage by *Diabrotica balteata* was reported during the months of July, August, September, and October in the years of 1922 and 1923. The low temperature in the winter of 1923 seemed to reduce the abundance of this insect in 1924. The belted bean beetle has been observed feeding on the following plants in Alabama: bunch beans, cabbage, okra, cotton, vetch, and onions.

Pecan Weevil, *Balaninus caryae, Horn.* (Henry G. Good).—When soil containing the pecan weevil larvae is treated with

calcium cyanide all the larvae are killed. However, this treatment is also detrimental to trees, causing the leaves to turn brown and drop off when the calcium cyanide is used in too large quantities and put too close to the trees. From hibernation cages, in which 50 larvae were put in sandy loam and 50 in clay pots, 13 of the larvae were found in the former, 10 being alive and 3 dead. In the clay soil 7 were found, 3 of which were alive and 4 dead. During the examination for the weevils in the clay pots the adults were found about 4 inches below the surface of the soil, while in the sandy loam they were between 5 and 6 inches from the top.

Cotton Aphis, *Aphis gossypii.* (Henry G. Good).—Tests were made on the productivity of aphids. This test was started on September 1, 1924 and carried through to November 15. During this time 7 young was the maximum produced by any one aphid in a day, occurring on September 22 when the temperature was 90. The increase in the temperature plays a very important part in productivity.

Cattle Lice Control. (F. E. Guyton).—An attempt was made to control the common chewing and sucking lice of cattle with sodium fluoride. There was one species of chewing louse (*Trichodectes scalaris*) and two species of sucking lice—the long-nosed ox louse (*Linognathus vituli*) and the short-nosed ox louse (*Haematopinus eurysternus*). They were found principally on the head, neck, and shoulders of the cattle.

Infested portions of the cattle were rubbed with sodium fluoride on a clear day to prevent washing off by rain. It took approximately one ounce per animal, herd run, for the applications. This material cost 25c per pound, making the treatment cost less than two cents per animal. This material gave practically 100 per cent control of all species of lice treated.

Satsuma Disinfestation and Cleaning. (W. E. Hinds, J. E. Buck).—The purpose of this project was to find the best method of removing infestations on satsuma fruits. Hot water tests indicated that a temperature of 135 degrees fahrenheit would kill all insects on the satsumas if kept in the solution more than one minute. The satsumas could be subjected to the 135°F. two minutes without injury to the color and keeping quality of the fruit. When satsumas were kept in water at 140°F. for more than one minute the color and keeping quality of the fruit was seriously affected. Sooty mold was completely removed from satsumas by dipping them in a caustic soda solution from 15 to 30 seconds. The solution should be at a strength of one ounce per gallon of water and at a temperature varying from 125 to 135 degrees F. The treated fruit should be rinsed immediately in fresh water after the treatment, at the same temperature and for a longer time. This treatment completely removes the sooty mold.

Apple Variety Test. (C. L. Isbell).—The trees in this orchard were set in 1898. There were from one to four trees of each of fifteen varieties, including varieties native to the South, varieties commonly grown in other apple sections of the United States, and foreign varieties being introduced into America.

General observations to date warrant the following statements concerning the various varieties:

The Early Harvest when mature is a small tree. It produces heavy crops of light-colored to yellow fruit, which is medium in size, mildly subacid, and of good quality for a very early ripening variety. The fruit ripens over a short period.

The tree of the Red Astrachan when mature is medium in size. It produces heavy crops of brightly striped fruit that is medium in size and quite acid. The fruit begins to ripen very early in summer. However, some of it does not ripen for several weeks, which means that this variety furnishes apples over a long period.

The Beitingheimer is a foreign variety which when mature is a large tree that produces very large light-striped very acid fruit that ripens over a short period during midsummer.

The tree of the Fanny variety when mature is medium in size. It produces a medium to large light-colored fruit with good quality which ripens over a long period during midsummer. In some apple districts this variety is not grown because it is a poor bearer, but at Auburn it has proved very productive.

The Hackworth is native to the South—probably to Alabama. The tree when mature is medium in size and has a characteristic upright growth with a compact head. It produces a bright-colored fruit medium in size with a peculiar, pleasing flavor. The ripening period extends from the last of June to the first of September. The tree and fruit are remarkably resistant to injurious insects and diseases.

The Hanes tree is medium to large at maturity. It has produced light crops of medium to large brightly striped fruit that watercores, does not hang on the tree until well ripe, and is low in quality.

The Maiden Blush tree at maturity is medium in size. It produces heavy crops of light yellow fruit of medium size which ripen in midsummer. The fruit has proved to be low in quality and very susceptible to disease.

