PROCEEDINGS

ANNUAL STAFF CONFERENCE

January 1-2-3, 1953

for 1952

CULTURAL EXPERIMENT STATION
Alabama Polytechnic Institute, Auburn, Ala.
E. V. SMITH, Director

Alabama Agricultural Experiment Station, Auburn.

FOREWORD

The Agricultural Experiment Station of the Alabama Polytechnic Institute consists of the Main Station at Auburn and 23 outlying units. Staff members reside at 19 of these outlying units. The size and complexity of the agricultural research program make it necessary for the staff to spend two or three days together each year to review and discuss existing research projects and to make plans for needed changes in the program.

In 1951 the formal discussions that were presented at the Annual Staff Conference were reproduced and made available to staff members, to cooperators in the United States Department of Agriculture, to the state staff of the Extension Service, to the state office of the Soil Conservation Service, and to the District Supervisors of Vocational Agriculture. The same practice is being followed for the proceedings of the 1952 Staff Conference.

The following statement was prepared by Dean E. V. Smith as a part of the 1951 Proceedings. The statement applies equally well to the papers presented here.

"Of our staff and of our friends who receive copies of the Proceedings, we make only one request. Please remember that the various papers are not necessarily the published results of accomplished research; sometimes they are simply progress reports, and further experimentation may result in other conclusions; sometimes they are statements of problems in need of future investigations. Let us use the Proceedings carefully."

C O N T E N T S

PROCEEDINGS

Annual Staff Conference

Agricultural Experiment Station
of the
Alabama Polytechnic Institute

January 1-3, 1953

REPRODUCTIVE DISORDERS in DAIRY CATTLE .... William Hansel,
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How the Problem is Being Studied

The sterility problem in dairy cattle has become so acute in the past few years that many states and the U. S. Department of Agriculture have found it necessary to set up research programs to find and solve the major causes of sterility.

In 1946 the United States Congress passed the Research and Marketing Act providing funds for cooperative research on a regional basis. It was decided that the most urgent animal husbandry problem in the Northeastern region was the problem of sterility. Accordingly, a Technical Advisory Committee consisting of a representative of each state in the region was set up to coordinate this cooperative research. South Carolina and the Ontario Veterinary College, Canada have also become associated with this work.

Sterility is a complex problem, and it is being approached from the following aspects: (1) the role of nutrition in infertility (2) the role of inheritance in breeding difficulties (3) endocrine imbalances and sterility and (4) diseases contributing to sterility. Such an approach calls for the cooperative efforts of nutritionists, physiologists, geneticists, pathologists and biochemists.

The cooperative work being done on the sterility problem in the Northeast has recently been outlined by Asdell (1).

In the field of nutrition as it relates to sterility long time experiments are underway at Cornell and Pennsylvania State College to determine the effects of calfhood nutrition on lifetime reproductive and productive performance. The effect of trace mineral deficiencies on reproduction is being studied at New Hampshire, and Rhode Island is studying the effect of other mineral deficiencies. Field studies on the blood levels of various nutrients in fertile and infertile cows are being carried out in New York State with the aid of a mobile laboratory.

In the field of genetics the repeatability and heritability of various measures of breeding efficiency, such as the services required per conception, and the length of the calving interval are being determined in studies at New Jersey, Connecticut, Maryland, New York and the Bureau of Dairy Industry, United States Department of Agriculture. Work is underway at the University of Connecticut to develop a formula that can be used as a measure of a cow's lifetime breeding efficiency.

In the field of physiology attempts are being made to measure the levels of the ovarian hormones in the blood and urine of fertile and infertile cows at the Bureau of Dairy Industry, U. S. Dept. of Agriculture and at Cornell. The urinary ketosteroids are being studied at New Jersey. The factors controlling ovulation in the cow are being investigated at Cornell and South Carolina.

The disease aspects of sterility are tremendously important. Vibrio fetus infection as a cause of sterility is being intensively investigated at Connecticut and Cornell. The relationship of granular vaginitis, or vulvitis to infertility is being studied at Rhode Island and West Virginia.

This brief outline of the nature and scope of the work being conducted in the Northeast serves to emphasize the complexity of the sterility problem. Nevertheless, the results obtained to date indicate that considerable progress can be made in improving the breeding efficiency of the average dairyman's herd.

There are many causes of sterility, and it became apparent at the outset that it was necessary to study the problem in the field in order to find the most widespread causes so that research could be directed toward their solution. Accordingly, a mobile laboratory has been set up to study sterility on the farms of New York State. This laboratory visits farms on which sterility is a major problem. An attempt is made to visit only farms on which good breeding records are kept. The laboratory is usually manned by three men; a veterinary pathologist, a man especially familiar with reproductive problems in the cow, and one especially familiar with reproductive problems in the bull. Each herd visited is studied thoroughly. The breeding history of each cow is recorded, and rectal examination of the genital tract is made on each cow in the herd. Blood samples are drawn from all cows in the herd that are having breeding trouble and from an equal number that are not having trouble. This blood is analyzed for carotene, vitamin A, vitamin C, Ca, P, I, hemoglobin and plasma proteins. Blood agglutination tests are run for Brucellosis and Vibriosis. Vaginal mucus samples are collected for examination for Vibrio organisms and Trichomonads. Semen is drawn from any bulls that are being used and the routine semen tests are run. The farmer, the artificial inseminator and the local veterinarian are usually present.

<u>Management Factors Contributing to the Sterility Problem</u>

The results of this work to date indicate that bad management practices and Vibrio fetus infections are the main causes of dairy cattle sterility in the State today. Nutritional problems and endocrine disorders have played a lesser role in the sterility problem on the farms visited.

Since bad management practices seem to contribute as much to the problem as any other single factor it is advisable to consider some of these practices in detail.

Many dairymen use several different bulls in an attempt to settle a cow that is hard to breed. If this cow has an infectious disease, such as Vibrio fetus it will probably to transmitted to all the bulls used and subsequently to all the other cows that those bulls breed. Dairymen should be advised to use only one bull on a cow, and if conception does not occur after 3 services it is a good policy to have the cow examined by a veterinarian and to switch to artificial insemination for subsequent breedings.

Many farmers breed their cows back too soon after freshening. The uterus returns to normal size and tone slowly after calving. Normal cows should not be bred back sooner than 60 days after calving; cows having calving trouble should be held off an even longer time.

A third bad management practice is the failure to breed or inseminate cows at the proper time. The cow is a unique animal in that the egg is not shed from the ovary until 10-12 hours after the end of heat. The egg lives only about 5 hours and sperm live in the female tract only about 24 hours. The average cow is in heat about 18 hours. These figures add up to the fact that if the sperm are placed in the cow's reproductive tract early in the heat period they are likely to be dead before the egg is shed. Most artificial insemination stations try to breed cows coming into estrus in the morning during the afternoon of the same day. Cows coming in heat in the afternoon are bred the following morning. The farmer must be careful not to call the inseminator before a cow is actually in "standing heat", or she will be bred too soon. The chances for conception are also lowered when cows are inseminated after the end of the heat period.

Heat periods are often missed because dairymen fail to turn their cows out daily during the winter months and observe them for signs of estrus. Few farmers record the dates for all the heat periods for each cow. It is important to know the date of the first heat period after calving, and whether or not the subsequent heat periods are regular. Cows that do not come in heat for long periods of time after calving frequently have an infection in the uterus or some other abnormality that demands veterinary treatment.

Many dairymen do not keep adequate breeding records; others spend a great deal of time and effort in keeping good records, and then neglect to use them. This information can be put to good use in improving the breeding efficiency of a herd. If all the heat periods are recorded it is a simple matter to list the cows due in heat each week. These cows can then be watched more closely for heat, and matings can be planned so that one bull is not used too much. When adequate breeding records are kept little effort is required to calculate the services per conception for each bull being used. When this is done at regular intervals breeding troubles are noticed sooner and the cause may often be corrected before the entire herd is involved. This may also be accomplished to some extent by having pregnancy examinations made by a veterinarian at regular intervals.

Vibrio Fetus and Other Diseases

Work with the mobile laboratory indicates that Vibrio fetus infections are widespread in New York State, and this organism appears to be contributing heavily to the sterility problem. Vibrio fetus is a small, comma-shaped organism transmitted largely if not entirely by the bull through the semen. Cows infected with Vibrio fetus show a rather characteristic breeding pattern. They usually do not conceive to the first 4 or 5 services, returning to estrus at intervals of about 25 to 45 days. On the next subsequent service they often do not return to estrus for 60-90 days, the pregnancy being terminated by fetal resorption or, less frequently, by abortion. Following this, the infected animals are likely to conceive and have a normal pregnancy. The cow apparently builds up an immunity to the disease and after a herd has an outbreak of the disease the older cows will become immune and the trouble will be largely confined to the heifers. The disease is difficult to diagnose.

A blood agglutination test is available, but it is not too reliable. An agglutination test for vaginal mucus has been developed and appears to be much more reliable. The organism has been cultured from the semen of many bulls in New York State. The disease can be readily traced from one farm to another in cases where infected bulls are sold or loaned. It is not known how long the infection may persist in bulls.

The addition of streptomycin to the semen appears to be an effective control measure, although the problem has not yet been adequately studied. Most artificial insemination centers now routinely add streptomycin to the semen. Several Vibrio fetus infected herds visited by the mobile laboratory have switched to artificial insemination entirely and the breeding efficiency has increased markedly in one year.

Brucellosis has been checked fairly well in New York State, and since the methods for controlling it are available in all states it will not be discussed here. Trichomonad infection was encountered in only one of the herds visited with the mobile laboratory.

Blood Levels of Various Nutrients in Fertile and Sterile Cows.

The data on the blood analyses for the first 28 herds visited with the mobile laboratory have been summarized in Table 1. There were 1533 cows and heifers of breeding age in these herds, and blood samples were taken from 275 or 18 per cent of the animals. It may be seen from Table 1 that 140 of these cows were having breeding trouble at the time of the visit, and 135 of these cows were not having breeding trouble and serve as a control group. There was no significant difference in the levels of carotene, vitamin A, plasma proteins, calcium, phosphorus, or vitamin C in the blood of the sterile and the control cows.

When the sterile cows are broken down into various groups according to the major cause of sterility there are no significant differences among any of the groups for any of these blood constituents except hemoglobin. It may be noted that the cows in which the sterility was due to a failure to come in heat have lower blood hemoglobin levels than any of the other groups. Most of the cows in this group came from a few farms on which the forage grown was deficient in cobalt, and in one case, copper. A deficiency of either of these elements may contribute to a lowered blood hemoglobin level and a failure of cows to come in estrus. This problem needs to be studied further. The blood levels of protein bound or "hormonal" iodine were essentially the same in the control and the sterile cows.

In general, it appears that deficiencies of specific vitamins or minerals, with the possible exception of cobalt and copper, are not important factors in the overall problem of dairy cattle steriltiy. Undoubtedly, severe deficiencies of some of these nutrients, such as vitamin A and phosphorus can cause reproductive failure, but animals fed rations adequate for good milk production will probably receive all of the important vitamins and minerals in sufficient quantity to insure good reproduction. Ascorbic acid has been widely used in the treatment of sterile cows. Considerable evidence now exists showing that ascorbic acid does not improve fertility in dairy cattle.

Nutrition in Early Life and Reproductive Performance.

The question of the influence of nutrition in early life on later reproductive performance is being studied at Cornell in several long time experiments.

Table 1

Blood Data for Infertile and Fertile Cows in Twenty-Eight

New York State Dairy Herds.

Group	No. of Cows	Plasma Carotene /ug/100ml	Plasma Vitamin A/ug/100ml	Hemo-globin gms%	Plasma Protein gms/100ml	Plasma Calcium mg/100ml	Plasma Phosphorus mg/100ml
Infertile Cows							
1. Failed to conceive after 4 or more services	76	1070	64.9	10.71	8.94	10.1	5.63
2. Abortion or fetal resorption	16	742	47.9	10.10	8.95	10.5	5.60
3. Failed to come in heat	23	736	53.1	9.33	8.99	10.1	5.52
4. Nymphomaniacs	6	1273	48.3	11.18	9.57	10.6	5.25
5. Pyometria, retained placenta	19	1029	61.2	10.00	8.95	9.9	5.57
Total	140						
Average		981	59.8	10.34	8.98	10.1	5.58
Control Cows							
Group							
1. Non-pregnant	51	720	43.6	9.98	9.07	10.2	5.57
2. Pregnant after 1 service	41	933	59.2	10.24	8.87	10.5	5.51
3. Pregnant after 2 services	12	1142	70.5	10.52	8.65	10.1	6.26
4. Pregnant after 3 services	5	987	65.3	10.67	8.66	10.0	5.82
5. Pregnant after 4 services	12	669	52.2	10.34	8.93	10.2	5.85
6. Pregnant after 5 services	5	1502	68.2	11.02	8.88	9.9	5.75
7. Pregnant after 6 or more services	9	865	65.4	10.80	8.98	9.8	6.20
Total	135						
Average		866	54.7	10.25	8.93	10.2	5.69

In these experiments each member of a trio of calves is placed at birth on one of three rations designated as "subnormal", "normal" or "supernormal". Both bulls and heifers are being studied. The "normal" heifers are fed Total Digestible Nutrients according to the upper level of Morrison's feeding standard until the time of first calving; the "subnormals" are fed 65 per cent of this level and the "supernormals" are fed at 140 per cent of Morrison's standards. The rations vary both quantitatively and qualitatively. The "subnormals" receive poor quality hay and pasture; the "supernormals" are fed excellent quality hay and receive excellent pasture and additional vitamins and minerals. Data are being obtained on body growth and development, lifetime milk production and reproductive performance. To date 84 heifers have been placed on this experiment and some have now completed their second lactation.

Definite conclusions can not yet be drawn since this experiment is still in progress and will not be completed for a good many years, but the data obtained to date are of interest. Marked differences in the growth rates of the three groups have been obtained, as is shown in Table 2. None of these heifers are bred until they are 18 months of age.

Table 2. - The effect of calfhood nutrition on reproductive performance.

Plane of Nutrition	Average Weight at Calving (lbs.)	Average Age at First Heat (mos.)	Services per Conception
Subnormal	984	17.6	1.38
Normal	1209	11.2	1.40
Supernormal	1417	9.3	1.64

The age at first heat differs markedly in the three groups, but the services required per conception are not significantly different. More calving difficulties have been encountered in the subnormals, emphasizing the fact that heifers must be well grown if dystocia at first calving is to be avoided.

In addition to the experiments just described two slaughter experiments are being conducted, one with bulls and one with heifers. Each experiment involves 72 animals, allotted to the same three planes of nutrition at birth and slaughtered at 0, 16, 32, 48, 64 and 80 weeks of age to study the development of the reproductive organs. Considerable data is being accumulated on other problems at the same time. The degree of development of the reproductive organs at a given age differs greatly with the plane of nutrition. "Supernormal" heifers slaughtered at 32 weeks of age have fully developed and functional reproductive organs. The ovaries are functional; ovulation has occured for the first time and corpora lutea or follicles are present. In contrast, the uteri of the "subnormals" are small at 32 weeks of age, and the ovaries contain only primary and secondary follicles. The uteri and ovaries of the "normals" are intermediate in development, but ovulation has not yet occurred at 32 weeks of age. Similar differences are found in the weights of all the endocrine organs.

The bull slaughter experiment has given similar results. At 48 weeks of age the average testes weights are 90, 115 and 250 gms. respectively for "subnormal", "normal" and "supernormal" bulls. Similar differences are found in the weights of the siminal vesicles and other endocrine glands. The first semen containing live spermatozoa was produced by the "supernormals" at an average age of 36 weeks, whereas the "normals" did not produce live spermatozoa until 42 weeks of age and the subnormals did not produce live spermatozoa until 50-60 weeks of age. Only the "supernormals" produce usable semen at 48 weeks of age, and even then the number of motile sperm is small in terms of the number needed for use in an artificial breeding center, although they could, of course, settle cows by natural service. A point of particular interest is the development of the penis in these bulls. In young bulls the prepuce is adherent to the glans, and if a young bull attempts to serve a cow or an artificial vagina before the glans is free from the prepuce it is likely to tear and cause inflammation to develop. In the "supernormals" the glans is free from the prepuce at about 32 weeks of age, but this occurs much later in the "subnormals". It is clear that nutrition influences the age at which young bulls can be used for breeding purposes and the age at which their breeding "proofs" can be appraised.

The Heritability of Fertility

The question of the extent to which fertility is inherited in dairy cattle is a difficult one. It is well known that certain anatomical abnormalities of the reproductive tract are inherited. Most of these conditions result in total sterility, and consequently their frequency in the total cow population is not high. From an economic standpoint it is probably more important to consider the inheritance of partial sterility or reduced fertility. When the heritabilities of such factors as calving internal, regularity of heat periods, services required per conception, days from first service to conception, and non-returns to first service in artificial insemination are studied they are found to be extremely low. (Table 3).

Table 3.

Repeatability and heritability of breeding efficiency in dairy cattle.

Factor examined	Repeatability	Heritability	Nature of data
Non-returns to 1st service	.027	.004	A. I. non-returns; paternal half-sibs.
Calving intervals	———	.00	
Regularity of heats	.18	.05	U.S.D.A. Beltsville herd; dam-daughter comparisons.
Services per conception	.12	.07	
Days from 1st service to conception	.11	.07	

These data indicate that with the present methods of selection, little can be done to improve breeding efficiency. In fact, if selection for breeding efficiency must be done at the sacrifice of selection for other economic factors with a higher heritability, such as milk and fat production, it could be harmful.

Successful selection for breeding efficiency must await the development of a better method for measuring a cow's lifetime reproductive performance.

Hormonal Aspects of Sterility

Most experiments attempting to demonstrate the value of hormonal treatments for reproductive disorders in dairy cattle have been disappointing. Asdell et al. (1941) attempted to improve reproduction in repeat-breeder cows by estrogen therapy. Forty per cent of the treated cows conceived, but 50 per cent of the control group of cows conceived. Frank (1950) obtained similar results. The percentage of conceptions was about the same in three groups of infertile cows receiving no treatment, uterine douches and hormone therapy. All experiments of this nature point out that there is a high rate of spontaneous recovery, a result not too difficult to explain when the high incidence of Vibrio fetus infection is considered.

Two major factors are hindering the successful application of hormonal therapy to sterility problems at the present time. The first of these is our lack of knowledge of the exact amounts of the various harmones being produced in the normal cow at various stages of the estrous cycle. This problem is being studied intensively, but the technical difficulties involved are great, and little progress has been made to date.

The second major factor hindering progress in this field is a lack of knowledge of the exact mechanism by which ovulation is brought about in the cow. Some progress that may have practical application has been made in this field.

It is generally believed that ovulation in most mammalian species is brought about by the reciprocal interaction of the hormones of the ovary and the anterior pituitary. Follicle Stimulating Hormone (F.S.H.) produced by the anterior pituitary causes the growth of graafian follicles, which in turn produce estrogen. Estrogen secretion is thought to produce a diminution of F.S.H. secretion, which is followed by an increased secretion of luteinizing hormone (L.H.) which brings about ovulation and corpus luteum formation. A third anterior pituitary hormone, prolactin, or luteotrophin, causes progesterone secretion by the corpus luteum.

Several recent experiments challenge the adequacy of this concept as a complete explanation for ovulation even in those species, such as the rat and the cow, in which the stimulus of coitus is not required for ovulation to occur.

Several recent experiments by Everett, Sawyer, Markee and others (4) show that ovulation can be prevented in both the rabbit and the rat by properly timed injections of atropine, a para-sympathetic nerve blocking agent. Atropine injected at the beginning of estrus in the cow blocks ovulation (Table 4). When both atropine and luteinizing hormone (chorionic gonadotropin) are injected at the beginning of estrus ovulation occurs at the normal time or even earlier (Table 5).

These results indicate that some nervous mechanism having a cholinergic component is involved in the ovulation mechanism in these species in addition to the hormonal mechanism.

Since ovulation appears to be influenced by a nervous mechanism in the cow, it became of some interest to study the effects of the ovarian hormones, estrogen and progesterone, on ovulation time. It was somewhat surprising to find that small amounts of progesterone administered at the beginning of estrus hastened the ovulatory process in the cow, (Table 6) whereas estrogen administered under the same conditions had no influence on ovulation time (Table 7).

Table 4. The Effect of Atropine on Ovulation Time

Heifer No.	Control Period	Atropine Period			
		Treatment [1]			
	Time from beginning of estrus to ovulation	Mg. Atropine Sulfate per Kg. body weight	Time of treatment from beginning of estrus	Time from beginning of estrus to ovulation	Ovulation Delayed
	(Hrs.)		(Hrs.)	(Hrs.)	(Hrs.)
54	28	19.6 15.2 4.1	2 5 7	52.5	24.5
62	22	39.5 26.3	1 25.5	88	66
63	25	13.3 13.3 6.7 6.7 6.7 6.7 6.7 6.7 6.7 6.7	1 5 11 19 25 31 37 44 51 57	60	35
67	27	19.8 13.2	3 6	17	0
67	27	39.0 26.0	4 28	47	20
71	25	39.2 26.3	1 25	83	58
Av.	25.6			57.9	33.9

[1] Atropine Sulfate was dissolved in 0.9% saline at the rate of 100 mg/cc. and injected subcutaneously.

Table 5. The Effect of the Simultaneous Administration of Atropine and Chorionic Gonadotropin on Ovulation Time

Heifer No.	Control Period: Time from beginning of estrus to ovulation	Atropine Plus Chorionic Gonadotropin Period — Treatment [a]: Mg. Atropine per Kg. body weight	Treatment [a]: Chorionic Gonadotropin	Treatment [a]: Time of treatment from beginning of estrus	Time from beginning of estrus to ovulation
	(Hrs.)		(I.U.)	(Hrs.)	(Hrs.)
54	28	39.2	1000[b] 4000[c]	2	20
62	22	39.5 26.3	1000[b] 2000[c] 2000[c] 4000[b]	2 2 6 32	 72
67	27	39.0	1000[b] 4000[c]	1	14
68	31	39.0	1000[b] 4000[c]	1	24
73	19	32.4	1000[b] 4000[c]	5	9
Av. Av.	(4) 26.2 (5) 25.4				16.7 27.8

[a] Atropine sulfate was dissolved in 0.9% saline at the rate of 100 mg/cc. and injected subcutaneously.

[b] Intravenously in aqueous solution.

[c] Subcutaneously in aqueous solution.

Table 6

The Effect of Progesterone Injected Subcutaneously at the Beginning of Estrus on Ovulation Time in Dairy Heifers

No. of heifers	Ave. length of estrus (hours)	Ave. time from end of estrus to ovulation (hours)	Ave. time from beginning of estrus to ovulation (hours)
		CONTROL PERIOD	
11	18.6	12.3	31.0
		PROGESTERONE TREATED PERIOD	
11	15.0	6.9	22.0

Table 7.

The Effect of Estradiol Injected Subcutaneously at the Beginning of Estrus on Ovulation Time in Dairy Heifers

No. of heifers	Ave. length of estrus (hours)	Ave. time from end of estrus to ovulation (hours)	Ave. time from beginning of estrus to ovulation (hours)
		CONTROL PERIOD	
11	19.6	10.9	30.0
		ESTROGEN TREATED PERIOD (1000 to 3000 I.U.)	
11	20.7	11.7	32.4

These results give little support to the idea that a rising level of estrogen at the time of estrus inhibits F.S.H. production by the anterior pituitary, and causes the release of the ovulating hormone (L.H.). The results do show that progesterone action is essential to the ovulatory process possibly by causing the release of larger amounts of luteinizing hormone from the anterior pituitary.

It is hoped that this knowledge will have an application in the treatment of cows having cystic ovaries, but work on this subject has not reached the stage where it is possible to draw any conclusions. Dutt (5) has recently found that both estrus and ovulation can be induced in the anestrus ewe by progesterone injections followed by pregnant mare serum injections.

Acknowledgment

Most of the experiments cited represent the cooperative efforts of the following:

K. L. Turk, J. K. Loosli, J. T. Reid, R. W. Bratton,

R. H. Foote, K. McEntee, C. R. Henderson,

G. W. Trimberger, A. M. Sorensen, H. J. Bearden,

S. A. Asdell, H. O. Dunn, S. W. Musgrave,

R. Dunbar, J. W. Pou, and W. Hansel.

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SWINE DISEASES in ALABAMA . . . . W. B. Gibbons,

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During the last few years there has been an increase of a little over 50,000 head of swine per year on farms in Alabama. As of January 1, 1951, Alabama ranked 15th in the U. S. in the number of swine on farms. Swine raising has become an important livestock industry in this state. With the increase in numbers traffic within and importation of swine into the state has increased remarkably. With the importation of swine new disease entities have been introduced into the hog population. A briefing on some of these diseases might be valuable to this group.

Atrophic Rhinitis

In 1944 there appeared in the United States and Canada, an undescribed disease on the North American Continent. This disease was at first confused with "bull-nose", a necrotic infection of swine but was quickly differentiated. The condition affects chiefly young growing swine. Primarly symptoms are sniffling and a mucous discharge from the nose. As the condition progresses nosebleeds appear and later distortion of the snout becomes apparent. The distortion and hemorrhages are due to the erosion or wasting away of one or both of the turbinate bones in the nostrils. The condition is progressive until the animal looses condition, fails to grow and becomes non-profitable.

Atrophic or dystrophic rhinitis pursues an insidious course in the invasion of a swine herd. One or two pigs are affected at first, the next year more, until finally after four or five years most of the pigs being raised will acquire the disease, and force the owner out of business.

The cause of dystrophic rhinitis in swine is unknown. Some have thought that it is due to a hereditary factor, but others favor the theory of a transmissible agent, possibly a virus. The disease has been produced experimentally by internasal injections of the nasal discharge.

Treatment is hopeless. The only solution seems to be in selling all swine on the place whether sick or not and starting with new breeding stock on new ground. Some have advocated the disposal of sick pigs as soon as symptoms are nocticeable and the selling of sows in whose litters affected pigs appear.

Tranmissable Gastro-enteritis.

A new and rare disease for Alabama appeared in the state about a year ago. This is one of the so-called "baby-pig" diseases. It affects newborn pigs one to three days old. It is characterized by sudden illness, vomiting, diarrhea, protration and early death. The mortality usually is 100% of the litter. The brood sows are affected if not immune and usually show dullness, fever, vomiting and diarrhea. Sows usually recover in three to four days. The transmissable agent is supposed to be a virus.

Pencillin, other antibiotics, and the sulfas do not alter the course of the disease. Hog cholera serum given in large doses may aid in a few cases, probably due to its general immunizing properties. As recovered sows might confer immunity through the placenta and milk, they should be saved for future breeding. They might also serve as a source of immune blood for treatment of subsequent outbreaks.

Vesicular Exanthema.

Vesicular exanthema of swine is a contagious disease caused by a virus and resembles foot-and-mouth disease of swine. The disease has existed in California for 20 years and during the last year spread from coast to coast with 16 states reporting the disease. So far, as is known the disease has never been diagnosed in a foreign country or outside of California until 1952. It first appeared in garbage fed swine in California on April 23, 1932 and was diagnosed as foot-and-mouth disease. In an attempt to eradicate it 18,000 swine on 17 premises were slaughtered and buried. The disease recurred in 1933 and again eradication by slaughter was attempted. By 1934, when the disease again reappeared, it was apparent that it was not foot-and-mouth disease.

The virus was then identified as a new entity by Dr. J. Traum and the disease was given the name of vesicular exanthema. The disease continued to exist in California since then but no attempts to eradicate it by slaughter methods have since been made.

Vesicular exanthema has been considered as primarily a disease of garbage fed swine. It is highly contagious and has an incubation period of only one to five days. Man, ruminants and carnivara are said to be wholly resistant to this disease but horses show a slight susceptibility on artificial inoculation.

The outbreak of last summer started in early June in swine near Cheyenne, Wyo., presumably from virus-infested garbage taken from eastbound transcontinental trains. On June 18, it was diagnosed at Grand Island, Nebraska in hogs recently received from Cheyenne. Hogs from Grand Island were shipped to Omaha and reshipped from there to various points in the states where the disease subsequently reappeared.

One lot of pigs was shipped to a slaughter plant in Birmingham, Alabama. These pigs developed the disease. Another lot of slaughter pigs was shipped to Mobile. The disease was immediately recognized by federal veterinarians and the State Veterinarian in cooperation arranged for quarantine and slaughter. No further outbreaks have occurred in the state and it has never appeared on a farm. In New Jersey, in spite of quarantine immediately placed on a shipment from Omaha, the disease spread in a month to over 20 farms in eight counties of a garbage feeding area.

Vesicular exanthema is an acute febrile disease in which confluent vesicles or blisters appear regularly on the soles, in the space between the toes (interdigital tissue) and the coronary region, severe lameness results from sloughing of the soles and walls. Often vesicles form on the snout, nose and lips, and in the mouth and nostrils. Losses result from crippling, shrinkage, condemnations, death of baby pigs and abortions in pregnant sows. Control consists in early recognition, quarantine, slaughter, processing of meat by heating to at least 143°F., disinfection and subsequent testing of infected premises.

Jaundice and Liver Degeneration

During the past fall months many cases of a disease of swine have been seen by veterinarians in Alabama, North Florida and South Georgia. The onset of the disease is sudden, although many farmers have reported their hogs losing weight for two or three weeks before being sick, in spite of being on plenty of corn. A dead pig or two may be the first symptoms. Losses vary from two or three pigs in a drove to nearly 50%. Severe losses are less frequent than the loss of only a few pigs. Pigs have continued to die for two weeks or more after removal from the cornfields.

At first this condition was thought to be due to plant poisoning possibly of the nature of bracken or crotalaria. This conclusion was based upon the symptoms and lesions found after death. Jaundice is an outstanding symptom. On autopsy hemorrhages are found throughout the body and the liver shows fibrosis and degeneration, being firm and a very light yellow color. Yellow or blood tinged fluid is usually found in the abdominal cavity.

Investigation of this condition in Georgia (1) connected it with the turning of pigs into cornfields where the corn was mouldy. Most of the corn was of the McCurdy 95 variety. Corn collected from fields in which sick hogs had been previously fed was incorporated as ground corn in a standard hog ration and fed to experimental hogs. The animals on experiment died with lesions typical of the field outbreaks.

Moulds isolated from the corn were of the genus Aspergillus. This mould has been previously incrimunated with producing air-sac infection in poultry, emphysema of the lungs in cattle, and with a systemic toxic poisoning of cattle producing lesions indentical with the systemic degeneration of the liver being observed in swine.

An occasional case of swine erysipelas has been found in Alabama but most outbreaks investigated have proven to be photosensitization produced by forage affecting hogs with white skin. Although these new diseases have caused considerable losses amongst the swine population, the greatest disease problems are the ones that have been with us continuously. Hog cholera is still public enemy no. 1 of the swine industry though there is evidence of a decrease in the number of outbreaks since the use of virus has been discontinued in this state. Much of the swine disease problem could be classified under the title "management-disease problem". The raising of swine under a system of good sanitation, good nutrition, and the use of disease prevention measures would prevent parasitism, nutritional deficiencies, necrotic enteritis, and many pulmonary infections which collectively cause enormus losses to the swine raiser.

(1) Dr. W. L. Sipple, Coastal Plains Experimental Station, Tifton, Ga., Personal Communication.

OUTDOOR, INDIVIDUAL PORTABLE PENS COMPARED with CALF BARN for RAISING DAIRY CALVES . . . . Leonard Reid Davis, Parasitologist, USDA, Regional Laboratory and K. M. Autrey

In search for a method of controlling bovine coccidiosis at the U. S. Regional Animal Disease Research Laboratory, one of the authors (L.R.D.) found that outdopr, individual, portable pens were desirable for raising young dairy calves. In addition to preventing clinical coccidiosis, the use of the pens effectively reduced the incidence and transmission of white scours, pneumonia, worm parasites, and other diseases. Shortly after this information became known, many farmers in the southern states converted from the customary calf barns to the portable pens, but no controlled experiments, except the ones carried out at the Regional Laboratory, had been conducted on their use under farm conditions. Consequently, the authors began cooperative experiments in the fall of 1950 at the Alabama Polytechnic Institute dairy farm in order to compare the degree of parasitism and the relative growths of calves in the portable pens and others raised in the Alabama Polytechnic Institute calf barn.

<u>1950-1951 Experiment</u>: - Sixteen calves were divided at random and placed in the two types of shelters within three days after birth. The feeding and care of the two groups were identical, with the following exceptions: Calves in the portable pens were moved to a fresh site once each week, while the individual stalls in the calf barn were cleaned and fresh bedding added twice each week. The barn calves were allowed to exercise in an adjoining lot 15 x 40 feet, when the weather was clear and not too cold. When the experiment

started, there was a small amount of vegetation on the exercise lot, and a small amount of grass was also available along the edges of the lot. In the portable pens, the calves could get a small amount of grass for a short time each week, when the pens were moved to fresh sites. Individual fecal samples were obtained per rectum three times each week, and were examined microscopically for oocysts of coccidia and for worm eggs. Weights and measurements were obtained at 28-day intervals. The calves were moved to pasture on March 30, 1951, when the average age of the barn calves was 148 days, and that of the portable pen calves 150 days. Rumen contents were obtained from all calves at the end of the experiment to determine whether ciliated protozoan organisms were present. Some authors believe these ciliates are necessary to prevent pot-bellies and poor general physical condition.

Results, 1950-1951. Every calf in the barn showed respiratory trouble, while none of the calves in the portable pens had colds or pneumonia, despite the fact that the winter was the coldest experienced in Alabama in many years. At four months of age, one of the barn calves died from chronic pneumonia, following coccidiosis caused by *Eimeria zurnii*, one of the most pathogenic of the ten species of coccidia found locally.

Between the third and seventh weeks of age, which is when the young calf is the most susceptible to coccidiosis, the barn calves discharged about 30 times as many coccidial oocysts as those in the portable pens. Both groups showed comparably low numbers of oocysts during the remaining period of the experiment. There was a lower incidence of scours in the movable pen group than in that in the barn, also, the barn calves had a higher incidence of stomach and intestinal worms and they appeared earlier in this group than in those raised in the pens. However, neither group had enough worms to seriously impair their health.

The average gains from birth until the time all calves were placed on pasture are shown in Table I.

TABLE I. Average gains in weight and measurements of calves in portable pens and those in a calf barn (1950-1951).

Calves in:	Weight (lbs.)	Height (withers)	Chest Girth	Belly Girth
Portable pens	120.09	6.22	12.42	16.31
Barn	88.91	5.73	10.21	13.60
Differences	31.18	0.49	2.21	2.71

Examinations of the rumen contents showed that every calf in the barn had acquired rumen ciliates. None of the calves in the portable pens harbored these protozoa at the end of the experiment. In addition to the greater weights and measurements, the general appearance of the eight portable pen calves was superior to the seven surviving barn calves.

1951-1952 Experiment: - With the favorable results obtained in the portable pens, despite the absence of rumen organisms, it was decided to repeat the experiment, and inoculate half of the eight calves in each group with rumen contents from a cow. Unlike the conditions which prevailed in the first experiment, the fenced-off area reserved for the portable pens was found to be contaminated by older cattle, which had accidentally entered the lot before the second experiment was started. Visible manure was removed, but rains had scattered some of the contaminated material. The decision was made to go ahead with the test and to observe results obtained in contaminated surroundings.

Results, 1951-1952. The eight barn calves showed oocysts of coccidia in greater numbers and earlier than the calves in the portable pens, but the differences were not as great as in the previous experiment. The rumen-inoculated calves passed less than one-half as many oocysts as the controls. When examined three times each week for six months, the eight barn calves were diarrheic 70 times, compared with only 43 times for the portable pen calves. The four rumen-inoculated calves in the barn showed diarrhea only 19 times compared with 51 times for those in the barn. However, the rumen-inoculated calves in the portable pens were diarrheic 24 times, compared with 19 times in the controls in the pens. The eight rumen-inoculated calves were diarrheic 43 times, compared with 70 times in the calves which did not receive the rumen material. At the end of six months, all of the barn calves were found to have rumen protozoa, while two of the four uninoculated calves in the portable pens were still free of these organisms.

Every calf in the barn had respiratory troubles, with spasmodic coughing, nasal discharges, rapid breathing, general weakness, and other symptoms of early pneumonia. Early in December, the veterinarian responsible for the health of the dairy animals administered antibiotics to every calf in the barn because their condition had grown worse. Despite the previous contamination, none of the calves in the portable pens showed respiratory troubles. Growth records are shown in Table II.

On the basis of worm eggs found in the droppings, all calves became lightly infected with one or more species of parasitic worms in low numbers. The calves in the portable pens acquired a few more stomach worms (Haemonchus) and intestinal worms (Cooperia) initially, than did calves confined in the barn and exercise lot. This was probably due to unintentional contamination by mature cattle trespassing in the area originally reserved for the portable pens. The early evidence of worms and coccidia in calves in the portable pens is in contrast with the results of the first years's experiment. These results illustrate the importance of excluding ever-infected older cattle from areas intended for new-born calves.

Since a question has arisen as to the possibility of the portable pen calves getting enough extra grass as the pens are moved to new areas, to account for these more favorable results, the first year's experiment is being repeated, with the following variations. Three calves in the portable pens are getting a fixed amount of clipped grass on five days of each week.

Table II. Calf Experiment 1951-1952, showing average weight and growth gained from birth until the calves were placed on pasture at the age of six months.

Calves and Treatment	Weight Gained (pounds)	Height (inches)	Chest Girth (inches)	Belly Girth (inches)
8 Portable Pen	170.317	9.529	15.576	23.615
8 Barn	146.657	8.308	14.041	24.322
Difference	23.660	1.221	1.535	0.707
<u>Barn Calves</u>:				
4 Rumen Inoculated	159.438	8.630	15.638	26.892
4 Not Inoculated	133.878	7.985	13.434	21.752
Difference	25.560	0.645	2.204	5.140
<u>Portable Pen Calves</u>:				
4 Rumen Inoculated	162.750	9.222	15.402	21.33
4 Not Inoculated	178.938	9.845	15.750	25.91
Difference	16.188	0.623	0.348	4.58
<u>All Calves</u>:				
8 Rumen Inoculated	161.094	8.926	15.025	24.106
8 Not Inoculated	156.413	8.910	14.592	23.831
Difference	4.681	0.016	0.433	0.275

Three calves are being moved to scraped, bare ground each week, while three others are being placed on unscraped sites each week. In the calf barn, three are receiving the same fixed amounts of clipped grass as three in the outdoor pens, and three others are not getting any grass. This year, the exercise lot next to the barn is being kept free of grass by scraping it once each week.

SEED PRODUCTION in ALABAMA . . . . T. Hayden Rogers

Seed production in Alabama has, within the last few years, become big business. During 1951 farmers in the State received approximately $5,000,000 for seed to be used for planting purposes. As a result of adverse weather conditions, total seed production in 1951 was not as great as in 1950. The above figure includes only certified seed of cotton, corn, oats, wheat, peanuts and soybeans. If all planting seed, certified and uncertified, were included, the total value would be considerably higher than $5,000,000.

A dollar spent for good seed of the best variety probably returns more to the farmer than any other dollar spent in the production of the crop. It has been estimated that a 15 to 20 per cent increase in crop productivity can be secured by the widespread use of pure seed of the most satisfactory varieties. A few years ago the Wiregrass Substation obtained approximately 480 pounds of peanuts per acre more from pure Dixie Runner seed than from farmer stock Dixie Runner seed. Last year at the Plant Breeding Unit and at two substations, one source of Louisiana white clover seed proved to be much inferior to similar types of white clover. The use of low quality seed often results in poor stands, low yields, poor quality and may infest the field with noxious weeds.

With the exception of a very few crops, principally cotton, plant breeding in the south is relatively new. We are just beginning to benefit from the work of the plant breeder. A number of new and improved varieties of both row crops and forage crops have recently been introduced. These superior varieties are better adapted to southern conditions, and produce higher yields of better quality products. Farmers have received these improved varieties very enthusiastically. The value of these varieties depends to a considerable extent on maintaining the genetic purity of the seed until it reaches the farmer.

Production of Quality Seed

As the Alabama Station, and the stations in surrounding states, increases its plant breeding program, the responsibilities of the Station increase. When the Station plant breeders develop new and improved crops, it is the responsibility of the Station to make the initial increase of seed of those crops. Seed of improved crops are usually divided into four classes. These are (1) breeder seed, (2) foundation seed, (3) registered seed and (4) certified seed. The Experiment Station has the responsibility of producing and maintaining the genetic purity of seed of the first two classes i. e. breeder and foundation seed. Foundation seed is released to the Alabama Crop Improvement Association for further increase by its members.

In the production of all four classes of seed, the Experiment Station and farmers need to follow the approved practices for producing seed of high quality.

Some of the most important of these practices are listed.

1. Select the best variety available.
2. Plant pure seed.
3. Follow fertilizer recommendations.
4. Plant on a wee-free area.
5. Have proper isolation to prevent cross pollination or mechanical mixing.
6. Rogue any off-type plants.
7. Harvest with a clean machine.
8. Dry seed when necessary.
9. Clean and store seed in such a way as to avoid injury to the seed and mixture with other seed.
10. Take a representative sample for analysis.
11. Bag in clean, new bags with analysis on the tag. (Only seed of the highest quality, and produced by the Experiment Station, should be bagged in bags bearing the Experiment Station label.)

The information on the analysis tag should be as complete and accurate as possible. When the seed producer places an analysis tag on a bog of seed, he is actually guaranteeing that the seed in the bag are as good or better than the analysis on the tag indicates. In Alabama the State Department of Agriculture, through the Seed Laboratory and seed inspectors, has the responsibility of enforcing the State seed law. Periodically this agency publishes a report listing alleged violations of the Alabama Seed Law. The following information was taken from one of these reports dated December 2, 1952:

Crop	% Viable Seed	
	On Tag	Found.
Bahiagrass	96	79
Blue lupine	94	63
Crimson clover	85	48
Orchardgrass	90	38
Victorgrain oats	90	57
Imported Dallisgrass	64	31

Farmers should study the analysis tag very closely in order to know just what they are buying. Only a small percentage of noxious weed seed may be enough to infest a field for years. There is no substitute for high quality seed.

The production, storage and distribution of high quality seed of the improved crops depend primarily on the Alabama Experiment Station, the Alabama Crop Improvement Association and all Alabama seed dealers. Previous mention has been made concerning the responsibilities of the Experiment Station and the Crop Improvement Association. Alabama seedsmen, both wholesale and retail, have a large share of the responsibility of making good seed of the best varieties available to farmers. The above three groups are dependent on each other. The Experiment Station determines the varieties of crops best adapted to various sections of the State. Members of the Crop Improvement Association take this information and grow seed of the recommended varieties. This seed is then purchased by seedsmen and resold to farmers. Seed producers, seedsmen and farmers all benefit by the information given in the variety reports. The earlier variety reports can be made available to these groups the greater their value. Every possible effort should be made to publish all variety reports as early in the season as possible.

National Foundation Seed Project

Although Alabama has become a large seed producing state, we are now producing seed of only three crops in excess of what we are planting. These crops are crimson clover, white clover and tall fescue. We probably never will produce all the seed that we plant of such crops as Ladino clover, red clover, alfalfa, vetch, Austrian winter peas and Italian ryegrass. Seed of these crops is produced primarily in the northwestern part of the United States. The National Foundation Seed Project was organized in 1948 for the purpose of coordinating seed production in one part of the country with seed consumption in other parts of the country. The work of the Project is largely financed through the USDA from funds made available by the Research and Marketing Act. Only improved varieties or strains of small seeded grasses and legumes are included in the Project. Suppose a plant breeder produced a superior forage crop for the south, but the plant would not produce seed satisfactorily under southern conditions. After the new strain had been tested throughout the southern region and found to be superior in more than one state, it could be recommended for inclusion in the national program. The originating experiment station could request the Southern Regional Forage Crops Technical Committee to recommend that the strain be included in the national program. The Planning Committee of the National Foundation Seed Project would study the data presented and accept or reject the crop. There are sixteen members of the Planning Committee. Two members are selected from each of the four experiment station regions and two each from the American Seed Trade Association, the International Crop Improvement Association, the Production and Marketing Administration and the Bureau of Plant Industry, Soils and Agricultural Engineering. If the crop were accepted by this Committee, arrangements would be made with the plant breeder to furnish breeder seed to seed growers in other parts of the country. Foundation seed produced from breeder seed would be under the control of the National Project. The seed is increased through the registered class and kept under the control of the National Project until sufficient volume is obtained for release to seed growers and seedsmen. Commodity Credit Corporation furnishes the financial assistance for growing the early seed increase and thus keeping it under the control of the National Project. (See slide)

WHITE CLOVER and the WHITE CLOVER BREEDING PROGRAM in ALABAMA . . . . Price B. Gibson

White clover is the most important pasture plant both in Alabama and over the entire nation. It contributes most if grown as a companion crop with a grass. We refer to this combination as a clover-grass pasture or an improved permanent pasture. In this combination, the clover makes a double contribution, its own growth and stimulates growth of the grass by furnishing nitrogen. The total digestible nutrients produced in one year by one acre of a properly managed, properly fertilized, clover-grass pasture often equals the total digestible nutrients in 100 bushels of corn. The livestock farmer who has such a pasture can produce both milk and beef cheaper than his neighbor who depends upon other crops. White clover is the base or fundamental plant of this clover-grass pasture. More meat and milk are produced from white clover than from any other pasture plant.

White clover is a valuable pasture plant in all 67 of the counties in Alabama. The county agents estimate that the total number of acres of improved pastures in Alabama is about 2,000,000 acres. White clover furnishes much of the grazing on these acres.

Although white clover is grown primarily for grazing the production of seed is an important farm enterprise in Alabama. This year about 8,000 acres were harvested for seed. Considering an average production of 70 pounds per acre and assuming a price of 50¢ per pound, the farm income from white clover seed is $280,000. Much higher seed yields can be obtained by practicing good management. This scene of a field in full bloom is in the Black Belt, which is one of the best white clover regions in the State. Such fields make profitable yields of seed.

Characteristics, types, varieties, and strains of White Clover

White clover is a perennial where conditions permit it to persist. It spreads vigorously under favorable conditions by means of creeping stems (stolons) that root at the nodes. Single plants will occupy several square feet of area within one season after planting. By far the majority of this growth is made during cool moist periods.

Our native white clover plants blossom profusely during the months of April and May. These flowers must be cross-pollinated for the production of seed. Crossing by insects is the primary means of pollination. Many farmers are providing one or more colonies of bees per acre for white clover seed production.

White clover is a highly variable species. Differences in the size of vegetative parts and the intensity of flowering are examples of this variation.

The variation in size of vegetative parts is the basis for dividing white clovers into types. Three agronomic types (large, intermediate and small) are recognized. Within each type there is a variation in the intensity of flowering.

Clover produced in one locality may be given a name. This same clover may be given a different name in a different locality. This practice unfortunately results in varietal names without justification. This situation is comparable to that which existed with cotton about 1930. The same variety of cotton had many different names. This resulted in the existence of as many as 30 so-called varieties within the area serviced by one gin. As a result of standardized names, a good extension educational program, breeding, and testing, over 95% of the cotton acreage is now planted to six recommended varieties.

We are testing nine white clovers at one or more locations. These are:

1. Louisiana white produced in Louisiana
2. Louisiana white produced by an Alabama farmer
3. Louisiana Improved Mother White
4. Louisiana Synthetic Number One
5. An intermediate white produced on the Upper Coastal Plain Substation.
6. Ala Lu
7. Ladino, certified seed from Oregon
8. Ladino, Breeder seed
9. White Clover from New Zealand

The New Zealand clover has been inferior to the other clovers. The only other important difference is the difference between Ladino and the intermediate whites. In one test in which there were three intermediate whites and one Ladino, we obtained the following results:

White Clover Variety Test
Tallassee Plant Breeding Unit, 1952

Forage Yields

	Pounds Oven-Dry Forage Per Acre for Periods Indicated				
	1st. Period: ending March 7	2nd. Period: March 8 - April 8	3rd Period: April 9 - May 2	4th. Period: May 3 - June 16	Total
	lbs.	lbs.	lbs.	lbs.	lbs.
Intermediate Whites	756	1665	1340	544	4305
Ladino	679	1618	1681	2307	6285

Seed Yield

Type	Clean Seed Per Acre
Intermediate Whites	130.2 lbs.
Ladino	10.6 lbs.

The most important decision confronting the farmer is choosing between Ladino and adapted Intermediate Whites. We have found little difference between the so-called varieties of the same type.

Our results so far indicate that the use of Ladino should be limited to areas where White clover normally persists as a perennial; for example, moist fertile bottom land soils which are rather high in clay content. Unfortunately, white clover is suseptible to a number of pests. These pests and unfavorable growing conditions cause white clover to behave as an annual on much of the land in Alabama. On this land, an adapted intermediate white should be planted. The intermediate types produce an abundance of seed and behave as reseeding annuals.