The Pasman, a foreign variety, is a slow grower, but at maturity is a large well formed tree. It is a biannual bearer of very heavy crops of medium to large light or yellow fruit of good quality. The fruit matures in August. The tree and fruit of this variety are remarkably free from injurious insects and diseases.

The variety Texas or Carters Blue, native to the South, is at

maturity a small tree. It produces light crops of large pale striped fruit which ripen in late summer. The fruit hang on the tree well and develop good quality.

The striped Ben Davis produces a medium to large tree noticeably susceptible to scale. It yields fair crops of medium to large light-striped apples of poor quality, which ripen in early fall and keep well in common storage.

The Jonathan at maturity is a semi-dwarf tree. It has proved to be susceptible to twig blight, and is a heavy bearer of high quality which russets badly when sprayed often enough to prevent injury from insects and diseases. The fruit ripen in early fall and, though it tends to shrivel considerably, it keeps well in common storage.

The Keskemet is another of the foreign varieties which is a large tree at maturity. It produces heavy crops of medium to large fruits with poor color and quality. The fruit ripen late and store well. The quality improves in common storage.

The Mangum variety is supposed to be of Southern origin. At maturity the tree is medium in size with many small slender branches forming a compact head. It produces medium crops of small poorly-colored fruit of high quality which ripen in the early fall and keep well in common storage. The blossoms on this variety open so late in the spring that they are not likely to be killed by spring frost.

The Yellow English, a foreign variety, produces a tree which is almost a dwarf at maturity. It yields heavy crops of small to very small poorly colored fruit with fair to good quality. The fruit ripen in late fall and is an excellent keeper in common storage.

Pecan Variety Test. (C. L. Isbell).—This test was started in 1914. The varieties included were Centennial, Columbian, Delmas, Frotscher, Pabst, Russel, Schley, Stuart, Success, Tesche and VanDeman. The planting also contained an unknown variety or seedling which is probably the variety now known as the Brooks. The variety Sawyer was added to the test about 1920.

Comparisons have been made with the varieties as to their relative rate of tree growth, the quantity of nuts produced, and their relative susceptibility to injury from diseases and insects.

All varieties have made a fair amount of growth, but the Delmas has been outstanding in that it has grown much faster than any of the other varieties. The Delmas has led also in the quantity of nuts produced. Centennial, Columbian, and Russell have either failed to produce nuts or have been very low yielders. All other varieties have given fair to good yields.

The only variety that has been damaged by the pecan's worst disease (scab) is the Delmas.

Examination of nuts during harvest of 1923 showed that the Success had the highest infestation of shuck worm, with Schley and Stuart about equally infested next to Success. Schley nuts appeared to be damaged most by pecan weevils. The nearness

of the Schley trees to a hickory grove may account for the apparent preference of the weevil for the Schley rather than for the Stuart, which nut it is generally believed to prefer.

Pecan scab was controlled on the Delmas by use of Bordeaux mixture. The application of Bordeaux was made after catkins and foliage appeared, but before pistillate flowers became receptive, without any apparent damage to pistillate blossoms.

Pecans:- Studies in Fruit Bud Formation and the Growing Habits Associated With It. (C. L. Isbell).—This project has been continued from last year, and the following observations have been made:

Catkins are formed in buds on primary or first growth shoots early in the growing season, and in those on second growth shoots soon after they appear.

If a shoot makes a second growth most of the catkins and practically all of the pistillate blossoms appearing the following spring will be out of buds on the second growth.

The production of a second growth shoot or shoots may influence the weight of nuts on the shoot from which the second growth arises.

Practically all new growth on most varieties is out of subterminal buds.

Some varieties not only drop the terminal bud before or during the dormant season but may drop a part or all of the buds at any given node, and other buds will appear later out of which future growth occurs. (Examples: Success and Pabst).

Due to increase in size the number of buds at a given node may appear to increase on some varieties during the time when there are no leaves on the tree. The Stuart is an example.

The most apical bud at a given node may be removed and the subsequent bud at that node may take its place so far as functioning goes, even to fruiting. Preliminary disbudding as late as just before growth starts in the spring indicates that this cannot be carried to the second subsequent bud in case of young Stuart trees.

The apical bud and its adjacent bud at a given node may both give rise to a fruiting shoot the same year. This is not the rule, however.

Different varieties fruit on more or less definite shoot lengths.

In general long shoots that fruit produce more nuts per cluster than short shoots.

Vegetative growth as well as fruiting may be shifted by pruning from the more terminal nodes to more basal ones on a given shoot.

Preliminary observation indicated that ringing may influence fruit bud formation.

Technical examination of buds indicates that the pistillate flowers are formed in late winter or early spring.