The White Clover Breeding Program

Objectives

Our ultimate objective is to develop a white clover that will persist as a perennial and will produce more than the white clovers we are now using. To accomplish this objective, we have immediate objectives. We are studying the variables that cause white clover to behave as an annual. This information will be used as a basis for guiding the breeding program. For example, when we know the relative importance of the different diseases we can breed for resistance to the important diseases. Until we know more about these variables, we must breed for general agronomic type. I shall describe briefly five tests which we have in progress that should contribute valuable information.

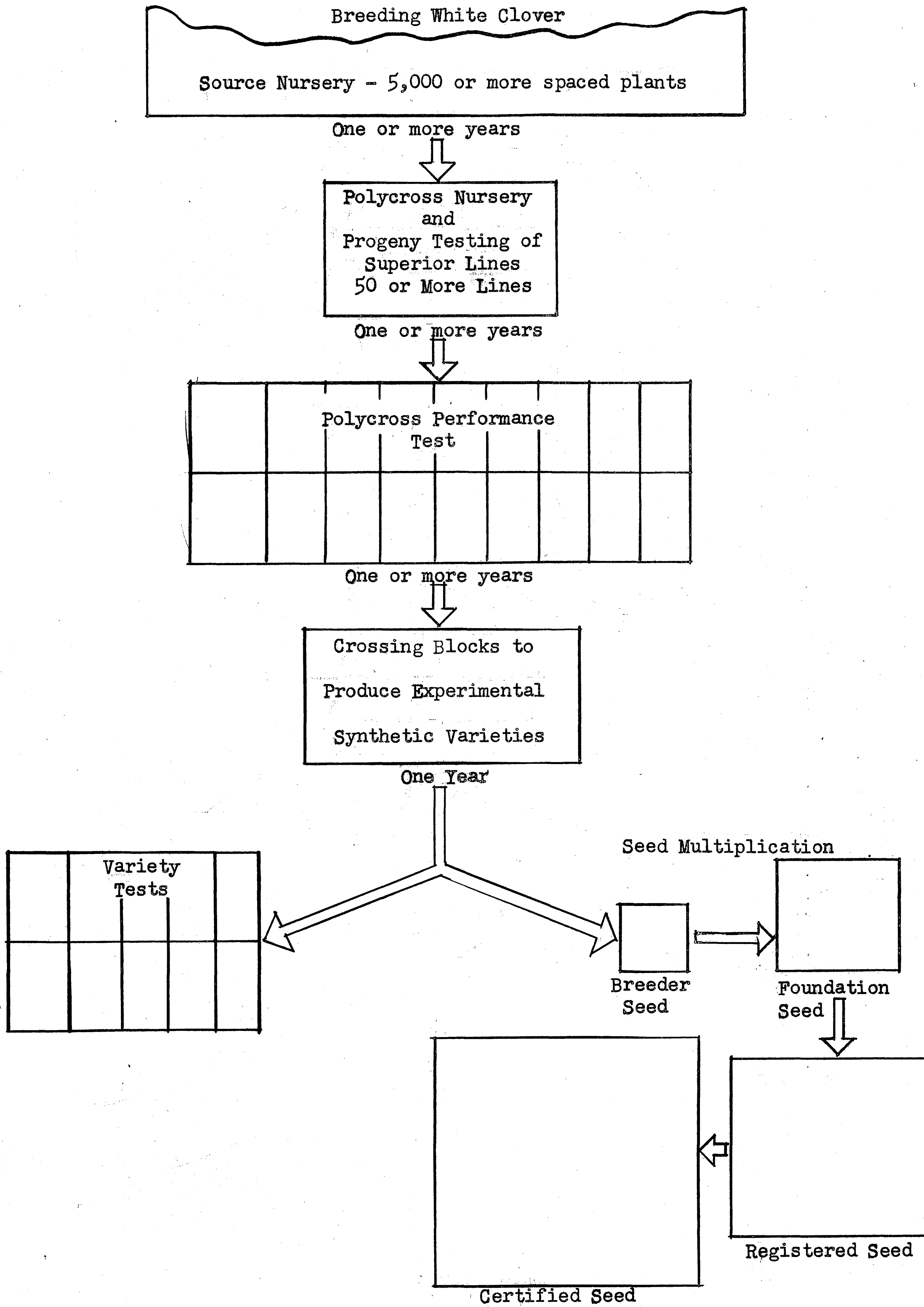
1. Relation of flowering to incidence of diseases.
2. Persistence of white clover plants growing in four different plant populations--alone, with Coastal Bermuda-grass, with Dallisgrass, and with Tall fescue.
3. Importance of nematodes.
4. Irrigation study designed to distinguish between damage from drought and from diseases.
5. Relationship between root pattern and persistence of plants.

Our present white clover breeding project has been active for only two years. The white clover breeding project which was initiated about 1938 was a casualty of the recent war. In the white clover breeding project now in progress, we are following the method outlined below in an attempt to develop a better adapted variety of white clover for Alabama.

With proper supervision and management, white clover seed produced as outlined above, will be the same year after year. This method of seed production minimizes the shift in genotype caused by management practices. In an ordinary field of white clover which consists of plants of many different genotypes, close grazing favors the seed production of the small type. Light grazing favors the larger type.

Breeding white clover compared to breeding of corn and cotton is more expensive. White clover plants are perennials and must be maintained 12 months per year. Yields must be taken four or five times per year. Therefore, there are more data to obtain and to analyze. This means that relatively more of a breeder's time must be spent on the breeding program. There are no cash returns from the crop until the breeding program has progressed to the point where a variety is released. In the case of corn and cotton, there are returns from sales each year.

Few people other than those who work with forage crops are cognizant of the problems involved and the possibilities of progress of breeding forage crops for Alabama and the Southeast. This slide contrasts an adapted and an unadapted white clover. If we can offer the farmers a reliable source of good seed, the additional returns will pay for many breeding programs.


Breeding White Clover
Source Nursery - 5,000 or more spaced plants
One or more years
Polycross Nursery and Progeny Testing of Superior Lines 50 or More Lines
One or more years
Polycross Performance Test
One or more years
Crossing Blocks to Produce Experimental Synthetic Varieties
One Year
Variety Tests
Seed Multiplication
Breeder Seed
Foundation Seed
Registered Seed
Certified Seed

RECOMMENDATIONS for SEED TREATMENT of GRAINS and LEGUMES in ALABAMA . . . . J. A. Lyle

There are a number of approaches to the prevention of losses from disease, all of which have as their goal increased crop yields. These include improved cultural methods, breeding productive disease-resistant varieties, or fungicidal treatment of seeds, which is the subject of this discussion.

Chemical treatment of seed has become a recognized practice in the production of many major crops, such as corn, cotton, peanuts, and small grains. However, the treatment of seed of legumes, especially the small-seeded ones, is a relatively new concept to many people.

Diseases Subject to Control by Seed Treatment

Good seed germination is, and always will be, desirable; but once seed are planted, they are on their own. Many hostile organisms exist on the seed and in the soil, ready to attack the seedling plants as soon as they start to grow. These organisms cause seed rot, seedling blight, damping off, etc. They are the causes of such diseases as the seedling-blight stages of anthracnose of small grains, alfalfa, blue lupine, and the clovers; bacterial blight, spot blotch and scab of barley; Victoria blight of oats; the Fusarium, Helminthosporium, and bacterial blights of oats and wheat; spring and summer black stem of alfalfa and the clovers; and brown spot of blue lupine.

Kinds of Treatment Available

For years, it has been known that legumes are subject to seed rot, seedling blight, and damping off the same as corn, cotton, and the small grains. Most progress on the chemical treatment of legume seeds has been made since World War II. Perhaps the best reason for this is because of the great increase in grassland farming. Then too, there have been several new fungicides developed that are much safer to use than previous ones. Pre-war fungicides for seed treatment were based on the heavy metals -- mercury, copper and zinc. These materials are quite toxic to legume seed, and gave poor results. Non-metallic organic materials have proved safe to use at very high rates, and have been shown to be particularly effective for protection against soil-borne organisms.

Most of the fungicides used as seed treatments fall in one of three general groups:

1. Mercurials organic and inorganic.

2. Copper and zinc inorganic materials.

3. Non-mercurial organic compounds, metallic and non-metallic.

A fourth or miscellaneous group which might be added, includes such materials as hot water, hot vapor, dry heat sulfur gases, ultra-violet and infrared rays, and shortwave or high-frequency oscillations. Most of these either have objectionable features or have not been proved effective or practical.

Mercurials

Inorganic mercurials such as mercuric oxide, mercurous chloride (calomel) and mercuric chloride (corrosive sublimate) have been used to some extent only for the treatment of seeds or tubers of certain vegetables.

Organic mercurials have proved to be more effective in cereal seed treatment than any other class of fungicides. This is partly due to the fact that they are more or less volatile, and the fumes penetrate the hulls of such seed as barley, oats, and some sorghums to reach the disease organisms underneath.

Copper and Zinc Inorganic Materials

Copper is the metal most commonly used in inorganic nonmercurial fungicides for seed treatment. Copper carbonate is the best known and most widely used copper seed treatment. It has been recommended for treating wheat and sorghum seed.

Zinc is not used so widely in fungicides as is copper. Zinc oxide is applied to some extent as a treatment for vegetable seed.

Non-Mercurial Organics

Fungicides of this type were developed during the last war when mercury and copper were scarce. A number of them have proven effective for treating seed of corn, sorghum, vegetables, peanuts and other legumes. They are not recommended, in general, for barley, oats, and wheat. Materials such as Arasan, Phygon and Spergon are included in this group.

Among the non-metallic organic materials, one should not fail tb mention formaldehyde, one of the early treatments which is still used for treating seed of oats and wheat, and to some extent, barley.

Miscellaneous Treatments

Most prominent among these is the hot water treatment of barley and wheat for the control of loose smut. This is a laborious and exacting procedure that requires great care and also special equipment usually not found on farms. Frequently, for this reason, only a small quantity of seed is treated and this is sown in an isolated field to furnish smut-free seed for the following year.

Micronized sulfur has been used at times for controlling bunt in wheat and kernel smuts in sorghum. It is cheap and abundant but is not highly recommended because of its failure as a seed protectant.

The use of various gases, vapors, diathermy, ultraviolet and infrared rays, and other devices, have occasionally been advocated for seed treatment, but their feasibility has not been demonstrated sufficiently to warrant their recommendation.

Methods of Applications

Dust Treatments

Equipment for treating seed with dust fungicides ranges from small home-made hand operated mixers, capable of treating about 25 bushels an hour, to large commercial outfits that can treat 500 bushels an hour.

The small home-made treaters are of two types -- the rotating barrel or oil-drum "batch" type suitable for all fungicide dusts, and the small continuous or gravity type, suitable only for volatile organic mercurials. The barrel treater is easier to make but is less durable than the oil-drum treater. The barrel treater may shrink or warp so that it is not dust-tight, or may even collapse after prolonged exposure to hot dry weather.

The gravity type of treater usually does not mix the dust and seed very thoroughly and, therefore, is recommended for applying volatile dusts but not for dusts whose effectiveness depends on a thorough coating of the seed. The seed is put into a hopper, the proper amount of dust is added, and the two are mixed by a series of baffles as they pass down the mixing chute and into a sack.

Slurry treatments

Treaters for applying fungicides in slurry form are somewhat expensive for the average farm. This form of treatment eliminates all dust problems since the chemical is suspended in water. The volume of the suspension applied is kept constantly in direct ratio to the weight of seed treated. Most of the commercial seed companies treat the seed of hybrid corn and small grains prior to delivery to their customers by this method.

Limitations of a Seed Treating Program

Effectiveness in disease control is the main standard by which a fungicidal seed protectant is judged. Testing the fungicidal efficacy of materials for seed treatment presents a number of difficulties. One such problem is the matter of obtaining a supply of seed that is sufficiently infected to furnish an adequate test for the fungicides. If lightly infected seed is used for seed-treatment experiments, the merits of the fungicides cannot be adequately tested. Again, heavily infected seed may be available, but the conditions during the period of germination and early growth may be highly unfavorable for the development of the disease, and the consequently low percentage of infected plants from untreated seed makes the test inconclusive.

Effectiveness of a seed protectant in disease control is expressed in terms of increased germination, stand, and yield. More vigorous plants will make a more rapid recovery and regrowth after grazing or mowing. Laboratory tests under controlled conditions have demonstrated that proper seed treatment neither increases nor decreases the inherent germinability, viability, or natural vigor of common varieties of small grain and legume seeds. Furthermore, stands from identical seed may differ in different parts of the same field whether the seed is treated or not. Good seed treatment substantially improves the chances of survival for each seedling.

Other standards by which a seed protectant is judged are as follows:

a. Its margin of safety,

b. Its corrosive effects on machinery,

c. Its disagreeable or injurious effects upon the persons applying it,

d. Its physical properties such as fineness, adherence to the seed, and stability, and lastly

e. Its cost per unit of seed treated.

DIFFICULTIES in OBTAINING TREATED PLANTING SEED of GRAINS and LEGUMES . . . . E. F. Schultz, Jr., And J. A. Lyle

That treated seed are not available to (or, at least not planted by) farmers in large quantities is borne out by the answers received from recent questionnaires sent to Substation and Experiment Field personnel and county Extension workers.

Only 38% of the Experiment Station's lands planted to oats this fall were planted with treated seed.

Thirty-seven of Alabama's 67 county agents responded to the inquiry, resulting in 28 sets of usable answers as to acreages of oats planted. Their figures regarding acreages have been compared with the 1950 agricultural census to establish some estimate of the general reliability of the answers received. Unfortunately the two estimates are not in agreement. The census data indicate 54,000 acres of harvested oats for the 28 counties in 1949 versus 162,300 acres estimated by the county agents this fall - exactly 3 times as many acres.

Whether their estimates of percentage area planted with treated seed would come any closer to possible existing other estimates is unknown. Their weighted average percentage estimate is 15.8% of oats planted with treated seed.

Replies of Substation and Field superintendents indicate that only 3 Experiment Station units are relatively close to commercial facilities for treating small grains. The prices charged for treating seed oats varied from a low of 6¢ per bushel to a high of 48¢ per bushel. For treating seed directly on the station, 3 alternative methods were mentioned - all slow and laborious, one even dangerous. They are (1) the barrel treater, (2) mixing in a small concrete mixer, and (3) shoveling in the protectant on a smooth floor.

Of 37 reporting county agents 25 (68 per cent) indicated no facilities for treating small grain seed in their counties; 2 of these stated that such facilities are available in adjoining counties. Seven agents indicated that if cotton and peanut seed treating equipment would work, that such plants are available in their counties. It is highly probable that this type of equipment exists also in some of counties reporting no facilities.

Only 5 counties reported existing commercial seed treating equipment for treating small grains. Prices for this service varied from 5 to 48¢ per bushel.

One of the 3 Experiment Station Units and 3 of the 5 county agents reporting facilities, plus 4 of the seven agents reporting cotton or peanut seed treating facilities, state further that even though these facilities are available, there is no sizeable demand for their services in treating oats.

Such facilities are run by business men who expect returns on their investment. These operators try to calculate in advance of investment the prospects for sufficient demand to make an enterprise profitable. One of their chief methods of decision is to observe whether similar enterprises in other localities of equal potential are profitable. Perhaps lack of facilities in many areas can be attributed to lack of financial success of existing ventures, due to lack of demand for their services.

But if the service is profitable to the farmer, why is the demand not present?

Fourteen of the 37 reporting county agents (or 38 per cent) either made statements relative to the necessity of treating oat seed only when planted for grain harvest; alluded to the presence or absence of smut in their region; acknowledged the use of formaldehyde seed treatment only; or otherwise indicated the possibility that, to them, seed treatment of oats is still performed for the reason that it was 15 years ago - control of smut.

If 14 of 37 reporting county agents have such misconceptions, what percentage of farmers are likely to understand the reasons for treating oat seed?

Probably only a small proportion of Alabama farmers believe that there is any advantage to treating oat seed with fungicidal seed protectants.

If this is the case, then it is the obvious explanation of the limited demand for the services of existing facilities for treating oat seed.

It is proposed that exact recommendations and procedures for treating oat seed, together with results of tests supporting such conclusions, be widely circulated to agricultural workers and farmers in Alabama. If our own data are inconclusive, results from neighboring states where conditions are similar to ours may be cited.

It is also proposed that the owners of cotton, peanut and other seed treating equipment be advised as to how their equipment might be operated, or if necessary, modified to treat oats and other seeds in addition to its present uses.

STATUS of the ALABAMA CROP IMPROVEMENT ASSOCIATION . . . . . . Ralph R. Jones

The Alabama Crop Improvement Association is an organization of Alabama farmers. Its purpose is to maintain and make available to the public in large quantities high quality seed of superior varieties or strains that have been tested, or both bred and tested, by the Agricultural Experiment Station of the Alabama Polytechnic Institute.

This purpose should be highly significant to you as a group of agricultural research people. The program of developing and testing of improved strains and varieties of crops is of major concern to you because it is one of the initial steps in the progress of agriculture. I would remind you, however, that regardless of how successful your efforts in this direction may be, breeding and testing will never alone solve the problem of increasing the use of superior varieties on a scale commensurate with their value. A few handfuls of breeder seed of superior qualities or volumes of research data showing outstanding varietal performance are of little or no value unless the masses of our farmers can obtain seed of the superior plants and put them to use on the thousands of acres normally devoted to crops.

Seed certification, therefore, opens new avenues to progress in agricultural research work. If you do not have an appreciation for seed certification, I would plead with you to seek such appreciation — if only for selfish reasons. To those of you who have an appreciation, I would say good!

But let's not keep all good things to ourselves. Let's use certification; let's preach certification. It can broaden your contributions to agriculture.

The Alabama Crop Improvement Association was organized in 1945 under authority of, and in compliance with, Act Number 404 (S229-Smith), passed by the 1945 regular session of the Alabama Legislature. It is a democratic, self-supporting organization, receiving no appropriations or subsidies for its operation. Its membership is open to any bonafide farmer of the state, but all membership is subject to review by the directors of the association and any members can be expelled by the directors.

Officers consist of a president, a vice president, a secretary, and a treasurer. The president and vice president are elected by the members. Both serve for a period of one year. The secretary and treasurer are selected by the board of directors.

All affairs of the association are under the immediate control of the board of directors, which is made up of six members plus the president, who serves as chairman of the board. The directors are elected by the membership, with the terms of office staggered so that two new directors are elected each year to serve for a period of three years.

All officers and directors of the association serve without pay.

The association obtains its operating funds from membership and field inspection fees.

The Experiment Station and Extension Service of the Alabama Polytechnic Institute are cooperating agencies of the association. This cooperative relationship was established in the Act creating certification, which provides: "The Agricultural Extension Service and Agricultural Experiment Station of the Alabama Polytechnic Institute are hereby authorized and directed to cooperate and work with such associations of farmers in order to aid in the promotion of more widespread use of superior varieties and strains of crops bred and tested by such Experiment Station".

In line with this responsibility, both the Experiment Station and the Extension Service have cooperated. They assisted with organizing the association, and since its organization they have advised with the directors in setting up certification standards and in the development of policies, rules, and regulations governing seed certification work. Further, they have undertaken and carried out programs designed to promote more widespread use of certified seed. I can assure you that certified seed growers are appreciative of this cooperation, but it is natural to assume that they want more, bigger, and better cooperation. They need it if certification is to serve its full objectives and potentialities.

The Alabama Crop Improvement Association has been successful in its operations since its beginning in 1946. This success is indicated by a measure of growth in three directions--a growth in membership, a growth in acres, and a financial growth.

The association started with a membership of 22 farmers in 1946. Today there are 673 members. In 1946, 510 acres of crops were approved for certification; in 1952, 83,358 acres were approved. Starting with a capital of zero dollars in 1946, the association showed a total operating surplus of $41,025.02 at the end of 1952.

To me this growth is significant because it is an indication that the job of certification in Alabama has not all been in vain. It is significant, too, because it is an indication that the job of certification has at least been done partially right, for I do not believe that such growth could have occurred with a program too far off base.

The millions of pounds or thousands of bushels of seed of superior crop varieties now being produced annually for use by the masses of Alabama farmers are more significant to me than the figures indicating a growth in membership, acreage approved, and financial stability. Unquestionably, these seed are bringing additional income to the farmers of Alabama. How much? There is no accurate way to measure this, but certainly it amounts to millions of dollars annually.

While the above measures of success have been attained in certification, I can assure you that the directors are not unaware of the opportunities and responsibilities that are ahead. The program for the past six years has been a pioneer program in many respects. Many things have been done wrong; many things which were probably needed, were left undone. For 1953 and future years, the directors are planning for expanded services, more rigid enforcement of certification standards, and a general streamlining of the organization to provide for more and better certified seed. All of this should serve to strengthen confidence placed in certification.

I am aware of some of the limitations and weaknesses of certification that often are pointed out. Sufficient policing is not done. A few members are not as conscientious as the association would like for them to be. The result is that sometimes ordinary seed are sold for certified seed, improper processing is done, and seed are mislabeled. These are only a few of the charges you will hear directed against certification. Many times the charges may be true. Doubtless they are, because the membership of the Alabama Crop Improvement Association is made up of people—and there is evidence all around us from time to time that people do wrongful acts. Seed certification cannot and will never be perfect because its membership, its officers, its directors, and you and I of the Alabama Polytechnic Institute who work with the association are not perfect--and will never be.

Even with all of its weaknesses and limitations, I quite often defend certification with an analogy, comparing it with our form of government. We have a democracy, the highest and most perfect system that human beings have ever been able to devise. Yet it is not perfect. Every day we hear, read, and see evidences of fraud, greed, and scandal in our governmental system. But do we want to scrap our form of government because of these weaknesses? You bet your life, we don't! We love our democracy and the freedom it assures. We correct its weaknesses by cutting out the rotten spots from time to time. But junk it? Never! Defend it? Always!

And so it is with certification. Perfect? NO! Yet it is the best system that mankind has been able to devise throughout the centuries to provide farmers with the highest quality seeds obtainable. As we move forward we will cut out the rotten places, take up the slack, and continually revise the program to do a better job.

STATUS of the SOIL TESTING LABORATORY and PROPOSED PLAN of OPERATION . . . . Clarence M. Wilson

Interest in soil testing as an aid in recommending fertilizers has been increasing by leaps and bounds during the past ten years. This interest has not been confined to a particular locality but is nation-wide. In July 1950, a Soil

Test Work Group was appointed by the National Soil and Fertilizer Research Committee to consider the whole field of soil testing. In December 1951, this committee published a report called, "Soil Testing in the United States". In this report it was stated that some type of soil testing service was available from state agencies in every state except Alabama.

According to this report our neighboring states were reported to be handling the following volume of farmers' samples annually:

Mississippi	41,000	South Carolina	10,000
Louisiana	6,000	North Carolina	85,000
Florida	5,000	Tennessee	26,000
Georgia	35,000		

We in Alabama have been aware of this interest in soil testing, and we have been aware of the fact that our surrounding states as well as the other states in the nation had fairly extensive programs in soil testing. Even though we have discouraged soil testing up to now, the experiment station receives a considerable number of soil samples every year with a request for analysis. Such samples come in both to the Agronomy and Soils Department and to the Horticulture Department. In the Agronomy and Soils Department some member of the research staff has handled these samples and at least determined the soil pH. In some cases other analyses were made. The Horticulture Forum, a student organization, has handled samples from gardeners, nursery men, etc.

As mentioned earlier, the Experiment Station has discouraged interest in soil testing in Alabama until now. There were reasons for this. I will briefly discuss a few of these reasons.

1. We have not wanted to start a soil testing program until we had obtained sufficient data to show what a soil test meant in terms of crop yields. Everyone knows that a soil test alone is of no value until it is correlated with crop yields. The soil test by itself will simply show relative differences between fertility levels of two fields. To determine whether either of these levels is such that a crop response may be expected from the addition of fertilizer, it is necessary to conduct field plot fertility studies on the various soil types, analyze soil samples from these plots and then determine the meaning of the soil test in terms of crop yields.

   Although we still do not have this information for all of the crops nor all of the soil types, we feel that we have a pretty good foundation from our major crops and soil types on which to launch a soil testing program. This information has been obtained and summarized by the leaders of the phosphorus, potassium and lime projects and is published in our report, "The Basis for Soil Testing in Alabama". Copies of this report will be distributed to the Agricultural Workers in the State. Other persons desiring a copy may request it from the Soil Testing Laboratory.

2. A second reason why we have not rushed into a soil testing program, I think, is that we are fortunate enough to have a very fine and extensive system of substations and experiment fields which cover the soil regions of the state quite well. I feel that we have been more fortunate in this respect than many of our neighboring states.

This set-up has enabled us to make fertilizer recommendations for the various soil regions with considerable confidence. All of us will admit however, that soils vary widely in their fertility level within a soil region and for that matter from field to field on the same farm. Many factors such as cropping history, fertilizer history, cover crop program and inherent characteristics of the soil type may be responsible for these variations.

Of course, the best way to determine the fertilizer and lime needs of a crop on a particular field would be to conduct a fertilizer test on that field. Obviously this is an impossible task. The next best method then for making recommendations for a specific field would appear to be the use of soil tests which have been correlated with crop yields on similar soil types at various fertility levels. Along with the soil test other information such as cropping history, fertilizer history, cover crop program, topography and drainage must be considered in order to make a sound recommendation. Thus, with the fairly accurate determination of the fertility level of a particular field by soil tests and with the supplementary information requested with the soil sample, it should be possible to more accurately recommend fertilizer and lime for a particular field within a region than can be done with our general recommendations which are necessarily based upon a relatively few field tests within a soil region.

3. A third item which has ranked high in the consideration of soil testing program was space in which to operate and financial support on which to operate. The release of the building formerly occupied by PMA to the Extension Service has made it possible for satisfactory laboratory and office space to be obtained. Also, some financial support is now available for the soil testing program, but it will have to be partially self-supporting.

Beginning the first of this year the office of the Experiment Station Director approved the initiation of a soil testing program for Alabama to be operated by the Agronomy and Soils Department in cooperation with the Extension Service. Space for the laboratory and office in the Extension Annex building was allotted by the Extension Service. Money was allotted by the Experiment Station for the purchase of laboratory equipment and for the alteration of rooms B-2 and B-3 in the Extension Annex for a laboratory and soil-preparation room.

There was no project leader for the Soil Testing Project until August 1, when I was hired for that job. Until that time Drs. Rouse, Ensminger, and Davis of the Agronomy and Soils Department spent considerable time in deciding upon and requisitioning the necessary chemicals and laboratory equipment.

After August, plans and specifications for the laboratory construction were drawn up and the contract was finally let October 15. The laboratory is now completed and ready for operation.

I have mentioned earlier that the Soil Testing Program is to be operated by the agronomy and Soils Department of the Experiment Station in cooperation with the Extension Service. The Agronomy and Soils Department will be responsible for the operation of the laboratory and for sending out the fertilizer recommendations. Mr. Lowery and Mr. Harbor, the Extension Agronomists, will handle the educational program through the office of the county agents.

To begin the program, Mr. Lowery, Mr. Harbor and I plan to meet with all the county agents to explain the plan of operation as concerns the taking of soil samples and getting them to the laboratory.

Soil sample cartons and shipping containers will be placed in the county agents' offices and distributed to interested farmers. Along with these cartons will be an information form on which the farmer will supply information as to cropping history and the other factors we have mentioned. After samples have been taken, farmers will be encouraged to bring the samples by the county agent's office where he will be assisted in completing the information sheet which accompanies the samples. A subsoil sample will be requested with each topsoil sample. This subsoil sample will not be analyzed, but will be used in classifying the soil as to type and physical characteristics. A fee of $1.00 per sample will be charged for each topsoil sample. No charge will be made for subsoil samples. Farmers will be requested to enclose the completed information blank with a check or money order to cover the cost of analysis in an envelop attached to the soil samples.

After the samples reach the laboratory, they will be dried, classified as to type, sieved, and analyzed for available phosphorus, exchangeable potassium and calcium. The pH will also be determined. Fertilizer recommendations will then be made in terms of so many pounds of a particular fertilizer grade per acre. Three copies of this recommendation will be made. The original copy will go direct to the farmer, one carbon to the county agent and one for our files. Farmers will be encouraged to discuss these recommendations with the county agent if they desire. In case a farmer has reason to question the soil analysis, he may request that it be checked by writing the Soil Testing Laboratory within three months after the analysis was made. Samples will be stored for that period of time and will then be discarded.

This soil testing program is being planned not only as a service for the individual farmer, but also as a part of the research program of the Experiment Station. Therefore, soil testing will not decrease the need for field-plot work, but instead will encourage an expansion in field tests to be utilized not only as a basis for improving our general fertilizer recommendations but also as a means of better correlating soil tests with crop response for all of the important agricultural crops. In addition the research phase of the program will be directed toward the continuous improvement of chemical methods to increase the accuracy of predicting the need for fertilizers.

As has been true in past, general fertilizer recommendations based on information obtained from field tests will continue to be published and distributed as a general guide for fertilizer programs for the various soil regions of the state. Soil tests will aid in making more specific recommendations for a particular field within a soil region.

The Substations and Experiment Station are encouraged to use the service of the Soil Testing Laboratory especially in their general crop work and also in locating areas for fertility experiments when this is desirable.

We believe a sound soil testing program will accomplish the following:

1. Enable us to more accurately diagnose the fertilizer needs of a crop to be grown on a particular field.

2. Encourage more farmers to follow a sound soil management program.

3. Give agricultural workers a more accurate and complete picture of the fertility status of soils within the state.

4. Increase farmers' interest in the results of scientific research and bring those agencies involved in closer contact with the farm population which they serve.

CREEP-FEEDING of BEEF CALVES . . . . Wilbur B. Kelley

Interest in creep-feeding of beef calves has increased for the past several years and for this reason a cree-feeding experiment was planned for the Black Belt Substation and one year's results were obtained in 1952.

This experiment included both fall and winter calves (dropped Sept. 5 - Jan. 31) and spring calves (dropped Feb. 1 - May 7). Past performance records on these two groups of calves indicated the need of including both in this experiment.

Extreme care was exercized in dividing the calves for this test. Factors considered in making the division were production records of dams, age of dams, breeding of dams, age of calves, and breeding of calves. Since records were available relating to these factors it is believed that a uniform division of calves was made for the feeding and check groups.

It should be noted that this experiment was conducted with cattle that come from a well bred herd and that the dams of the calves were good milkers. Rotation of pastures was practiced and the pastures used in this test have been properly fertilized and managed for a number of years. The available grazing was not normal during a major portion of the grazing season due to abnormal weather conditions, but the tables will show a near normal gain for non-fed calves. The degree of finish on the non-fed calves was slightly under the finish that such calves have normally carried in the past.

The following tables give data resulting from the 1952 creep-feeding test for both fall and winter and spring dropped calves.

Table 1. Creep-feeding data — fall and winter calves: (1952)

	Creep-Fed	Non-Creep Fed
Total no. of calves	40	40
Av. initial wt., lb.	230.0	223.5
Calf-days in test	171.0	173.4
Av. final home wt., lb.	588.3	566.5
Av. additional gain to feed	15.3	
Av. gain per day, lb.	2.095	1.978
Av. market wt., lb.*	557.92*	536.45
Per cent shrink**	4.11	5.30
Market price per 100 lb.	$31.12	$28.80
Av. mkt. adv. to fed calves	$19.12	
Av. feed consumed, lb.	412.7	
Feed cost per 100 lb.	$4.244	
Av. cost of feed consumed	$17.51	

Av. additional value above feed cost	$1.61
Feed consumed per additional 100 lb. gain, lb.	2697

*adjusted because of additional in-weight.
**Figured on actual selling weight.

Table 2. Creep-Feeding data -- dam performance, fall & winter calves. (1952)

	Creep-Fed	Non-Creep Fed
Total no. of dams	40	40
Av. initial wt., lb.	1001.17	1055.52
Av. final wt., lb.	1170.67	1209.10
Av. gain for period, lb.	169.50	153.58
Av. adv. of creep-feeding in gain of dam, lb.	15.92	

Table 3. Creep-feeding data -- spring calves. (1952)

	Creep-Fed	Non-Creep Fed
Total no. of calves	15	17
Av. initial wt., lb.	150.4	159.0
Calf-days in test	171.7	167.5
Av. final home wt., lb.	521.5	487.2
Av. additional gain to feed	42.9	
Av. gain per day, lb.	2.161	1.959
Av. market wt., lb.	501.1	461.0*
Per cent shrink	3.90	3.60**
Market price per 100 lb.	$23.94	$23.24
Av. mkt. adv. to fed calves	$12.82	
Av. feed consumed, lb.	441.67	
Feed cost per 100 lb.	$4.29+	
Av. cost of feed consumed	$18.98	
Av. additional value above feed cost	- $6.16	
Feed consumed per 100 lb. additional gain, lb.	1030	

*Adjusted because of additional in-weight.
**Figured on actual selling weight

Table 4. Creep-feeding data -- dam performance, spring calves. (1952)

	Creep-fed	Non-Creep Fed
Total no. of dams	15	17
Av. initial wt., lb.	1084	1052
Av. final wt., lb.	1154	1154
Av. gain for period, lb.	70	92
Av. adv. of creep-feeding in gain of dam, lb.	- 22	

In table 1 it can be seen that on the fall and winter calves an additional value of $1.61 was realized per calf above feed cost for the fed calves in comparison with the non-fed calves. This amount did not pay for the additional labor that was necessary in the daily feeding of the calves. Even though there was a considerable spread in price in favor of the creep-fed calves, there was not enough additional gain to make the feeding profitable.

Table 3, relating to spring dropped calves, shows a spread in gain more in favor of the creep-fed calves than was realized with the fall and winter calves, but there was not near the spread in the price received for the calves. A loss of $6.16 per calf resulted from the feeding.

The feed ration consisted of cracked yellow corn and cottonseed meal mixed 8 parts corn to 1 part meal. Calves in both the fall and winter group and the spring group consumed approximately 2½ lb. feed per day average for the feeding period.

The creep-feeding results herein reported are submitted as a progress report with plans made for continuing the work for two additional years. No effort is being made to draw conclusions from this one year's work. The results indicate that with well bred and good milking dams running on productive pastures the addition of grain to the ration of the calves may produce calves carrying a higher degree of finish but a smaller degree of profit.

1951-52 BEEF CATTLE WINTERING and SUBSEQUENT SUMMER GRAZING DATA . . Wilbur B. Kelley

In recent years commercial feed concerns have sold on the market a pellet containing approximately 20% protein and some carbohydrates for beef cattle feeding. Until this pellet was put on the market the concentrate generally fed beef cattle in the winter had been cottonseed meal.

A need was seen for comparing the feeding value of the "commercial" or "range" pellet with cottonseed meal pellets. It was for this reason that winter feeding experiment was planned. Included in the rations for comparison were straight hay feeding substituting three pounds of hay for concentrates and a 20% protein ration consisting of crushed corn and cottonseed meal. Hay alone is the normal ration for dry cows in winter.

The rations of the four lots of cattle and the performance of each lot are shown in table 1. Also shown in this table are the comparative costs of the concentrates fed to each lot.

Table 2 shows the performance of the lots of cows after calving and the performance of the calves. A point of interest in this table is that the cows in lot 3 (commercial pellet) made a lower gain per day after calving than did the other three lots. This lot had given the best performance during the winter feeding period and it was to be expected that since this occurred the gain per day would be less during the spring and summer.

In studying the calf performance data it can be seen that the calves from the cows wintering on straight hay made the least gain per day, with their selling or final weight being the least. The seven calves in this lot weighed on an average 33 pounds less than did the 20 calves in the other three lots. If in the future this trend continues this experiment could change the winter rations that are generally fed pregnant cows during the winter in the Black Belt area. Their normal ration is hay without concentrates.

There is a considerable spread in the weaning weights of the three lots of calves coming from concentrate fed cows. The high protein ration (lot 4) gave the best performance. The spread between lots 2 and 3 (both 20% protein concentrates) was not expected.

The data resulting from this feeding test are far from conclusive since it involves only one year and few cattle. Some changes are being made in the feeding plan for the coming year that will improve the experiment and it is believed that valuable information will result after the test has been conducted over a several year period.

Table 1. Cow performance and concentrate cost for winter period, 1951-2

	Loss per cow* (91 days)	Loss per cow per day	Conc. cost per cow	Saving on conc. over highest cost
Lot 1 (15 lb. Hay)	48 lb.	.52 lb.	$2.73**	$5.19
Lot 2 (12 lb. Hay 2 lb. Home-mix***)	43	.47	5.42	2.50
Lot 3 (12 lb. Hay 2 lb. Com. pellets)	24	.27	7.92	----
Lot 4 (12 lb. Hay 2 lb. 41% CSM)	49	.54	7.01	.91

*Includes only cows dry for entire period
Lot 1 -- 6 cows; Lot 2 -- 6 cows; Lot 3 -- 9 cows; Lot 4 -- 5 cows

**Additional hay cost over 12 lb. to all groups

***Crushed corn-cottonseed meal mixed to 20% ration

Feed costs:

Hay	$20.00	Ton
Home-mix	59.56	"
Com. Pellets	87.00	"
41% CSM Pellets	77.00	"

Table 2. Cow performance after calving and calf performance, concentrate feeding experiment, 1951-52.

	No. Cows Calving	Cow Gain/Day while suckling	Calf gain per day	Calf Weaning Wt. (adj.)
Lot 1 (15 lb. Hay)	7	.481 lb.	1.891 lb.	491.3 lb.
Lot 2 (12 lb. Hay 2 lb. home-mix)	8	.536	2.003	527.2
Lot 3 (12 lb. Hay 2 lb. Com. Pellets)	7	.406	1.929	508.7
Lot 4 (12 lb. Hay 2 lb. 41% CSM	5	.677	2.046	539.8

PROGRESS REPORT of IRRIGATION-FERTILIZATION EXPERIMENT, LOWER COASTAL PLAIN SUBSTATION . . . . Lavern Brown

Due to the great demand for information on irrigation of pastures, an irrigation-fertilization experiment was initiated at the Lower Coastal Plain Substation in the fall of 1951, with the following objectives:

1. To determine the effects of irrigation at several fertility levels on the quality and yields of beef on fescue-white clover-Dallis grass permanent pastures.

2. To determine the effects of irrigation at several fertility levels on the botanical composition, stand, quality, and yields of forage of fescue-white clover-Dallis grass permanent pastures.

3. To determine the consumptive use of water for fescue-white clover-Dallis grass permanent pastures on a leaf fine sandy loam soil.

4. To study the correlation between herbage yields obtained by caging and beef yields of grazing steers.

The entire area was limed initially with 2 tons of lime, and three fertilizer rates are being used as follows:

1. 500 pounds 0-16-8, annually

2. 1500 pounds 0-16-8, annually

3. 1500 pounds 0-16-8, + 120 pounds of nitrogen in split applications, annually

Each fertilizer treatment is replicated four times using 2-acre plots (paddocks). Two replications are irrigated and two unirrigated.

White clover was seeded broadcast at the rate of 5 pounds per acre and fescue was seeded in 20-inch rows at the rate of 8 pounds per acre. Since there was a good stand of Dallis on the ground, no Dallis seed was added in 1952. It is planned to plant at least 10 pounds of P.L.S. per acre in the spring of 1953.

The overhead or sprinkler system of irrigation is being used. Soil sampling by 6-inch increments is used to determine when to irrigate. Water is applied when the top 18 inches reaches an average of 31.8 per cent moisture.

An irrigation schedule is being maintained from calculated consumptive use data and this is compared to the irrigation schedule actually followed.

Records are kept of the amount and rate of rainfall, evaporation rates, humidity, and temperature. This data is correlated with soil moisture data to determine the consumptive use of water.

Grade yearling steers of uniform type are being used to measure beef yields and six 4' x 4' pasture cages per acre are used to determine forage. The difference method of caging is used to determine the amount of forage actually consumed.

A complete record is kept of all cost of irrigation.

The area was stocked on April 9, 1952, and there was sufficient rainfall in April to meet moisture needs. The plots were irrigated once in May but this was followed shortly by rain. Consequently, the first differences to be expected from irrigation would be in June.

The following data covers the period from April 9, 1952 to November 18, 1952.

TABLE I. IRRIGATION-FERTILIZER EXPERIMENT, LOWER COASTAL PLAIN SUBSTATION, 1952

Treatment	Per acre	April 9 - May 6		May 6 - June 3		June 3 - June 28		July 1 - July 28		July 28 - Aug. 26		Aug. 26 - Sept. 23		Sept. 23 - Oct. 21		Oct. 21 - Nov. 18	
		I*	NI**	I	NI	I	NI	I	NI	I	NI	I	NI	I	NI	I	NI
500 lb. 0-16-8 annually	Beef yields, lb.	92	93	38	52	27	12	37.5	23	-5	-8.7	25	15	36.2	21.2	7.5	.6
	Animal unit, days	28	28	29.2	29.2	25	25.7	28	14	36.2	14.5	35	14	31.5	9.5	12	2.5
	Green forage, lb.	4,418	5,862	1,856	738	2,264	278	91	34	1,142	205	755	37	524	70	106	261
	Dry forage, lb.	1,193	1,577	540	220	720	110	33	21	410	124	240	16	198	32	40	132
	Green forage consumed, lb.	2,384	3,708	3,044	2,474	1,577	-24	871	510	878	614	1,042	109	992	221	323	154
	Dry forage consumed, lb.	708	1,194	901	720	552	-12	332	374	280	281	350	48	376	104	126	78
	Per cent Clover	9.8	8.0	23.8	12.3	26.2	4.0	21.0	0	21.6	0.2	23.0	0.4	10.8	0.2	14.6	0
	Per cent Fescue	38.3	47.5	37.7	56.2	37.5	58.6	37.5	80	26.9	82.1	34.0	77.1	39.6	79.0	54.0	85
	Per cent Weeds	51.9	44.6	38.6	31.4	36.0	37.5	41.4	22	51.4	17.7	39.2	21.2	48.8	20.0	31.4	15
1,500 lb. 0-16-8 annually	Beef yields, lb.	84	86	32	40	64	36	51.5	12	-76.2	-12.5	40	12.5	21.2	15	15.6	0
	Animal unit, days	28	28	30.5	29.2	37.5	28.5	42	14	43.5	14.5	35	14	31.5	5	16.5	0
	Green forage, lb.	7,402	6,039	2,496	966	2,840	314	749	-149	321	84	502	-205	790	178	57	68
	Dry forage, lb.	1,880	1,558	644	282	830	118	280	-95	126	50	156	-92	256	76	22	34
	Green forage consumed, lb.	2,906	3,220	4,921	2,624	1,934	744	1,740	137	691	68	1,094	225	1,085	132	569	97
	Dry forage consumed, lb.	802	1,024	1,304	706	646	366	738	106	230	30	327	98	394	58	240	55
	Per cent Clover	12.7	18.8	22.9	23.6	27.5	16.0	25.8	0	22.1	11.9	27.5	7.3	11.9	1.0	19.4	0.4
	Per cent Fescue	36.9	37.0	55.0	57.3	54.2	54.8	59.8	80.2	56.9	52.5	54.6	45.6	71.2	57.1	68.2	77.1
	Per cent Weeds	50.4	44.2	22.1	19.2	18.4	29.2	14.4	19.8	21.0	35.6	15.2	45.8	16.6	41.8	12.5	22.5
1,500 lb. 0-16-8 + 120 lb. N. annually	Beef yields, lb.	83	98	45	40	52	43	41.5	20.5	-1.2	-6.2	25	17.5	13.7	28.7	15	7.5
	Animal unit, days	28	28	30.5	30.5	37.5	32	35	14	38.2	14.5	35	14	31.5	14	16.5	14
	Green forage, lb.	5,721	5,185	2,394	1,640	1,870	2,256	658	-909	1,449	536	101	95	558	520	251	156
	Dry forage, lb.	1,476	1,348	656	446	576	726	243	-482	510	266	31	30	192	186	102	66
	Green forage consumed, lb.	3,338	2,014	4,521	4,510	1,195	1,057	644	216	1,305	747	1,156	880	749	761	874	330
	Dry forage consumed, lb.	928	578	1,284	1,186	411	428	242	139	411	-248	370	292	290	290	362	156
	Per cent Clover	11.0	9.6	23.8	21.0	23.3	11.9	22.1	0.2	21.0	7.0	13.2	10.0	3.8	2.3	8.8	1.0
	Per cent Fescue	45.0	60.2	56.4	57.2	59.6	62.5	62.5	80.4	52.1	70.8	60.6	67.9	78.4	73.6	78.6	82.7
	Per cent Weeds	44.0	35.2	19.8	21.6	17.1	27.4	15.4	19.4	26.9	22.1	23.6	22.1	17.9	24.2	12.7	16.2

* = Irrigation

** = No irrigation

TABLE 2

SUMMARY
for
Period beginning April 9,
and ending Nov. 11, 1952

Per Acre	500 lbs. 0-16-8 Annually		1500 lbs. 0-16-8 Annually		1500 lbs. 0-16-8 + 120 lbs. N. Annually	
	I	NI	I	NI	I	NI
Beef Yields, lbs.	258	208	232	189	274	249
Animal Unit Days	225	137	264	133	252	161
Green Forage Produced, Lbs.	11,156	7,485	15,157	7,295	13,002	9,479
Green Forage Consumed, Lbs.	11,111	7,766	14,940	7,247	13,782	10,515
Dry Forage Produced, Lbs.	6,746	4,470	8,385	3,860	7,569	5,174
Dry Forage Consumed, Lbs.	7,252	5,576	9,365	4,763	8,598	5,641

Table No. 3

CONSUMPTIVE USE BY PERIOD OF FORAGE YIELD SAMPLES

DATE		PLOTS 10, 11, 12 Rep. I	PLOTS 4, 5, 6 Rep. II	AVERAGE I AND II
From	Through	Water Use (In. Per Day)	Water Use (In. Per Day)	Water Use (In. Per Day)
5/7	6/4	.210	.195	.202
6/5	7/2	.165	.185	.175
7/3	7/28	.130	.175	.152
7/29	8/27	.135	.120	.127
8/28	9/23	.085	.105	.095
9/24	10/20	.055	.060	.057

Table No. 4

CONSUMPTIVE USE BY MONTHS

MONTH	AVERAGE ACTUAL USE (In. Per Day)	CALCULATED USE (In. Per Day)
MAY	.191	.182
JUNE	.180	.200
JULY	.155	.207
AUG.	.122	.192
SEPT.	.087	.167
OCT.	.050	.145

Remarks and Notes

There is no tangible reason for the cattle losing weight as they did in August. Blister beetle attacked the clover in the irrigated plots in late July. On August 6, the plots were dusted with 12 pounds of 15 per cent Methoxychlor per acre. It is possible that this could have upset the metabolism of the cattle on irrigated plots, but cattle on non-irrigated plots lost weight, which would tend to destroy this theory. Fescue made up a large percentage of the forage during this period and may have had some bearing on yields.

The plots were all to be stocked to capacity and it is possible that in an attempt to do this, the irrigated plots were over-grazed. Cattle on irrigated plots would have had to consume considerably greater amounts of green forage to receive the same amount of nutrients due to the difference in water content.

I would offer only one explanation of the wide variation in actual consumptive use of water. There was a decrease in the amount of forage present from June, and, of course, we would expect a lower transpiration rate.

I feel that the picture may be entirely different by the end of a grazing year. The clover on the irrigation plots is established and coming back in good shape, whereas clover on unirrigated plots had to come back from seed and will be much later furnishing grazing.

IMPROVEMENT of PERFORMANCE of BEEF CATTLE THROUGH MASS SELECTION . . Keith E. Gregory

The three major factors that contribute to performance in beef cattle are: (1) Cow performance, which includes both reproductive performance and mothering ability; (2) rate of gain and (3) conformation as it contributes to carcass desirability.

Estimates on the heritability of these characteristics indicate that information on an individuals own performance in these characteristics is a good estimate of what it will transmit to its offspring. With these high heritabilities for these characteristics mass selection should be the most efficient method of effecting permanent improvement in the performance of beef cattle. Before maximum advantage can be taken of the rather high heritabilities of these traits we need more precise estimates on their heritabilities, their relative values and information on the genetic correlations between them. This information is necessary in constructing a selection index for estimating the net breeding worth of each individual.

The objectives of this project are to develop criteria for evaluating and selecting breeding animals and to determine the effectiveness of mass selection for total performance in beef cattle.

Foundation stock for Angus, Hereford and Shorthorn lines have already been assembled and the first calf crop is being dropped this year.

The items that will receive primary consideration in this study are weaning weight (as an expression of the calf's inherent growth impulse and the mothering ability of the dam), postweaning growth rate, and conformation items indicative of carcass desirability. Some additional selection for cow performance will be practiced on the basis of the first and second calving records.

It is planned to keep inbreeding at a low level in these lines, at least in the early stages of selection. In general, two sires will be used in each line. With about 40 - 45 females per line most of the sires could be selected within the lines without any appreciable increase in breeding. However, if necessary to avoid intense inbreeding, or if a need for additional germ plasm is clearly indicated, performance tested bulls that have demonstrated their superiority may be brought in from outside sources.

The information to be gathered on the experiment will be birth weights and weights at four, six and eight months of age. All animals will be weaned at about eight months of age.

At weaning time all animals will be placed on performance tests for about 150 days in connection with the Performance Testing Project that is being carried out in cooperation with the purebred beef cattle breeders of the state. All animals will be scored on conformation items and graded at weaning and at the termination of the postweaning performance tests. Weights of all female replacements will be taken at about 6 month intervals until calving and all females in the herd will be weighed at calving and weaning time.

All females will be kept on improved pasture and an attempt will be made to graze the cattle as nearly as possible over the twelve months period. Roughage and possibly some protein supplement (depending on type of roughage) will be fed when adequate pasture is not available due to unfavorable climatic conditions. All replacement females should be sufficiently grown out to calve at twenty-four to twenty-six months of age, and the practice of late fall and early winter calving will be followed.

All bulls that do not show sufficient promise will be castrated before weaning time; however, all bull calves in which superior total performance is indicated will be left as bulls until the performance tests are completed, and bull selections will be made at this time. Heifer selections will also be made at this time.

The CAGE SYSTEM of EGG PRODUCTION . . . . D. F. King

The cage system, first introduced to southeastern poultrymen about two years ago, is creating great interest and definitely finding a place in South Alabama, South Georgia and Florida. There are known to be over 200,000 hens in cages in this area at the present time. This system of producing market eggs is being adopted very rapidly and will aid greatly in a few years in overcoming the egg deficit of the Southeast as well as adding materially to farm income.

A study of 50 cage operators who have been in business for an average of 15 months with an average of 1200 cages each, shows 94 per cent to be satisfied or well pleased with the results and only 6 per cent to be dissatisfied. These operators, many of whom also have hens under floor management, state that they are able to obtain higher production (69% vs. 61%) and lower mortality (5% vs. 15%) from cage-managed birds. These two items indicate that they are realizing a labor income of about $1.75 per year more from a cage hen than from a floor-managed hen.

Seventy-five per cent of the cage operators report flies to be the most serious problem. No other problem was listed by more than 5 per cent of those reporting.

Those desiring additional information on details of housing as well as management practices for hens under this system can obtain this information from the Alabama Agricultural Experiment Station Circular No. 110.

CONTROL of AVIAN COCCIDIOSIS THROUGH IMMUNIZATION . . . . S. A. Edgar

Coccidiosis of chickens is a protozoan disease of the lower intestinal tract that in nature is acquired by the ingestion of infective oocysts from contaminated litter or surroundings. The life cycle is direct being completed in from 6 to 9 days, depending upon the species involved. A part of the cycle occurs inside the chicken and a part outside. Due to the parasite's microscopic size and prolific nature, it is easily trasmitted from bird to bird and from flock to flock having world-wide distribution and causing losses to poultrymen amounting to millions of dollars annually.

There are several recognized species of chicken coccidia, the most common being _Eimeria tenella_. It invades the inner lining of the cecal pouches and in severe infections causes excessive hemorrhage and sloughing of the lining resulting in bloody diarrhea, unthriftiness and often death. The two or three most pathogenic of intestinal types invade and damage the lining of the small intestine. The course of intestinal coccidiosis is usually longer than the cecal type, thus causing prolonged unthriftiness with an occasional death.

However, severe infections sometimes occur in which there is marked interitis with considerable sloughing of the lining, some hemorrhage and often mortality. The severity of either form of coccidiosis among susceptible chickens depends upon the number of infective organisms ingested.

Coccidiosis is combatted in two general ways, (1) preventing birds from exposure to the parasite, and (2) attempting to allow mild exposure, reducing losses either through (a) management practices alone, or through the feeding of coccidiostatic drugs at (b) therapeutic or (c) prophylactic levels. The first method is not feasible since most chickens are reared on litter or ground where absolute prevention from exposure is nearly impossible. Thus control of coccidiosis has been attempted usually by one of the three methods listed under (2). With the advent of several new coccidiostatic drugs, coccidiosis during the past few years has been controlled with considerable success by methods (b) and (c). With method (a) there is often high mortality plus considerable weight loss. With method (b) there is often considerable mortality plus weight loss before treatment is administered, and sometimes it is necessary for the grower to treat birds two or three times for the same type of coccidiosis. Method (c) usually prevents mortality from cecal coccidiosis but seems to be less effective in preventing losses from intestinal types. However, at times the grower must resort to medication at a therapeutic level in order to prevent losses from either type. With any of these three methods, chickens eventually become immune to the types of coccidia they have been exposed to. Immunity to one species of coccidia does not give immunity against other species. Thus absolute protection against coccidiosis is attained only after birds have acquired immunity. Immunity can be acquired among survivors during a short period of two to four weeks using methods (a) and (b) but it uaually takes longer. Immunity usually occurs more slowly when method (c) is employed. Using any of the three methods, exposure is usually erratic so that chickens may not become immune until late in the growing period or even after maturity.

Since most chickens eventually come in contact with coccidia why not then expose them (1) at an early age when they are least valuable, (2) before they have had a chance to pick up a natural and erratic infection, (3) when medication with drugs to arrest infection would cost less because of low feed consumption, and (4) to get this common disease out of the way before birds might be subjected to other stresses and before weight-gains begin to count.

Studies on the development of a practical method of immunizing chickens against coccidiosis were begun by our laboratory in the fall of 1947. Cecal coccidiosis was attacked first since it was the type most often encountered in Alabama and it had been studied more intensively than other types. More recently numerous experiments have been conducted at this station to develop methods of immunizing against pathogenic intestinal types.

Numerous experiments have been conducted in connection with this project but space permits only a few statements of certain findings pertinent to the immunization method developed in our laboratory. It was found that mortality from coccidiosis could be prevented by the administration of certain drugs (e.g. sulfaquinoxaline) within 72 hours after a lethal dose of oocysts had been administered. Chickens reared free of coccidia were susceptible at any age. Chicks could be inoculated via feed at three days of age with a small number of oocysts resulting in a uniform flock infection provided chicks were hungry at the time of inoculation. The initial inoculum did not cause detectable symptoms of coccidiosis in the chickens but was sufficient to result in their seeding the litter and re-infecting themselves. The second cycle of infection was severe enough to result in birds developing solid immunity by the 28th day of age. However, it was found that a coccidiostatic drug should be administered at a therapeutic level for two to three days prior to the effects of the second cycle of infection. Losses from cecal coccidiosis averaged less than 0.5% during the immunization phase and when immunized birds were challenged at 28 days of age with inoculum, that killed 50% of non-immune controls, they continued to make normal weight gains and there was no mortality. This indicated solid immunity by 28 days of age.

That chickens should be immunized at an early age was substantiated by the results of experiments in which battery-reared chicks were inoculated orally at specific ages, each with numbers of infective oocysts of E. tenella in proportion to its body weight at the time of infection. The growth curves of uninfected controls, and chicks inoculated at 3 days, 2 weeks, 6 weeks and 10 weeks of age are shown in Fig. 1. There were 4 replicates of 10 chicks or a total of 40 chicks per group. Mortality among uninfected controls, and chickens inoculated at 3 days, 2 weeks, 6 weeks, and 10 weeks of age were 0%, 12.5%, 32.5%, 37.5% and 22.5% respectively, or an average mortality of 26% for inoculated groups. Chicks inoculated at three days of age exhibited a very slight and temporary drop in weight-gain below the normal growth curve. Those inoculated at two weeks of age experienced a greater drop in weight-gain never quite equaling uninfected controls by 12 weeks of age. Whereas, those inoculated at 6 weeks and at 10 weeks of age experienced the greatest loss in weight gain, weighing considerably less at 12 weeks than groups inoculated at three days and two weeks. Retardation in weight gain for the first three infected age groups was roughly proportional to body weight at the time of infection. In terms of final weight the groups infected early had a definite advantage over those infected at 6 and 10 weeks.

The procedure for immunization finally devised by our laboratory is shown in Fig. 2. Chicks are inoculated with oocysts in the feed at three days of age after having been starved over night. In anticipation of a reaction from the second cycle of infection, birds are given sulfaquinoxaline in the water or feed for 2-3 days, starting the 13th day after inoculation or when they are 16 days old. Within one or two days after medication is started, if immunization is occurring properly, the flock appears sick with coccidiosis and there may be some passage of blood. Any mortality usually occurs at this time, but severe mortality has been prevented by feeding the sulfa drug. Mortality from cecal coccidiosis seldom exceeds 0.5%. Birds recover quickly from the reaction and make normal weight gains.

After having conducted many experiments at A.P.I., a series of field trials using the method diagrammed in Fig. 2 were conducted utilizing commercial flocks in the vicinity of Auburn. Results of the first six tests are shown in Table 1. Mortality from cecal coccidiosis averaged 0.37% per flock for the first four weeks and none thereafter. When challenged at 28 days none of the test chicks from immunized flocks died, there was no retardation in weight gain and only one bloody dropping was seen in one group, whereas 20 to 70% of the control groups died and all survivors exhibited significant weight losses. Immunized flocks were better than average when marketed. Similar trials were then conducted in cooperation with Dorn & Mitchell Co., Inc. of Birmingham, Alabama. Their test involved 40,000 birds in North Alabama, Georgia and Mississippi and results were even more promising than those conducted near Auburn. Thus, it appeared that sufficient evidence was available to warrant making the product available to growers.

Table 1 Field trials near Auburn, Alabama, on the immunization of chickens against cecal coccidiosis (E. tenella).

Field trial	Number of birds	Breed	Mortality from coccidiosis: During immunization: Number	Per cent	After challenging*: Number
1	2,700	NH X WL Cross (production)	12	0.44	0
2	6,000	New Hampshire (broiler)	52	0.87	0
3	450	NH X WL Cross (production)	3	0.67	0
4	450	NH X WL Cross (production)	3	0.67	0
5	4,300	New Hampshire (broiler)	2	0.05	0
6	6,000	New Hampshire (broiler)	0	0.00	0
Total 6	19,900		72	0.37	0

* Twenty-five birds from each flock were challenged with 50,000 oocysts each as were an equal number of coccidia-free reared controls.

To date, between 7 and 8 million chickens have been immunized with considerable success by this method.

The packaged product inculdes inoculum and sufficient water soluble sulfaquinoxaline for a 2-3 day treatment. The present cost to the grower is one cent per bird. This compares favorably with the cost of continuous medication (c) and is less than the usual cost of treating when coccidiosis appears, 1 to 4 cents per bird, method (b) page 53.

Several experiments have been completed in which birds were immunized at the same time against both cecal and one intestinal type (E. necatrix). Chicks from both inoculated and control (not inoculated) pens were challenged at 28 days with both E. tenella and E. necatrix, and records similar to other experiments were obtained. Inoculated pens in each experiment received sulfaquinoxaline at the time described for E. tenella-immunization and all but one non-immunized pen was treated one or more times for natural outbreaks of coccidiosis during the growing period. Control pens were observed daily and treatment was started at the first sign of the disease. Results of the first six experiments are shown in Table 2. Except in experiment 4 immunized birds weighed more at 4 and 8 weeks than respective controls. For all experiments immunized pens averaged 0.155 pounds more per bird than non-immunized. Most mortality from coccidiosis occurred between the 4th and 8th week in control pens and before the 4th week in immunized pens. Three times as many chicks died in non-immunized pens as in immunized pens. At challenge it was found that some birds in two

Table 2. Average weight difference per bird for those inoculated with both *E. tenella* and *E. necatrix* versus control birds.

Experiment number	Number chicks started per pen*	Average weight Difference per bird in favor of immunized pens at: 4 weeks-in grams	8 weeks-in pounds
1	140	+ 49	+ 0.22
2	114	+ 29	+ 0.23
3	158	+ 18	+ 0.16
4	108	-25	-0.08
5	150	+.27	+ 0.25
6	137	+ 39	+ 0.10
Total 6	807	+ 24 grams	+ 0.155 pounds

* There was an equal number of chicks in each of the two pens per experiment. One pen was inoculated at 3 days of age and the control was not.

inoculated pens did not have solid immunity against *E. necatrix*. None of the birds in control pens had solid immunity for either type at 4 weeks. Certain details must be solved before immunization of commercial flocks against intestinal coccidiosis should be attempted, but preliminary data indicate that it is not only possible but may be feasible to immunize against intestinal coccidiosis on a commercial scale. However, it should be mentioned that very little intestinal coccidiosis of any type has been observed in flocks immunized against cecal coccidiosis. Experiments are in progress in which the merits of our method of immunization is being compared with a continuous medication method (0.0125% nitrophenide).

Like many products and methods which finally reach a marketable stage, new avenues of research open and unanticipated uses materialize. Field use of the vaccine has necessitated the re-investigation of certain aspects of the parasite and the disease that it causes, bringing to light certain errors of our knowledge that have persisted for 25 years. Although Dr. Johnson of Oregon State anticipated the practicability of immunizing chickens against cecal coccidiosis in the late twenties, it has taken us 25 years to put his thinking into effect. To our knowledge this is the first time that active immunization against a protozoan disease has been attempted on a widespread commercial scale.

Fig. 1. Effect of cecal coccidiosis (Eimeria tenella) on weight gain of laboratory-reared New Hampshire chickens inoculated at four ages with numbers of oocysts in proportion to body weight at time of infection. Average mortality for chicks infected at four ages = 26%

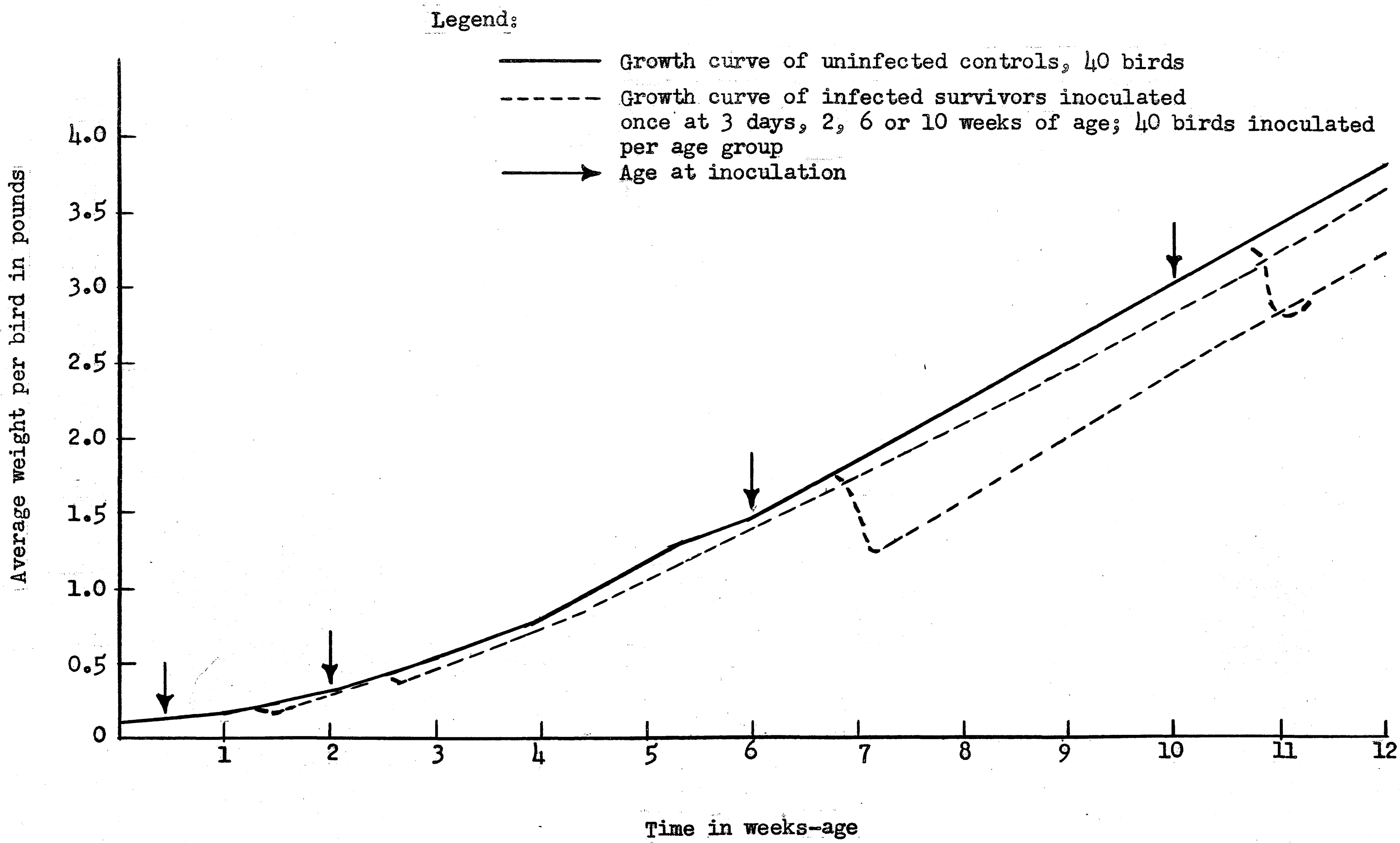
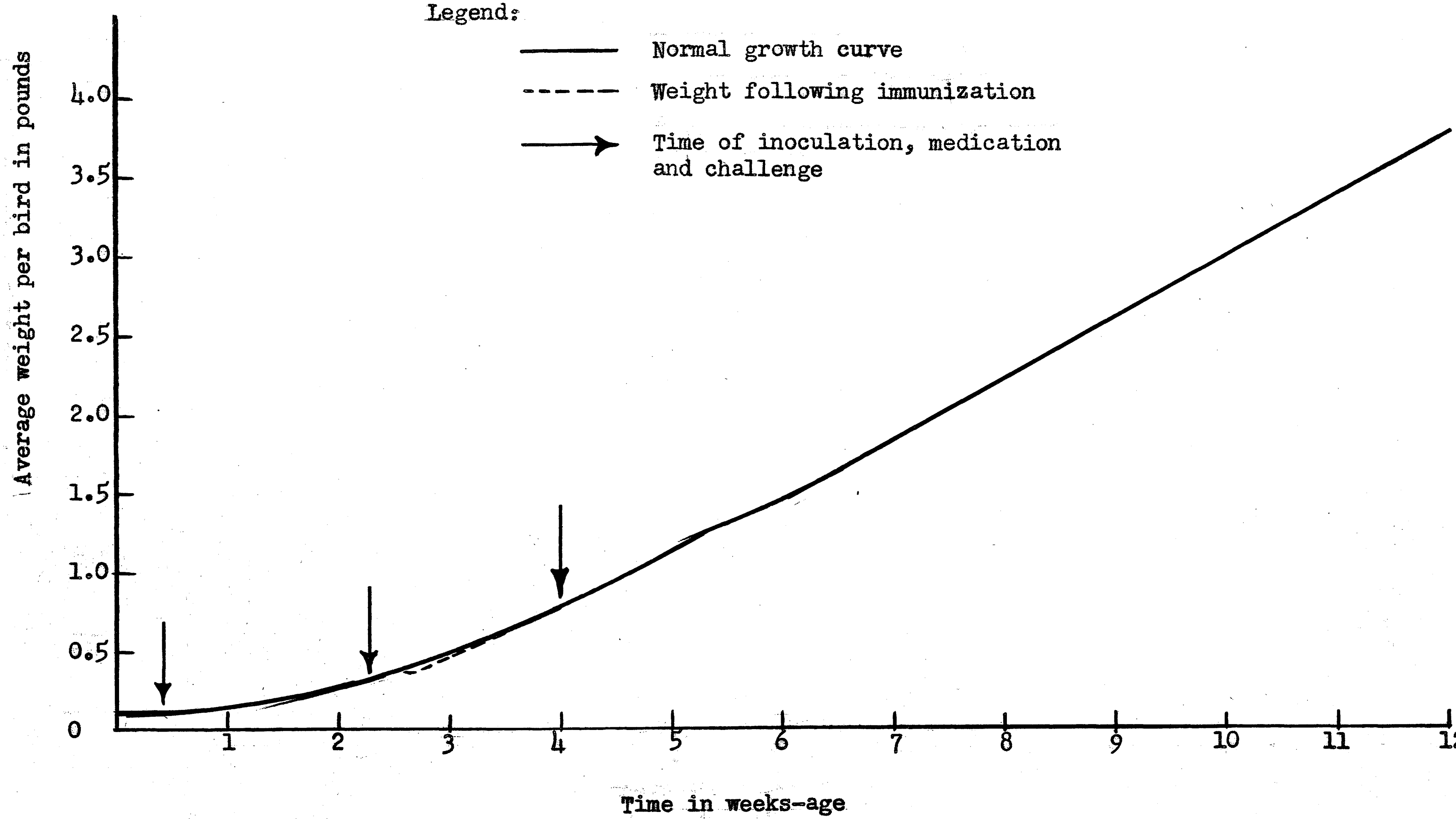


Fig. 2. Practical method of immunization of chickens against cecal coccidiosis (*Eimeria tenella*), inoculation at three days of age.



CHEMICAL WEED CONTROL . . . . V. S. Searcy

In view of the continuous decline in farm labor and the increasing cost per unit of labor, it is fairly safe to assume that the demand for chemicals for controlling weeds will continue to increase. The request for information on the control of weeds with chemicals for the past few years has been phenomenal. The research workers have been forced to make many suggested and tentative recommendations. In many instances, these suggestions, or recommendations, were not followed and consequently many people were dissatisfied or disappointed. Perhaps we should remind ourselves once again that all of the answers cannot be had in such a short time.

Chemical weed control should not be regarded as a cure-all for our weed problems. It is another tool to be fitted into the existing weed control program. It should be kept in mind that there are a vast number of weed problems and that in most instances each one calls for a different and specific approach. Very seldom can general recommendations be made. In most cases, the kind and amount of chemicals and their method of application will be very specific; and unless we are willing to accept this approach, it is doubtful whether the full potential of chemical weed control will ever be attained.

Obviously the entire field of chemical weed control cannot be covered in the time allotted here. It is not the intention of this discussion to present a mass of data but to cover very briefly some of the results of research; and to point out certain weed problems and how chemicals may be used for their solution.

The rest of this discussion will be divided into three main topics: (1) row crops, (2) special weed problems and (3) forage crops. They are not necessarily arranged in order of importance and no attempt will be made to cover all the crops or problems under these three broad headings.

Row Crops

Cotton and peanuts are the two largest cash crops in this State. Under average conditions, both crops require a relatively large amount of pre-harvest hand labor. It has been said that the pre-harvest hand labor requirement is the biggest stumbling block in the complete mechanization of the production of these crops. A considerable amount of research has been conducted in an attempt to find chemicals that could be used to replace the hoe, either wholly or in part, for weed control. The results have been gratifying, particularly with annual weeds. However, where perennial weeds are a problem in these crops, chemicals have not shown as much promise.

At the annual meeting preceding this one, cotton was discussed in detail. Recommendations were made in a Progress Report. For this reason, only a few statements will be made concerning cotton. The results in 1952 were essentially the same as 1951. An addition will be made to the 1951 Progress Report. 3-Chloro IPC will be recommended as a pre-emergence treatment at the same rate as the dinitro compounds.

Perhaps it is appropriate at this time to give you a very brief report on a belt-wide meeting held in Memphis, Tennessee the 4 and 5 of December for the purpose of discussing chemical weed control in cotton. Most of you know that some difficulty was encountered last year with the dinitros in Alabama and several other states. There was some evidence that the dinitros had directly or indirectly killed cotton. On the other hand, a survey in one state showed that as much cotton was planted over on non-treated cotton as on treated cotton.

All states that recommended the dinitros in 1952 will continue to recommend them during 1953. Most of the states are going to add 3-Chloro IPC to their recommendations as a pre-emergence treatment. Louisiana is the only state that will recommend CMU. Most, if not all, recommendations will be made with certain reservations.

Peanuts

The Alabama Agricultural Experiment Station has conducted more research on the control of weeds in peanuts than any other station in the peanut area. You have heard reports concerning the control of weeds in this crop at previous conferences. The dinitro compounds have been tested for five years and continue to look very good as a pre-emergence treatment. These are the only chemicals tested that have consistently produced high yields of peanuts and at the same time given satisfactory weed control. The results compare favorably with work conducted in North Carolina, Georgia and Florida. A Progress Report is being prepared at this time summarizing the results.

Corn

In Alabama the request for information on the control of weeds in corn have been after lay-by time. The requests have been mostly on how to control cocklebur, coffee weed, and morning glory. The 2, 4-D compounds at the rate of 1.0 to 2.0 pounds per acre do a good job controlling these weeds. However, there are certain precautions which everyone should know about before using 2, 4-D. This information is available to those who request it.

Special Weed Problems

There are numerous special weed problems, such as Bermudagrass, Johnsongrass, nutgrass, briars, honeysuckle, fence rows, brush, etc.

There is some information available on how to control all of these pests with chemicals; however, before recommendations can be made, one must consider such questions as what is the land to be used for; when is the land to be put into production; will special equipment be needed for application; cost of the chemical; and the hazards involved in handling the chemical with respect to animals and plants. To illustrate, methyl bromide is an excellent chemical for the control of nutgrass. It is practical and economical to use on plant beds, garden spots, or small areas in a field where one wishes to prevent the spread of nutgrass. It is costly; it requires special equipment for successful application, and is dangerous to the handler unless he follows the instructions carefully.

Forage Crops

There are so many different forage crops and weed species that invade those crops that only a few of the more common problems will be mentioned.

Wild Onions

To the dairyman or the producer of certified small grain and grass seed, wild onion is perhaps the most obnoxious weed in existence. For the grass seed producer, the 2, 4-D compounds have proven to be very effective and economical in preventing the onions from making aerial parts. This is also true in growing some of the small grain for seed. However, the important thing to remember is that small grain varieties vary considerably as to their susceptibility to 2, 4-D.

Unless a small grain variety has been tested for its susceptibility to 2, 4-D, it is risky to use this material.

Fortunately most of the grasses used for grazing are quite tolerant to 2, 4-D. This cannot be said for the legumes in general. However, some of the lespedezas are quite tolerant to this chemical. There are no proven methods or chemicals for the control of onions in a legume-grass pasture, that will not seriously damage or kill the legumes. One approach to the problem is for the dairy farmer to resort to grasses only and use 2, 4-D to keep the onions suppressed. Another approach is to use the method worked out by Dean E. V. Smith some 10 to 15 years ago. He found that most of the onions have germinated by January or February and that by applying a 5-95 or 10-90 mixture of creosote and kerosene at this time of year, for two successive years, wild onions could be practically eliminated. The minimum effective rate of application was approximately 200 gallons per acre. However, he pointed out that uniform coverage was the secret to successful control and with better spray equipment, the volume might be reduced. The work was conducted on a Bermudagrass sod and in every instance, the grass had completely recovered by or before July. No doubt this is still the best method where control approaching eradication is desired.

Cherokee rose-marsh elder-bitterweed

Cherokee rose is one of the most difficult pasture pests to control. Mechanical control at best has been only a partial answer. Experiments conducted at the Lower Coastal Plain Substation for the past three years have shown that Cherokee rose can be killed with the borate compounds and CMU. However, these chemicals are unsatisfactory from the standpoint of cost and their effect on the soil, where heavy infestations occur. It was noted in some of the early tests, that 2, 4-D was effective for killing the new growth of Cherokee rose. Based on this information another method is being studied whereby the Cherokee roses are removed by mechanical means followed by light applications of 2, 4-D when needed. This has resulted in three applications per year. After two summers of this treatment, many of the old Cherokee roses are still sprouting. The first study was located in an unimproved pasture; the desirable species were common lespediza and Dallisgrass. Dallisgrass is spreading on all plots treated with 2, 4-D. No detrimental effect has been noted on the common lespedeza except at the high rate of the low volatile ester of 2, 4-D. Perhaps the most interesting feature noted about this test was the disappearance of marsh elder (Iva S.P.) and bitter weed (Helenium tennifolium) after the first application of 2, 4-D. Other studies have shown that marsh elder can be controlled with 2, 4-D without injury to common lespedeza. Dog fennel or summer cedar (Eupatorium capillifolium) and one of the mints failed to appear in the 2, 4-D treated plots the second summer. However, it was noted that one of the St. Johns-wort (Hypericum gentianoides) was increasing in all treated plots except the one receiving the highest rate of the low volatile ester of 2, 4-D. From this evidence, it can be seen that it is possible to create a weed problem worse than the original. Another test is under way using intermediate and Ladino white clover as the desirable legumes. It appears at this time that the intermediate white clover is more tolerant of 2, 4-D than Ladino. A Progress Report is being prepared on the control of Cherokee rose and perhaps some other species. Therefore no further details will be discussed at this time.

Lespedeza Sericea

Frequently it is difficult to maintain a stand of sericea due to the competition of weeds. In many instances, where this crop is being used for hay, the first cutting is almost worthless due to winter or spring weeds. Fortunately sericea is quite tolerant to 2, 4-D. Some information is available on the control of weeds in this crop, but details will be omitted at this time.

MECHANICAL WEED CONTROL . . . . D. G. Sturkie

Weeds are usually considered as harmful in a number of ways, and we usually try to control them. They may have some very important values and perhaps we should learn to use them.

Weeds on the farm are usually considered in connection with (1) cultivated crops, (2) sod crops such as pasture or hay, (3) broadcast seeded grain crops such as small grains or soybeans, and (4) unused areas such as roadsides, ditch banks and fence rows.

Methods of control are (1) chemicals, (2) mechanical such as plowing, hoeing or mowing, (3) crop sequence or rotation, (4) use of better seed, and (5) fertilization.

The major effort spent in growing a cultivated crop is directed at weed control. Numerous studies have shown that the major accomplishment of plowing, cultivating and hoeing is weed control.

To control weeds the easiest and most rapid way should be our aim. Good seedbed preparation followed by rapid shallow cultivation done at the proper time is the key to weed control for most crops. The proper time is when the weed is in the seedling stage. This means frequent cultivation when the plants are young.

More recently some workers have called attention to the value of weeds and have suggested means of using them in crop production. This may be by use of herbicides or by some system of cultivation that enables the crop to get a start and produce in competition with the weeds.

The important points that we know about this are (1) weeds make excellent mulches, (2) weeds produce an ideal seedbed in the soil, (3) weeds make use of much higher rates of nitrogen imperative.

Maybe we should revise our approach to the weed problem and try to devise means of cultivation to utilize weeds. Maybe we can make larger yields with less effort by helping weeds to help the crop and the soil.

MECHANIZATION in ALABAMA PRODUCTION . . . . C. M. Stokes

We live today in a machine age. Probably the biggest change on Alabama farms during the last 10 years has been the increase in the number of tractors (Table 1).

There is a very noticeable decrease in the number of farm laborers (Table 1). We all have noticed the increase in the cost of farm labor during the recent years. From Table 1 we find that there were only about 75 per cent as many laborers on Alabama farms in 1950 as there were in 1940. In 1950 the hired laborers in Alabama received $26,835,922 as compared with $8,421,752 in 1940.

There is not much prospect the cost of labor will be less in the future. The cost of machinery is high, but where conditions and personnel for the suitable operation of farm machinery are available, it may not be too expensive to mechanize.

Table 1(a)

Recent Trends on Alabama Farms.

	Period	
	1940	1950
Mules and colts	292,345	220,163
Tractors	7,638	45,751
Size of farms, acres	83	99
Farm labor	403,162	311,792
Cost of hired farm labor, dollars	$8,421,752	$26,835,922
Cotton acreage	1,930,560	1,850,846
Bales of cotton	772,711	824,290

Table 2(b)

Comparison of Cotton Production in Alabama and California.

Cotton Bales	1941-50 Average	1952 Predicted
Alabama	899,000	895,000
California	627,000	1,865,000
Yield Per Acre		
Alabama	277	292
California	606	640

(a) 1950 U.S. Census of Agriculture.
(b) Alabama State Statistician.

In Table 2 we notice that the average cotton yield in Alabama from 1941-1950 was 899,000 bales with a predicted yield in 1952 of 895,000 bales. During the same period 1941-1950 California averaged 627,000 bales and it is predicted that there will be 1,865,000 bales produced there in 1952.

The big increase in cotton production in California probably can be attributed to the increased use of harvesting equipment. During the 1949-50 harvesting season it was found that a bale of cotton could be mechanically harvested in California for $14.65 per bale while it cost $34.63 to hand pick a bale of cotton. In 1950, 34 per cent of the cotton was mechanically harvested but in 1951 53 per cent of the cotton was mechanically harvested.

We realize that there are problems with mechanized production here that are not encountered in other places, but many of the mechanization problems in Alabama can be overcome. Where complete mechanical production is practiced, much expensive equipment must be used. The high cost of the equipment can be offset by doing a large volume of work with the machines and by reducing the time lost for repairs. Plans should be made to keep the machines at work every available hour. The harvesting equipment should be in use every available hour during harvest season.

Some farm equipment costs as much as $10,000 and more per unit. The owner of these machines should first know their limitations and capacities. This is necessary in order to prevent him from assigning these machines to jobs which they are not capable of performing satisfactorily or safely. He should select his operator and keep in mind that a poor operator can cause costly damage to them and may do unsatisfactory work.

Successful use of machinery in the production of any crop requires planning on the part of the producer prior to the preparation of the land. Land which is suitable and readily accessible with the machinery should be selected for growing the crop. The field should be free of ditches and banks that would interfere with the operation of the equipment. The area must be free of rocks and other obstructions that will hinder or damage the equipment.

The seedbed must be well prepared. The debris should be turned early to permit it to rot prior to time of planting. The land should be broken at least six inches deep to avoid hard spots which interfere with planting, growth of plants, and production of the crop.

We have found the land leveler to be one of the best implements to use in the final preparation of the seedbed. It smooths out the high and low places left in the field by the other preparation implements. On the smooth surface left by the leveler, it is easy to cover the seed at a uniform depth. At the location where we used the land leveler, we got the most uniform emergence and the best cotton stand. This permitted uniform growth and maturity of the plants.

Planting equipment must be selected that will plant the seed in the drill in the most satisfactory manner for the production and harvesting equipment. We have planted our crops on as flat a seedbed as possible. This seedbed is very desirable for the use of the rotary hoe which aids in the control of weeds and grasses that emerge with the crop.

Where the rotary hoe is used on the young crop, some damage can be expected. With cotton, as much as 15 to 20 per cent of the young plants may be destroyed with four to five operations of the rotary hoe. This makes an excess number of plants in the drill desirable. Where the plants are uniformly spaced in the drill, they can be eliminated with a mechanical chopper.

We find it desirable to space the rows 40 inches apart. Most of the equipment operates satisfactorily at this spacing. A variety of the crop should be planted that is suitable to the use of mechanical equipment for its production and harvest. Cotton should grow upright without too many long limbs and mature uniformly. It should produce bolls that open wide but resist wind losses well without having a tendency to stick in the burs thereby preventing the spindles of the harvester from picking it.

Good insect control must be maintained. Bolls of cotton damaged by insects are difficult to pick. The insect damaged locks of cotton lower the grade.

The crop must be kept free from grasses and weeds. They interfere with the operation of the equipment and lower the grade or quality of the harvested cotton.

HARVESTING . . . . T. E. CORLEY

The two main questions asked about mechanical cotton harvesting are:

1. How much cotton does the machine leave in the field?
2. What kind of grades do you get from the machine harvested cotton?

As in the case of many questions, the answer is: "It depends upon the conditions." A more specific answer to these questions should be correlated with data obtained under various conditions at the different substations. To give a better idea of what these conditions were, a short movie of the work at each location will be shown.

First of all, it should be pointed out that as in the case of any machine harvester you must expect some losses . The cotton plant is very sensitive to varying climatic conditions, fertility of soil, available moisture during the growing season, and different cultural practices. Cotton plants may vary from one to five feet or more in height--from a bushy type plant with long branches to an upright plant with short branches--from a well defoliated plant to a plant full of green or dead leaves--from a plant with fluffy bolls that shatter easily to a plant with knotty, immature bolls that never open completely. To expect a machine to harvest such a wide range of plants satisfactorily would be asking the impossible. Therefore, it is imperative that we establish a relationship of mechanical harvesting to varietal characteristics, type of stand, and related factors.

Sand Mountain Substation

In 1952 at the Sand Mountain Substation, most of the cotton was planted late (May 22) and rains came in time to produce a good crop of late maturing bolls on relatively small plants. An early freeze (October 22) damaged many of the unopened bolls and caused many of the leaves to stick on the plants. With the exception of the grass that came with the late rains after "layby" time and the frozen bolls and leaves, conditions were good for mechanical harvesting.

In thick-spaced Hi-bred (45,700 plants per acre) with a yield of 1503 pounds per acre, the International Harvester Picker left 175 pounds per acre or about 12 per cent of the cotton.

In thick-spaced Empire (46,200 plants per acre) and Coker (64,000 plants per acre) with an average yield of 1507 pounds per acre, the picker left 49 pounds of seed cotton per acre or about 3 per cent of the total yield.

In thin-spaced Empire (14,900 plants per acre) and Coker (17,900 plants per acre) with an average yield of 1550 pounds, the picker left 87 pounds per acre or about 6 per cent of the yield. It should be pointed out that the thin Empire was planted 4 weeks earlier than the thick Empire, but matured and opened about the same time.

In the thick-spaced Hi-bred, the John Deere and International Harvester strippers left an average of 87 pounds per acre or about 6 per cent.

In the thick-spaced Empire and Coker, the strippers left an average of 31 pounds per acre or about 2 per cent.

In the thin-spaced Coker, they left an average of 68 pounds per acre or about 4 per cent.

Of the four bales harvested with the pickers, 3 graded middling and 1 graded strict middling gray.

The grades for the two bales of stripper harvested cotton averaged low middling plus.

Tennessee Valley Substation

There was a different story at the Tennessee Valley Substation. The cotton was severely drought-stressed during the regular growing season, resulting in knotty bolls and poor yields. At harvest time the cotton plants were full of blooms and beginning to grow. All attempts to defoliate this cotton were unsuccessful, resulting in only partial leaf drop.

The plot area is divided into three tiers, one of which is located in a low area of the field. In the low area, the cotton defoliated and yielded better than the other tiers.

Empire (58,200 plants per acre) in the low area yielded 1670 pounds per acre and the International Harvester picker left 112 pounds per acre or about 7 per cent.

In the other two tiers, the drought-stressed, knotty-boll Empire (55,800 plants per acre) yielded only 700 pounds per acre and the picker left 170 pounds per acre or about 24 per cent.

Thick-spaced Plains and thin Empire were severely drought-stressed and gave about the same harvesting results as the drought-stressed thick Empire.

The Dearborn and Oklahoma brush-type strippers left an average of 58 pounds per acre or about 8 per cent of the drought-stressed Empire.

The grades of the harvested cotton were also very different to those of the Sand Mountain Substation.

Four bales were harvested with the International Harvester picker and all ginned at the same gin. However, they gave four different grades ranging from strict low middling to good ordinary. In 1951 two bales from the same picker ginned at the same gin were graded as middling and strict low middling. No explanation of the low grades is offered, but based on the grades of approximately 100 bales harvested with the picker over a two year period and ginned at eight different gins, such grades are very unusual.

The two stripper-harvested bales graded strict good ordinary, which is about what to expect from cotton stripped under such adverse conditions.

Wiregrass Substation

At the Wiregrass Substation, conditions were poor for mechanical harvesting. In addition to knotty bolls caused by the drought, grass and weeds, new growth that could not be defoliated, and erratic stands, another problem was encountered. This was pre-harvest loss. In 1951 and 1952 rain storms caused an average of about 100 pounds per acre or about 8 per cent of the cotton to fall to the ground before harvest time. The cotton on the ground was lost as far as the machine harvester was concerned.

In Hi-bred cotton yielding 1265 pounds per acre, the International Harvester picker left 219 pounds per acre or about 19 per cent of the available cotton (yield minus pre-harvest loss) and the pre-harvest loss was 127 pounds per acre or about 10 per cent of the total yield making an overall loss of 346 pounds per acre or about 26 per cent.

In Plains cotton yielding 1121 pounds per acre, the picker left 268 pounds per acre or about 25 per cent of the available cotton and the pre-harvest loss was 69 pounds per acre or about 5 per cent of the total yield making an overall loss of 337 pounds or about 30 per cent.

In thick-spaced Coker (47,000 plants per acre) yielding 1234 pounds per acre, the picker left 107 pounds or about 10 per cent of the available cotton and the pre-harvest loss was 159 pounds per acre or 13 per cent of the total yield making an overall loss of 266 pounds per acre or about 23 per cent.

In thin-spaced Coker (30,600 plants per acre) yielding 1365 pounds per acre, the picker left 179 pounds per acre or about 14 per cent of available cotton and the pre-harvest loss was 73 pounds per acre or 5 per cent making a total loss of 252 pounds or about 22 per cent.

The grades from the picker average strict low middling.

The Dearborn and Oklahoma brush strippers harvested one bale that graded low middling plus.

Summary

From the foregoing, it may be said that under favorable conditions cotton can be harvested mechanically with negligible losses of the cotton and with resultant grades equal to or slightly lower than the grades of hand-harvested cotton. It is obvious that improvements in our cultural and management practices along with so called "normal weather conditions" would aid materially in providing favorable conditions.

MECHANICAL HARVESTING of LIMA BEANS . . . . Hubert Harris

In tests at Auburn lima beans have yielded well and the quality has been very good. Labor and other costs of growing the crops have been reasonable, but the labor required for harvesting by hand has been excessive. Shelling and cleaning are also major operations in canning or freezing this crop.

In some of the Western and Northern states where lima beans and English peas are grown for processing purposes, machinery is used for harvesting the entire crop at one time. Shelling is usually a part of the harvesting operation. The vines are cut and run through viners that separate the peas and beans from the vines and hulls.

Work is underway at Auburn to determine if this practice would be feasible under Alabama conditions. Plantings have been made of the Henderson variety to determine the recovery and quality of beans in different grades obtained by successive hand pickings as compared to one-time harvests at different stages of maturity. In some cases the vines were plowed up and hauled to a viner at Prattville, Alabama, for vining. A vining test was also made with a Frick peanut picker.

All hand-picked samples were shelled at Auburn in a small viner type sheller.

Headland Planting, Summer 1950

Results of tests on a one-acre planting at Headland are given in Table 1. Two crops of beans were produced on the same vines in this planting. A small, early crop, apparently cut short by dry weather, had spoiled on the vines when the main crop was harvested. Pod counts showed a ratio of 1 to 2.63 in the number of pods in the early and main crops, respectively.

The early crop was left on the vines in the hand-picked treatments, but in the case of the mechanically harvested treatments the early spoiled beans were harvested and became mixed with the good beans. The vining and cleaning equipment at Prattville removed approximately 50 per cent of these bad beans, and the remaining 50 per cent wer picked out by hand. This required a great amount of hand work.

Yields per acre of shelled, cleaned beans obtained on August 10 ranged from 785 pounds with the peanut picker treatment to 1,556 pounds with the one-time hand harvest. Plots that were vined at Prattville ran 1,412 pounds per acre.

Results obtained in the test with the Frick peanut picker were unsatisfactory. Adjustments in the picker increased the recovery; although when most efficiently adjusted and the vines run twice through the machine, the total recovery of graded beans was only 785 pounds per acre with none in the No. 1 grade. By hand-picking, the recovery was 1,556 pounds per acre with 50 per cent in the No. 1 grade.

Grades of beans varied greatly with harvest dates and method of harvesting. Beans harvested August 4 graded 100 per cent U. S. Grade A (Fancy). The beans decreased rapidly in grade during the hot dry weather that prevailed from August 4 to August 10. The 1,122 pounds of beans per acre obtained on August 4 were considered to be of greater value than the 1,556 pounds obtained on August 10. The August 10 harvest from the selective hand-picked plots graded considerably better than the one-time hand harvest of the same day.

Auburn Planting, Fall 1950

Results obtained from the 1950 Auburn planting are given in Table 2. In comparison with the summer planting at Headland, the yield at Auburn was lower, the beans matured more slowly, there were fewer culls, and the Prattville viner was less efficient in recovering the beans.

The percentage of the total crop recovered by one-time hand harvesting increased rapidly as the season advanced. On October 5 the recovery was 42 per cent; on October 12 it was 77 per cent; and it appears that practically all of the beans were recovered on October 20. Approximately 60 per cent of the crop was recovered from the harvest on October 17 by the Prattville viner.

The records indicate that a larger yield was at prime maturity on October 20 than at any other harvest date, although 25 per cent of the beans had reached the dry stage.

Some heating occurred in the beans that were hauled to Prattville. This heating, together with unavoidable delay in processing after vining, resulted in considerable discoloration in the frozen product.

Auburn Planting, Summer 1951

Results obtained on the 1951 summer planting at Auburn are presented in Table 3. As in the case of the summer crop at Headland, maturity of the beans advanced at a very rapid rate. On July 6, only 2 per cent of the beans had passed the green stage. This percentage increased to 33 by July 10 and to 62 by July 12. The percentages in the mature white stage increased from 2 per cent on July 6 to 27 per cent on July 10 and to 52 per cent on July 12. With none of the beans in the dry stage on July 6, 10 per cent had reached the dry stage by July 12. The weather was dry and hot during this period.

Auburn Planting, Fall 1951

Results obtained on the 1951 fall crop at Auburn are given in Table 4. Included are data on yields and grades from four harvest treatments.

The 1951 fall crop, like the 1950 fall crop, matured more slowly than did the summer crops. Percentages of beans that had passed the green stage increased from 1 per cent on October 15 to 5 per cent on October 22, to 30 per cent on October 29, and to 40 per cent on November 5. Yields in pounds of shelled and cleaned beans per acre obtained by one-time harvests increased from 397 on October 15 to 686 on October 22, to 917 on October 29; yields on November 6 were back to 862. The October 22 harvest gave the highest yield of beans in the mature green stage.

Data on shelling and recovery show that the small viner type sheller recovered from 96.7 to 100 per cent of the total beans in the pods, with an average of 98.6 per cent on five tests. The machine shelled at a rate of 336 to 490 pounds of pod weight per hour. The average on six tests was 432 pounds per hour. Recoveries of shelled and cleaned beans from pod weights ranged from 22 per cent with the October 15 harvest to 42.4 per cent with the November 5 harvest.

Labor Required by Different Methods

The labor required to harvest, shell, and clean the beans by the vining process was approximately 8 per cent of the amount required by hand picking and hand shelling, and approximately 20 per cent of the amount required to hand pick and shell with a small laboratory sheller. The question as to the reduction in labor that could be obtained with suitable combining equipment has not been answered.

Concluding Statement

The following conclusions are indicated by the data obtained in these studies:

1. Results of vining tests with the Frick peanut picker, within the limits of possible adjustments, were unsatisfactory. The grades of beans and total recovery were very low.

2. The beans were satisfactorily harvested and shelled by the vining process when a regular bean viner was used, but the recovery of number 1 grade of beans was considerably lower than that obtained by hand picking.

3. Highest yields and grades resulted from successive harvesting by hand and shelling by laboratory sheller.

4. Labor requirements were greatly reduced by use of vining equipment.

5. Special bean combining equipment was not tested in these studies.

6. Lima beans normally bloom and set over a considerable period of time. Maturity is likewise extended over a considerable period. Sometimes there are two or more distinct crops on the same vines.

7. Since summer crops of lima beans mature faster than fall crops, the summer crops require more accurate timing and faster harvesting to obtain the beans in prime maturity.

8. The loss in percentage of number 1 beans resulting from mechanical harvesting could be greatly reduced by the practice of hand picking the early beans, followed by machine harvesting of the main crop.

Table 1. Yields and Grades of Lima Beans Recovered by Different Methods of Harvesting from Summer Crop at Headland, 1950

Harvest treatment	Harvest Dates	Weights per acre shelled clean beans	Grade distribution		
			Grade 1	Grade 2	Dry
	August	Lb.	Pct.	Pct.	Pct.
Hand-picked 2 times					
First picking early pods	4	434	100	0	0
Second picking later pods	10	1,102	68	30	2
Total		1,536	77	22	1
One-time hand harvest . .	4	1,122	100	0	0
One-time hand harvest . .	10	1,556	50	45	5
Vined in peanut picker					
First time through	10	600	0	88	12
Second time through	10	185	0	97	3
Total		785	0	90	10
Vined in Prattville viner	10	1,412	30	65	5

Table 2. Yields and Grades of Lima Beans Recovered by Different Methods of Harvesting from Fall Crop at Auburn, 1950

Harvest treatment	Harvest dates	Weights per acre shelled cleaned beans	Grade distribution Grade 1	Grade 2	Dry
	October	Lb.	Pct.	Pct.	Pct.
Hand picked 4 times					
First picking	5	420	63	37	0
Second picking.	12	208	56	40	4
Third picking	20	249	81	15	4
Fourth picking.	26	108	79	16	5
Total.		985	68	29	3
Hand picked 2 times					
First picking	5	316	65	35	0
Second picking.	20	437	82	11	7
Total.		753	75	21	4
Hand picked 2 times					
First picking	12	650	35	54	11
Second picking.	26	200	75	17	8
Total.		850	45	45	10
Hand-picked 1 time.	20	1,125	46	29	25
Hand picked 1 time.	26	742	41	18	41
Vined in Prattville viner . .	17	552	31	53	16

Table 3. Yields and Grades of Lima Beans Recovered by Hand Harvesting at Different Stages of Maturity from Summer Crop at Auburn, 1951

Harvest treatment	Date of record	Weights per acre shelled cleaned beans	Grade distribution		
			Grade 1	Grade 2	Dry
	July	Lb.	Pct.	Pct.	Pct.
Field counts on maturity . .	6	-	98	2	0
One-time hand harvest.	10	909	67	27	6
One-time hand harvest.	12	1,147	38	52	10

Table 4. Yields and Grades of Lima Beans Recovered by Hand Harvesting at Different Stages of Maturity from Fall Crop at Auburn, 1951

Harvest treatment	Harvest dates	Weights per acre shelled cleaned beans	Grade distribution		
			Grade 1	Grade 2	Dry
	October	Lb.	Pct.	Pct.	Pct.
Hand picked 2 times					
First picking	15	397	99	1	0
Second picking.	29	325	95	5	0
Total.		722	97	3	0
Hand picked 2 times					
First picking	22	686	95	5	0
	November				
Second picking.	5	186	86	6	8
Total.		872	93	5	1
	October				
Hand picked 1 time.	29	917	70	20	10
	November				
Hand picked 1 time.	5	862	60	20	20

THE AGRICULTURAL OUTLOOK*

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Farmers can look for a continued high level of demand for farm products during 1953. Marketings of farm products next year are expected to hold near record levels if growing conditions are favorable. Some further easing in prices farmers receive seems likely for 1953, particularly for meat animals and vegetables.

Demand Factors--At Home and Abroad

A further rise in defense spending into 1953 and prospects for only a moderate cutback in business demand for new plant and equipment are expected to result in a moderate rise in economic activity.

The productive capacity of industry has been expanded rapidly in recent years and some reduction in total business investment spending is in prospect for next year. However, remaining expansion goals should help to sustain a high level of business investment well into 1953.

With economic activity expected to rise, employment is likely to be maintained. Consumer income, after taxes, probably will be moderately higher than this year. The gain in consumer incomes, suspension of restrictions on consumer credit, and the rapid rebuilding of liquid asset reserves during 1951-52 probably will support a continued rise in total spending by consumers during most of 1953.

In contrast to the strength shown by United States demand, foreign demand for our farm products is declining. During the current marketing year relatively large declines are in prospect for exports of wheat, cotton, fruits, grain sorghums, and a number of other commodities.

Supplies, Farmers' Prices and Prospective Income

Larger supplies of basic metals and expanded industrial capacity probably will provide an increasing supply of both consumer goods and military equipment in the coming year. Farmers' output of food and other farm products in 1953 also is expected to be near record levels if growing conditions are average. Marketings of meat animals probably will be larger, with most of the increase in cattle. Supplies of most truck crops, vegetables, and fruits also may be larger in 1953 if the weather is not unfavorable.

With prospects for a continued large volume of marketings and a reduction in foreign demand for farm products, prices received by farmers in 1953 are expected to average a little lower than this year. Price changes over the past year, in general, reflect a high level of demand for farm products and the varying supply situations for major groups of commodities.

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*Presented before the annual staff conference of the Alabama Agricultural Experiment Station at Auburn, Alabama, on January 2, 1953. Based on material distributed at the USDA's annual "Outlook Conference" held in Washington, D. C., in October 1952. For detailed illustrations and explanations of the data presented herein, see "Agricultural Outlook Charts, 1953," and commodity situation outlook reports as published by the Bureau of Agricultural Economics, U. S. Department of Agriculture.

With prospects for some further easing in prices received by farmers and continued large marketings, farmers' cash receipts in 1953 are not likely to exceed 1952. Cost rates to farmers for most commodities used in farm production and farm wage rates are likely to rise gradually over the coming year. As a result, the farmers' realized net income is expected to be somewhat smaller than for 1952.

Farm Commodities Outlook

Food production in the United States in 1953 may equal or even exceed the 1952 output. The large number of livestock on our Nation's farms and ranches point to a continued heavy output of meat and poultry products. Likewise, if the weather is more nearly normal, larger food crops than in 1952 are likely. In addition, imports, which add to the total food supply, probably will be about as large in 1953 as in the preceding year.

Noncivilian purchases of food from the domestic supply in 1953 are expected to be smaller than the comparable 1952 total, unless the international situation should grow worse. On the other hand, the export demand for United States food commodities, principally grain, will be reduced in 1953 because of better harvests in other food exporting countries and in several of the major food importing countries.

United States civilian consumption of food per person in 1953 is expected to be substantially the same as in the preceding year. However, some change is likely in the composition of civilian diets, on the average. Present prospects point to some increases over the 1952 rates in per capita consumption of beef and veal; chicken; margarine; frozen fruits, fruit juices, and vegetables; fresh vegetables; and sweetpotatoes. These increases will to some extent be offset by likely declines in the consumption of pork, eggs, turkey, and butter.

Dairy Products

Dairy farmers can expect another year of good markets for their milk products. Consumer demand will continue strong and milk prices probably will average a little higher in 1953 than in 1952. Cash receipts from marketings probably will be up a little next year but production costs also will be large and net income from dairying in 1953 probably will be little different from 1952.

Production of milk in the United States has not increased in the past decade in contrast to large increases in population and in total agricultural output. This has resulted partly from the fact that on both specialized dairy farms and on general farms, hourly returns from dairying have increased much less than those from other enterprises. Recently, dairy prices have improved relative to some competing products. But the improvement in prospect by the end of 1953 is not likely to be sufficient to bring a large increase in milk flow. Milk output next year may be only slightly greater than that in prospect for 1952.

Meat Animals

More cattle but fewer hogs will be slaughtered in 1953 than in 1952. As the increase for cattle will be greater than the decrease for hogs, the total meat supply will be larger. Prices for cattle may average somewhat lower than in 1952, and for hogs about the same as in 1952.

In 1953 cattle prices in general will likely be somewhat lower than this year. Prices of cows and feeder cattle, though averaging lower than in 1952, will probably strengthen moderately this winter and, unless there is drought, will not likely decline as sharply next fall as they did this fall.

As farmers paid sharply lower prices for feeders this fall, prospects are for better profits from feeding this winter than last, despite somewhat reduced selling prices for fed cattle.

Cattle prices bore an unusually high ratio to other livestock prices in 1950 and 1951. Present declines are in part a return to more normal relationships. It is because cattle numbers have expanded so fast and because slaughter is due to increase over several years that prices are expected to adjust further. Even so, if employment and consumer demand remain high, the outlook for cattle in the longer run would appear to be favorable.

Pig crops have been reduced around 9 per cent in 1952. Hog slaughter will consequently be down about that much in 1953. Increased supplies of beef will prevent prices of hogs from strengthening greatly. However, hog prices this winter are expected to exceed the depressed prices of last winter. Later in 1953 prices of hogs will likely be about as high as this year.

Poultry and Eggs

The year now ending has not been a good one for egg producers. For most turkey producers, holiday marketings largely determine how good a year they have. Broiler producers, despite their ups and downs, have fared moderately well in 1952.

For egg producers, the outlook indicates considerable improvement. Against an expected good consumer demand there will be a reduced supply of eggs. This suggests higher springtime egg prices than in 1952.

Broiler production probably will increase slightly in 1953, but not as much as the increase that occurred in 1952. A slower rate of increase is expected because producers and financiers are coming to recognize that broiler production is no longer the bonanza that it used to be. In view of the potentially larger broiler supply, and increased competition from red meats, broiler prices in 1953 may average slightly lower than in 1952.

Feed

The Nation's supply of feed grains and other concentrates for 1952-53 is a little smaller than in any of the past 3 years but is again much larger than before World War II. This year, there are marked differences among areas. The bumper crop of good quality corn in the Corn Belt will provide ample feed for that area and permit heavier marketings than in 1951-52. In the South, however, where drought sharply reduced feed grain production, feed supplies are short. This is resulting in greater than usual price differences between these areas and heavier than usual movement of feed from the Corn Belt to the South.

The 1952 production of feed grains was 5 per cent larger than in 1951 and appears to be about adequate for 1952-53 needs, without requiring further withdrawal from reserve stocks. In 1951-52, feed-grain production fell somewhat short of our total requirements and carry-over stocks at the end of the season were reduced about 30 per cent.

The hay supply for 1952-53 is a little smaller than last year and the smallest in recent years per animal unit. Dry weather this fall over large areas of the country has greatly reduced feed from pastures and ranges, making it necessary to feed more hay than usual early in the season. Hay supplies are especially short in the South where drought sharply reduced 1952 production.

Cotton

The United States supply of cotton in the 1952-53 crop-year is estimated to be larger than in 1951-52. With disappearance likely to decline, the carry-over on August 1, 1953, will be larger than a year earlier.

Domestic consumption of cotton in 1952-53 will probably be about 9.5 million bales (plus or minus 300 thousand bales), moderately more than the 9.2 million bales of last season. This estimate is based on the prospect that economic activity and purchasing power will increase moderately over 1951-52, and assumes that international tensions will show no significant change.

If there is no material change in the international situation, exports of cotton from the United States in 1952-53 are expected to drop from the 1951-52 level of 5.5 million bales to around 4.5 million (plus or minus 300 thousand bales). Stocks at the beginning of the current season in foreign, non-Communist countries totaled about 2.2 million bales more than a year earlier.

Oilseeds

Prices received by farmers for 1952 crop soybeans probably will average at least as high as last year's season average price. In recent years , developments in soybean processing and marketing have had an upward effect on soybean prices. These include increasing crushing capacity and hence more intense competition for beans among crushers, higher oil yields resulting from increased use of solvent extraction, and the fact that farmers are extending their marketings over a longer period of time.

Prices to producers for 1952 crop cottonseed are likely to average near the 1951 season average. Drought, high-level livestock production, and a smaller output of cottonseed has created a strong demand for cottonseed meal and hulls for use as feed. Market prices for meal and hulls so far this year have been above a year earlier and about offset lower prices for oil and linters.

The 1952 peanut crop is the smallest since 1939, reflecting declines in acreage and yield. Supplies will be sufficient to meet domestic requirements for edible use but practically no peanuts will be exported and only those which do not meet standards for other uses will be crushed. Prices received by farmers are expected to average well above the 1951 crop. Last year's average included lower prices received for peanuts sold for crushing as well as quota peanuts sold at support prices or above.

Supplies of fats and oils in prospect for the 1952-53 marketing season are about as big as last season's peak, with a large carry-over of lard and vegetable oils offsetting an expected drop in output of lard and butter. With a continued high level of consumer income and industrial activity expected, domestic disappearance will be at least as great as in the past year. Exports of fats, oils and oilseeds in the past year were at a near record level and are expected to be nearly as great in 1952-53. Most of the decline in exports is likely to be in lard.

Fruit

Continued strong demand for fruit is expected in 1953. Although consumer demand probably will be about the same as in 1952, demand from processors may be somewhat stronger. Reduced exports of fruit are in prospect for 1953.

The 1953 deciduous crop probably will be moderately larger than the 1952 crop, assuming average weather. Under the above conditions, the general level of prices received by growers for the 1953 deciduous crop is likely to be about the same as in 1952. However, with reduced carry-over stocks of canned fruits, prices for some fruits for processing may be somewhat above the relatively low 1952 prices. Total production of tree nuts may be a little larger in 1953 than in 1952.

The 1953-54 pack of dried fruits may be somewhat smaller than the large 1952-53 pack. But output of canned fruits is likely to increase, as a consequence of smaller carry-over stocks at the start of the 1953-54 canning season and a larger 1953 deciduous crop. The 1953 crop of strawberries, the leading berry frozen, probably will be smaller than the 1952 crop.

Vegetables

Encouraged by the relatively high prices received in the last year or two, farmers in general are apt to plant increased acreage of potatoes, sweetpotatoes, and some fresh market truck crops in 1953 compared with the acreage planted in 1952. Whether such increased acreage will also mean larger supplies produced depends in considerable part upon the weather. Consumer demand for vegetables in 1953 probably will be fully as strong as in 1952. If production increases are only slight, prices for vegetables next year probably will average only moderately lower than in 1952.

The 1953 outlook for producers of truck crops for commercial processing is one of generally sustained demand at about 1952 levels. Supplies of commercially canned vegetables now available are generally adequate to supply the continued strong demand at no more than moderate increases in price until well into 1953.

Current supplies of frozen vegetables in commercial storage are ample. Further gains in the upward trend in consumption of frozen vegetables is expected to provide a ready market for these large quantities.

Summary

What size of business is needed?

Farm earnings in 1953 will depend more on how well the farm is operated than on any gradual or rapid price inflation. The well organized and efficiently operated farm business will call for few major changes in the year ahead. However, the situation existing is that most farm businesses are too small and the enterprises are too small for most efficient production. For these farmers to stay in the business and meet competition it is necessary that they establish and work toward size of farm businesses that are based on commercial farming realities. This is going to mean larger farms, larger fields, larger and more machinery, and larger livestock enterprises.

How about crop production this coming year?

Government estimates indicate that reserve supplies of feed grains by next October will be the lowest for that date in 6 years. This will not be a critical situation but it could mean higher feed prices for the 1953 feeding season.

All in all, the price trends of farm products appear to offer some farmers, especially on good land, an opportunity to emphasize crop production and then carry only the livestock which can be handled conveniently without additional help. In other words, livestock and livestock-product feeding ratios combined with high labor costs are not going to be favorable enough in 1953 to encourage any great increase in livestock numbers.

A crop factor which is keeping earnings low on many farms is the level of crop yields obtained. Good crop yields are always important but with expenses as high as they will be in 1953 it is fast becoming a greater necessity to get good yields if the farmer is going to make a go of it.

What about livestock production?

Livestock enterprises should be in good position in 1953 in spite of high costs. Seasonal price movements will be important in influencing livestock profits and should be given attention.

Dairying compared to other livestock enterprises is looking better than it has during recent years. Swine numbers are down from last year. It looks like a good time to increase spring farrowings if corn is available to feed out the hogs. Cattle feeders are expected to buy cattle and especially plainer types enough cheaper to more than offset the prospect of slightly lower slaughter cattle prices next year. Caution is advised relative to starting a beef breeding herd or carrying more cows than necessary now. Poultrymen will receive better egg prices and make more money next year than this.

It will be good business for the livestock producers to make the necessary adjustments for larger scale, more efficient production. Regardless of which kind of livestock is carried, the enterprises as a rule should not be smaller than needed for commercial production. Doing a good job on one or two enterprises will pay better than an average job on several.

What about the future in farming--1953 and beyond?

There will be fewer and larger commercial farms each year. High level management ability, high capital investment and high output per man will be necessary for those farmers who continue to compete. There are still good opportunities to make a good living in farming for able couples.

On the other hand there never has been more rigorous competition in the race for agricultural efficiency. For the less able couple or those who don't pay much attention to what is happening, their problems will become greater. They face a dull future on the farm. The year ahead, while industrial activity is high, offers these folks an excellent opportunity to get into some other line of work.

All farmers need to be cautious about investments. It is easy to make commitments when money is around which might be hard to pay for if price relationships become unfavorable. Farmers do not create financial reserves like corporations do in order to carry them through a period of hard times. Certainly, it is good business for able couples to borrow money for operating the farm business right or to make necessary improvements or even to enlarge the business. On the other hand, this is a good time too to pay debts and create some financial reserves.

CORN PRODUCTION with SPECIAL EMPHASIS on NITROGEN, FERTILIZATION, WINTER LEGUMES, SPACING, and TIME OF PLANTING . . . . J. T. Cope, Jr.

The November, Alabama crop report estimated an average corn production of 11 bushels per acre for 1952. This is less than 60 percent of that for 1951 and for the average of the last 10 years. Alabama normally produces about 1.5 percent of the corn produced in this country. In 1952 this figure was only about .8 percent. We have the potential and the need for much higher yields from the approximately 2 1/2 million acres devoted to this crop in Alabama. A brief discussion will be presented of the information which the station has on nitrogen fertilization, winter legumes, spacing and time of planting corn.

Spacing and Rate of Nitrogen Fertilization

Last year at the annual conference, a detailed summary was presented of the results of the Rates of Nitrogen and Spacing Experiments located at the Tennessee Valley, Sand Mountain, Lower Coastal Plain, Wiregrass, and Gulf Coast Substations. The first two slides will briefly review these results for the six year period 1946-51.

Table 1. Five Year Average Corn Yields in "Vetch Residue" Experiment at Auburn 1947-1951

Treatment[1/]	Bushels corn per acre	
	No N	80 N
No vetch	8.5	56.0
Vetch every year	59.6	59.2
Vetch every 2 years	44.0	60.1
Vetch every 3 years	33.7	62.4
No vetch	12.1	56.5

[1/] All plots receive 72 pounds P_2O_5, 60 pounds K_2O, and 10 pounds of $ZnSO_4$ annually.

Table 2. Seventeen Year Average Yields of Cotton and Corn in the Manure, Soda, Vetch Experiment at Auburn, 1925-41.

Treatment[1]	Bushels corn	Pounds Seed Cotton
0	6.6	415
5 tons manure	44.0	1773
325# $NaNO_3$	40.2	1488
Vetch	35.1	1418
0	8.0	451
Average green weight yield of vetch	6351	7004

[1] All plots received 60 pounds of P_2O_5 and K_2O annually.

In the recent revision of the fertilizer recommendations, the nitrogen recommendation for corn has been raised from 48-72 pounds N per acre to 60-90 pounds. This change is supported by the data on the previous two slides and most of the other limited data that we have on high rates of N for corn.

Farmers have been badly discouraged by the disastrous corn failure this year. There is a prevalent opinion among farmers in the state that the corn crop would have been better if no fertilizer had been used and plants had been spaced at 36 inches in the row. It is fortunate that the Station had these rates and spacing experiments this year so we can determine if these opinions are correct.

Figure 3 shows the average results of the five experiments in 1952. Yields at four locations were below 30 bushels and at two of these locations were only about 10 bushels. Only the Gulf Coast experiment made satisfactory yields. There was no appreciable decrease in yield brought about by close spacing. The only case where close spacing decreased yields was when nitrogen was insufficient and this occurs in both wet and dry years. Other differences due to spacing would not likely be significant. The recommended spacing is 18 to 24 inches, and these were satisfactory spacings in the tests this year.

Increases in the rate of nitrogen fertilization did not decrease yields. Rates above 60 N did not raise yields but this would not be expected under such drastic drouth conditions. There was about a two bushel average response to 60 N over 30 N and no response above 60 N. Alabama farmers cannot make corn without nitrogen; and since there is no indication that they have anything to lose except the price of the nitrogen, even in a year as dry as this, we cannot hesitate to recommend that they use it.

Figure 4 shows a summary of the data which the Experiment Station has on rates of N for corn. These data came from the experiments on Formulas; Sources of Nitrogen; Rates and Spacing; Manure, Vetch, Soda Residue and several others. It presents an average for the whole State based on work done on the Main Station, substations, and experiment fields over a long period of years. The curve shows dollar returns of approximately 6 to 1, 5 to 1, 4 to 1, and 2 to 1 on the cost of nitrogen in the first four 30 pound increments, respectively. Surely a 4 to 1 return on the third increment of 60 to 90 pounds of N is a good investment. There will be some years such as 1952 when it won't pay, but there will be other years when the return will be much greater. These figures are an average.

Winter Legumes for Corn

There has been considerable controversy over the relative merits of winter legumes and commercial nitrogen for corn production. The data which this Station has on comparisons of legumes with high rates of nitrogen is insufficient to satisfactorily answer this question. Most of the data that we have is from experiments with such low nitrogen applications that legumes have been placed in an advantageous position because of the amount of nitrogen they add to the soil.

Results of the "Vetch Residue Experiment" at Auburn from 1947 through 1951 are presented in Table 1. Yields from vetch every year and from 80 pounds of nitrogen every year were approximately the same. No advantage was shown from supplying both vetch and commercial nitrogen. Residual value of vetch decreased very rapidly in the second and third years after the vetch was turned.

Seventeen year average yields of cotton and corn in the "Manure, Soda, Vetch Experiment" at Auburn are presented in Table 2. The manure treatment was superior to both soda and vetch for both crops. Fifty-two pounds of nitrogen from soda produced yields intermediate between those from manure and vetch. Average yields of vetch indicate that this crop must have supplied from 50 to 70 pounds of nitrogen. Manure probably supplied about this same amount annually but the nitrogen in manure has much greater residual value than that from vetch or soda.

Some other data which can be used to compare legumes with commercial nitrogen are presented in Table 3.

Table 3. Corn Yields from Legumes and Commercial Nitrogen in the "Two Year Rotation" and the "Sources of Nitrogen #2" Experiments at Four Locations, 1949-51.

Plot No.	Treatment: Pounds N	Treatment: Legume	Monroeville	Sand Mountain	Tennessee Valley	Wiregrass	Average
			2 Year Rotation Experiment				
7	0	Yes	58.3	105.8	59.3	34.6	64.5
8	32	Yes	61.1	106.7	60.9	38.3	66.8
10	32	No	45.8	52.6	39.3	35.2	43.2
13	64	No	55.5	77.6	52.1	35.4	55.2
			Sources of N #2				
10	48	No	52.4	45.0	45.3	28.4	42.8
11	72	No	60.3	72.2	58.5	29.8	55.2
12	96	No	63.3	88.7	65.6	30.4	62.0

All of these data are not strictly comparable since too sets of experiments are involved but the data shown are for the same locations and years in both experiments. These data show, as do the data previously presented, that both systems will produce good corn yields, but is not complete enough to indicate a definite choice between legumes and commercial nitrogen at the rates used in these experiments. This then makes the choice largely a matter of economics, convenience, and personal preference.

Date of Planting Corn

The Alabama Experiment Station has only limited data on dates of planting corn (Table 4). Most of these data were obtained under low rates of nitrogen fertilization and over limited numbers of years at the various locations. Since the effect of date of planting on corn yield is largely dependent on weather conditions, particularly rainfall, date of planting experiments should be conducted over a period of several years in order to give a fair sample of variations in weather. The data in Table 4 are not sufficient to serve as basis for recommendation of date of planting in most of the areas in the State, but are presented here to show what information we do have.

Table 4. Corn Yields from Various Dates of Planting Experiments in Alabama.

Date	Wiregrass 1932-40	Tennessee Valley 1947	Gulf Coast 1946-48	Aliceville 1947-48	Brewton 1947-48	Prattville 1944-48
March 1	29.3		51.8			
" 15			48.3	39.3	42.0	
April 1	29.0		45.5	39.8	47.0	38.8
" 15			39.6	42.1	39.5	40.8
May 1	28.0	59		38.0	32.8	42.0
" 15		58	19.6	38.7	23.5	34.3
June 1		52				
" 20		49				
July		49				

Since Alabama is blessed with a much longer growing season than is required to produce a crop of corn, it may be possible to shift the planting date in order to make the period of maximum water need of the crop coincide with the period when the water supply is most likely to be adequate. Due to the failure to produce satisfactory corn yields at the Wiregrass Substation in the years since the rates and spacing experiment was established, a study of the rainfall data for the area was made in 1952. Results of this rainfall study for the Wiregrass area are presented in Table 5.

Table 5. Summer Rainfall in the Wiregrass Area by 10 Day Periods

	19 year avg. Headland 1932-1951(1) Inches	21 year avg. Ozark, Evergreen and Troy 1903-1924 (2) Inches	Years in 19 at Headland when: Rainfall was less than 1.0 inch	Period was the second of two successive periods less than 1.0 inch	Period was the third of three successive periods less than 1.0 inch
April 1-10	1.7	1.3	6	3	2
11-20	1.4	1.9	11	2	0
21-30	1.8	1.4	10	5	2
May 1-10	1.4	1.5	9	5	3
11-20	1.2	1.1	12	5	3
21-31	1.5	1.5	12	7	3
June 1-10	1.1	1.4	14	8	5
11-20	1.4	0.9	9	6	5
21-30	1.3	1.3	8	4	2
July 1-10	2.4	1.8	6	0	0
11-20	1.9	2.0	8	2	0
21-31	1.8	1.8	9	5	0
August 1-10	2.1	1.8	4	1	1
11-20	2.6	1.6	5	0	0
21-31	1.9	1.2	6	3	0
September 1-10	1.4	1.0	7	3	1
11-20	1.0	1.0	10	3	1
21-31	1.6	1.8	7	5	2

(1) Data not available for 1941.

(2) Data compiled by Funchess & Weidenbach.

This table includes average rainfall at the Wiregrass Substation for 19 years and the 21 year average from several other locations compiled by Funchess and Weidenbach in the 1920's. These data show an increase in rainfall in the first 10 days in July which lasts through the first 20 days in August. Rainfall in this period is considerably greater than during May and June, and as shown by the last two columns in the table there are fewer extended periods of drouth in July and August than in May and June.

The most critical period for moisture in the production of corn is from about 10 days before silking to about 30 days after silking. The data indicate that the moisture supply would be most adequate within this period if corn were planted to silk about July 10. The normal length of time between planting and silking for most corn varieties and hybrids being grown in the Wiregrass area is about 70 days. This means then that the optimun planting date should be May 1.

Corn planted in March or early April will reach the critical stage in June, which is the driest period of the summer. More periods of extended dry weather occur in June than in July or August.

These data will not apply in all sections of the State, but in cases where the planting date is in doubt such a study may help in indicating the approximate optimum planting date. Such an emperical approach is of course not nearly as dependable as good data from date of planting experiments. There are several factors other than rainfall that affect yields during different portions of the growing season. Therefore, more date of planting experiments should be conducted in areas where the optimum planting date is in doubt.

Other Factors in Corn Production

This paper was not intended to cover all of the phases of corn production. Best results cannot be obtained from any practice unless all production practices are properly done. These include method of planting and cultivation, mineral fertilization, and the use of adapted hybrids. Out variety reports list numbers of hybrids for all areas in the State. These hybrids are superior to the open pollinated varieties. It is very important that second year seed from hybrid fields not be used for planting purposes. Many experiments have shown that a yield reduction of 15 to 20 percent will result from planting second year hybrid seed. There is much less difference than this between our first and second choice hybrids.

SUMMARY:

1. Data were presented to show why the nitrogen recommendation for corn was raised to 60-90 pounds in the 1953 fertilizer recommendation.

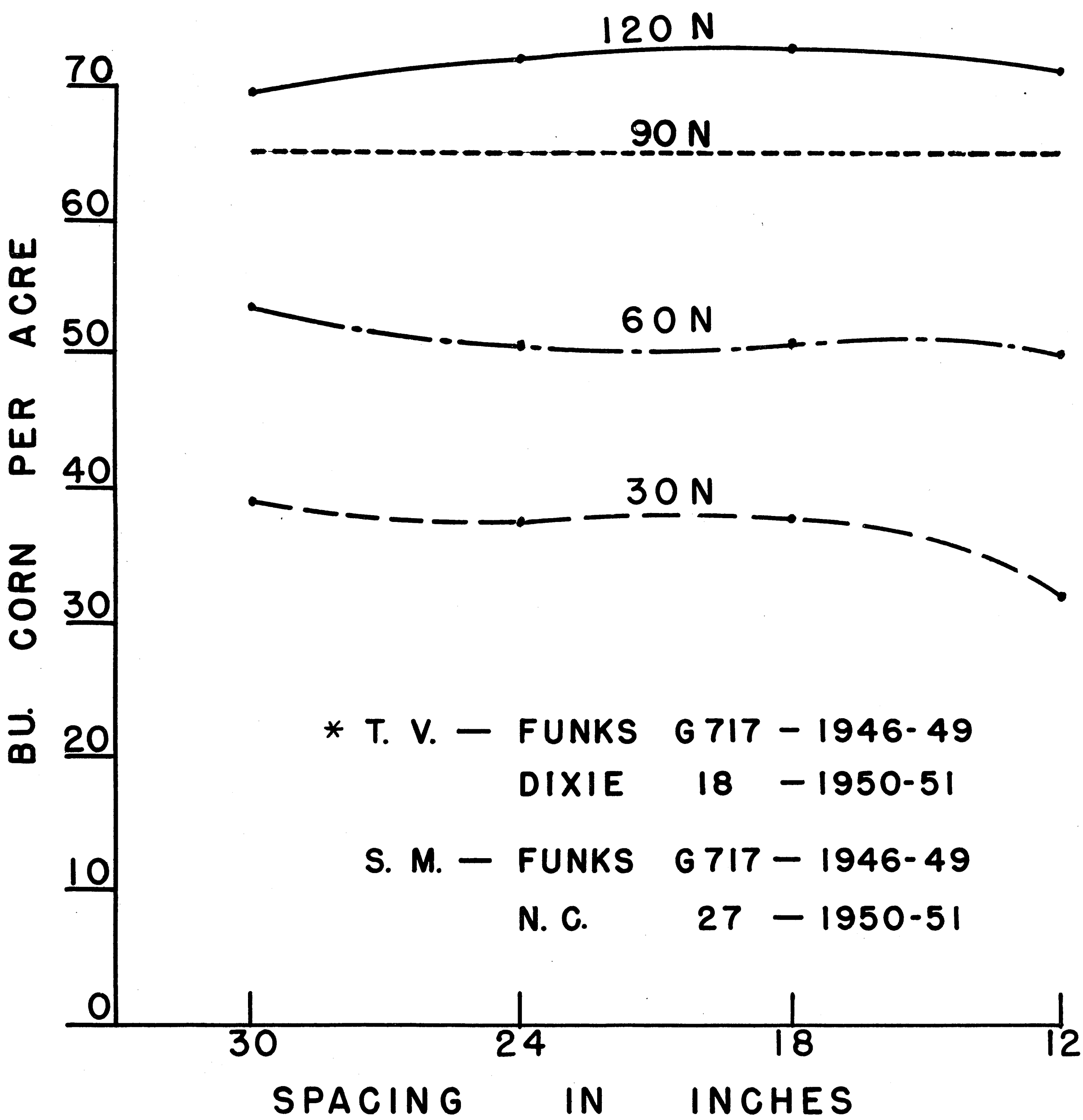
2. The recommended spacing is 18 to 24 inches for prolific corns and 15 to 18 inches for one-eared corns.

3. Yields of the 1952 experiments were seriously reduced by dry weather. The spacings recommended above did not reduce yields below wider spacing and the 12 inch spacing reduced yields only at the 30 pound nitrogen level. The average response to nitrogen was only two bushels for the 60 N over the 30 N rate and no response was obtained above 60 pounds. The higher nitrogen applications did not reduce yields.

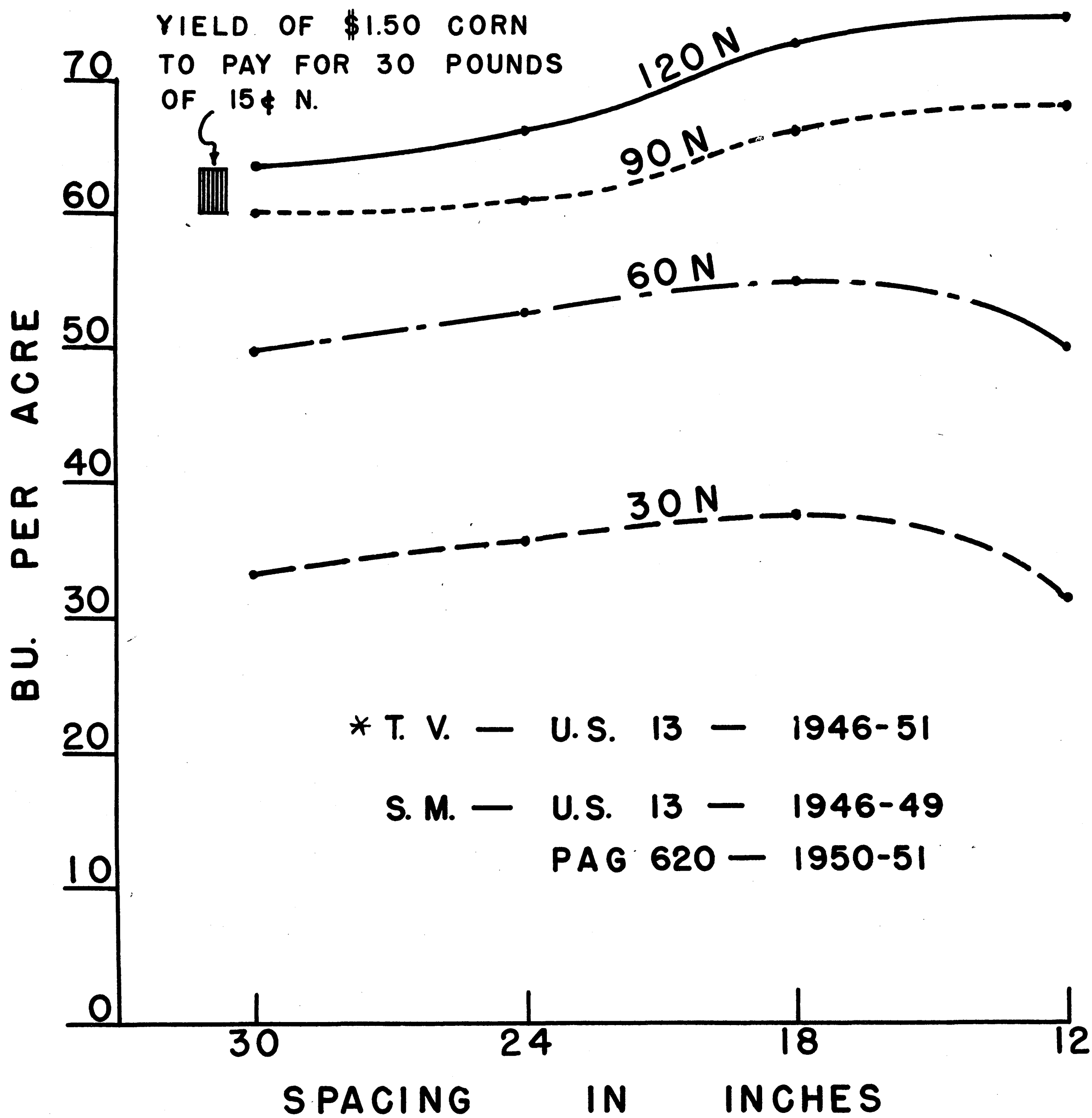
4. Results of several experiments comparing winter legumes with commercial nitrogen applications for corn show that good yields can be produced by either system. No distinct advantage of one system over the other can be shown from the data available, so the choice between them is largely a matter of economics, convenience and personal preference.

5. Data on date of planting corn is inadequate to serve as basis for recommendation. A system of studying rainfall data to help in determining the optimum planting date was presented using the Wiregrass area as an example.

AVERAGE YIELDS OF PROLIFIC CORN
*AT SAND MOUNTAIN & TENN. VALLEY
SUBSTATIONS — 1946-51



AVERAGE YIELDS OF ONE-EARED CORNS *AT SAND MOUNTAIN & TENN. VALLEY SUBSTATIONS — 1946-51



AVERAGE YIELDS OF CORN IN THE RATES OF NITROGEN AND SPACING EXPERIMENTS ON FIVE SUBSTATIONS 1952

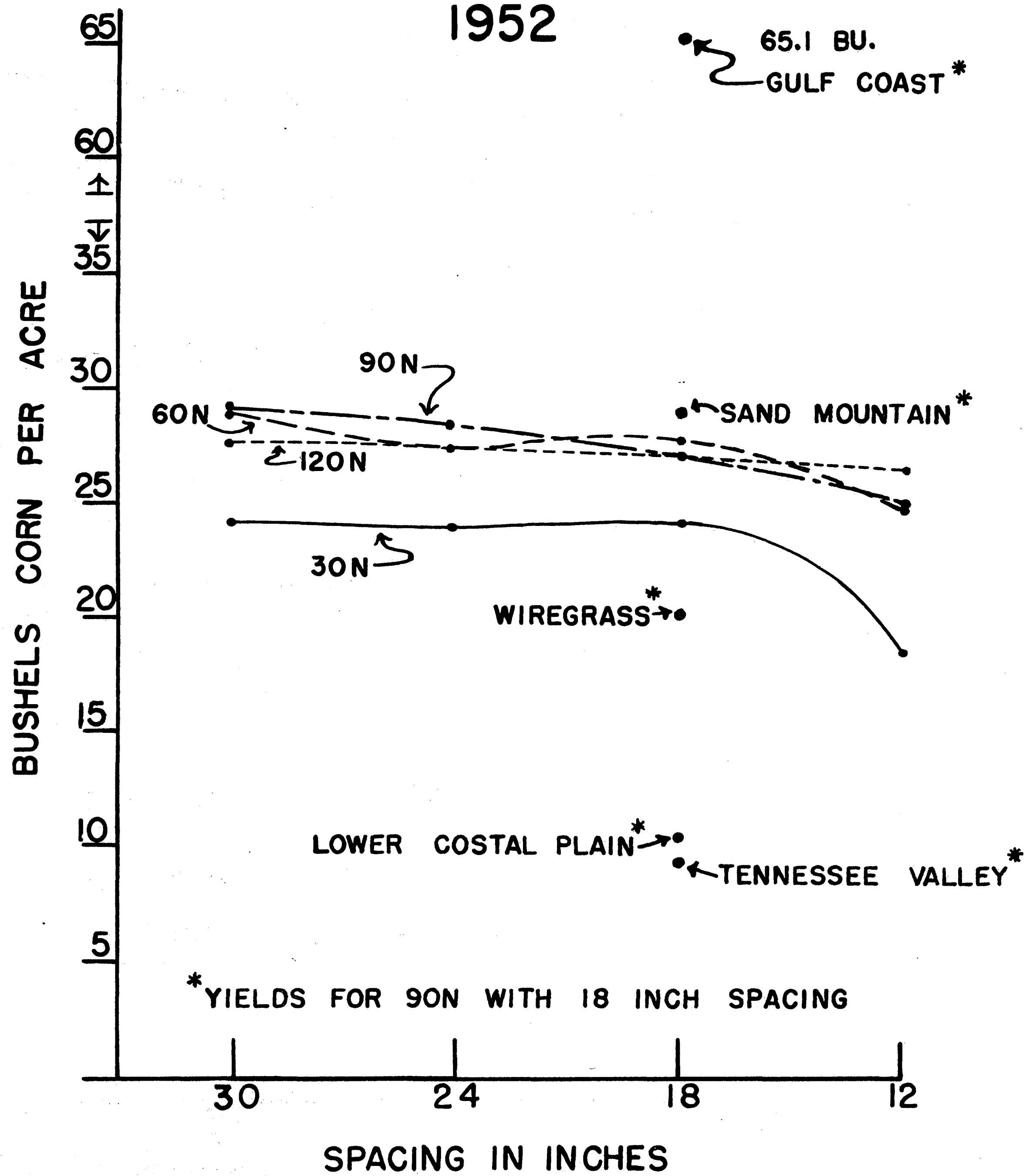
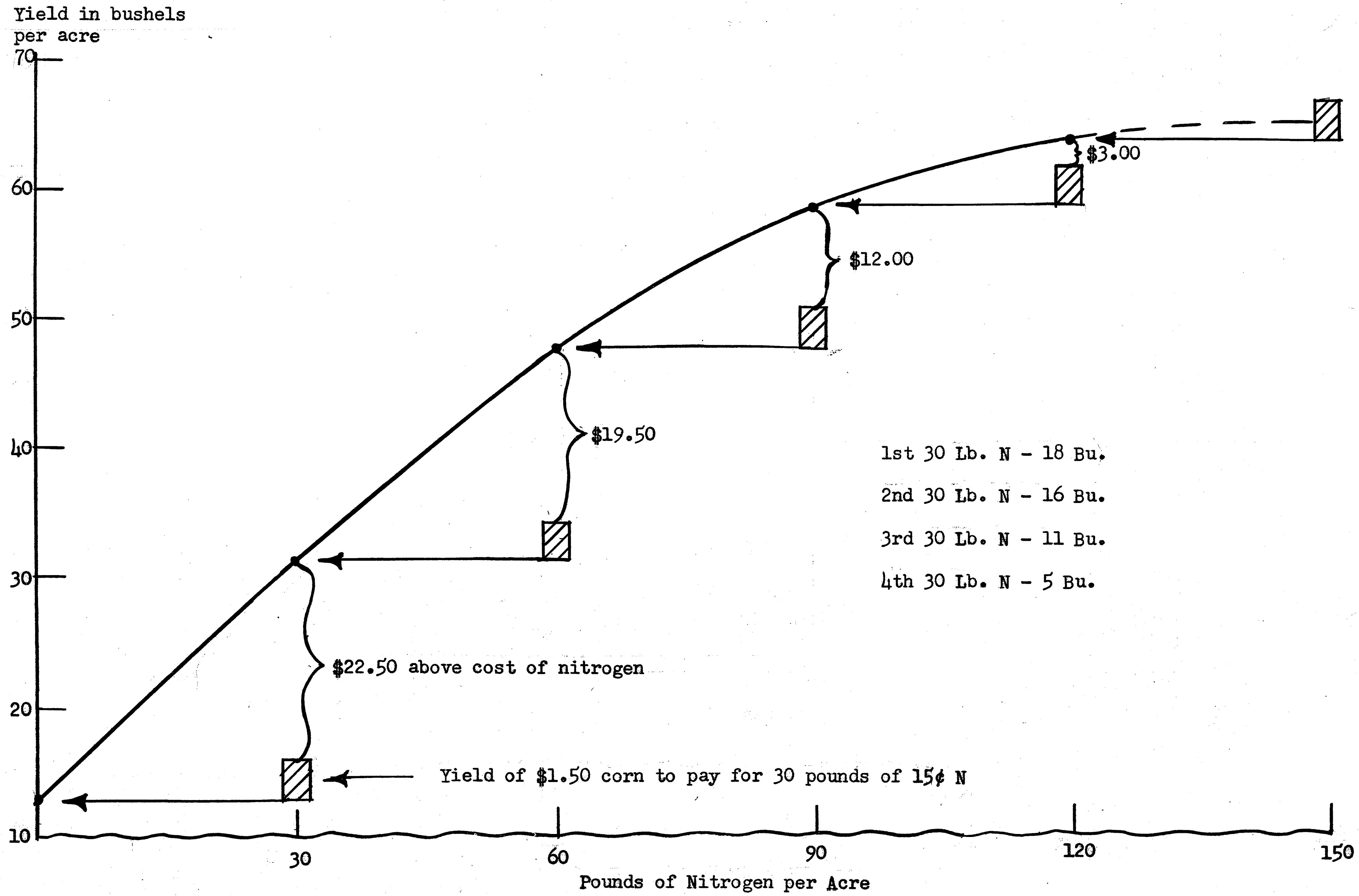


Fig. 4. Yields and dollar returns of corn from nitrogen fertilization in Alabama
309 Experiments



The FORESTRY SITUATION in ALABAMA .... W. B. DeVall

Each day we read in the press about the role agriculture is playing in producing food and fiber for the human population. Much has been published on food production and processing. Much less has come to the attention of the public on fiber production and use. Those fibers that have been in use over a long period of time are well known. Newer ones have yet to be fully publicized.

It is the purpose of this paper to set forth some of the more important trends in production of wood fiber and to suggest new concepts that may improve the forestry situation in Alabama.

Alabama has been and still is an agricultural state. Of the crops produced from her soil, processed wood and textiles lead the list in dollar value. The fact that processed wood rates high on the list in dollar value is not surprising since approximately 19 million out of 32 million acres in the state are forested. If recent figures may be assumed correct, there are 6 acres of commercial forest land for every man, woman and child living in the state. Who owns this land? Farmers own 37%, and when this is added to that owned by other small owners, 69% is held in small parcels; primarily by rural people. The average farm is 47% wooded. Wood produced on the farm plus that from other ownerships contributes much to the economy of the state. Twenty-three percent of the number of people employed by industry derive their income from wood. Seventeen percent of all industrial payrolls and profits is earned in forest industries. Wood is also the basic raw material on which a 424 million dollar annual income is realized in Alabama.[1]

Wood Fiber

What is this mysterious product, wood? Why is it still considered a neglected agricultural crop? Perhaps some of the mystery can be removed by briefly explaining how wood is produced. First of all, wood is a biological material, composed of cells which are commonly called fibers. Each year new cells or fibers are added in a conical layer just inside the bark. This layer of wood represents annual growth. Since this growth is not harvested annually, like the fiber yield from cotton, it accumulates like compound interest on a monetary investment. The process is similar to that of adding inverted cone-shaped paper cups, one upon another. It is comparable to investing the annual profit from a farm crop, at interest. At the end of any stated period of time the yield of wood fiber from one acre of land is the accumulated volume of these cones which make the trunk of the tree. This large supply of fiber is stored in living form in nature's outdoor warehouse until it makes a usable product. Harvesting in a managed forest is normally done at intervals of from 5 to 10 years and the amount removed seldom exceeds growth for the equivalent period. The mysteriousness of the units of measurement used to express the volume of this harvest can be removed. Instead of using cords, cubic feet and board feet, pounds or tons can and probably will be used in the near future.

Since wood is not harvested annually, and since it is measured in units not commonly used by the average person, and since it is produced by a plant that grows much larger than other farm crops, it continues to be a mysterious product.

1/ American Forest Products Industries, Inc., Alabama Forest Facts, 1952 edition.

If fibers, along with food, are the backbone of our standard of living, perhaps more serious thought should be given to the production of wood: primarily cellulose or fiber. Recent industrialization in the south in the pulp and paper field was made possible through research conducted by Dr. Herty. Today, fibers manufactured from wood in an average year by southern pulp and paper mills are equivalent to 23 million bales of cotton.[2/] Here is a new concept and one that only recently has been brought to the attention of the public. Alabama's forest acreage is now producing the equivalent of 560 pounds of fiber per acre each year. On 19 million acres this yearly growth amounts to approximately 5.3 million tons of fiber or a 560 pound bale of cellulose fiber on each forested acre each year. Research at Auburn has helped establish both practical and theoretical goals in wood fiber production. Although there are differences in yield between species and on sites varying in quality, research results show that yields of 2,000 to 3,000 pounds of fiber can be produced annually (Table 1). These yields have been obtained on eroded, sandy land, previously abandoned for agricultural use.

Table 1 - Annual Wood and Fiber Yields from Plantations at 6' x 6' Spacing, 19 years old, Auburn, Alabama.

Species and yield	Rough Wood (stacked) Cords	Peeled Wood (solid) Cu. Ft.	Fiber[1/] (cellulose) Pounds
Loblolly Pine			
Average	1.7	130	2,290
Maximum	2.1	160	2,820
Slash Pine			
Average	2.2	150	3,130
Maximum	4.0	290	6,050

1/ Cross & Bevan cellulose, assuming 60% cellulose and Sp. Gr. of 0.47 for loblolly pine and 0.56 for slash pine.

While not commonly thought of as wood fiber, pulpwood when converted into wood pulp is a good example of such a product. Since this product is produced in large quantity on Alabama farms, a glance at recent figures is quite revealing. In 1949, Alabama rated fifth in the south in pulpwood production. In 1950 it rose to fourth place and held this position through 1951. Baldwin County has led all Alabama counties in pulpwood production. Mobile County has ranked second and Washington third. Tuscaloosa and Clarke Counties appear as contenders for fourth and fifth places, respectively.[3/]

2/ Wood, April 1952.

3/ U.S.D.A., Forest Survey Releases, Nos. 35, 38 and 69.

New Concepts

Research on wood has produced new techniques by which it may be processed. The large trees characteristic of virgin stands are no longer available to the average processor. The continuing need for large sized wooden members for construction purposes has led to a study of lamination. Today, keels for mine sweepers, trusses for large buildings, and even airplane propellers are made by gluing together many small pieces of select wood. Lamination not only makes possible the use of small pieces of select wood but also permits the use of otherwise waste material. A research project at Auburn is now being conducted with these objectives in mind. Techniques have been worked out by the Forestry Department whereby short, select pieces of southern pine wood may be glued together endwise to make "long ones out of short ones." Research efforts by private industry have made it possible to fell a green tree on Monday, cut it into lumber, dry the boards, pressure treat the wood and glue it up into timbers that can be put into boats and painted by Wednesday of the same week — a three day job previously requiring weeks.

More and more trees of smaller size are forcing the permanent wood processing pine mills to adopt new methods of manufacture. When a small log is cut into lumber by conventional methods, the percent of waste is high. It is now possible to debark logs before milling, salvage all slabs, edger strips, and trimmings, put them through a chipping machine and sell the chips (formerly waste or used for fuel) to a pulp mill. Such a processing plant is now being installed at Chapman, Alabama.

The field of wood chemistry offers some of the most challenging opportunities for productive research. Research has recently produced two new processing methods, hydrolysis, or the conversion of cellulose and other carybobydrates into sugars, and hydrogenation, which under given conditions changes the components of wood into liquid products. These processes can operate on mill waste. Unused wood at the processing plant (principally sawdust and shavings) is equal in weight to one-fifth of the national petroleum production. Unused wood left in the forest amounts to 44 million tons each year. Trees killed by fire, insects, etc., but suitable for chemical conversion, account for another 23 million tons of wood.4/ In Alabama, this would amount to approximately 3.3 million tons of waste at an estimated value of 324 million dollars.

Wood when hydrolyzed yields an unlimited array of potential products. These include ethyl alcohol, wood yeast, furfural used as a solvent in oil and rosin refining as well as in making plastics and nylon, acetic acid, butyric acid, lactic acid, acetone, butyl alcohol, and butylene glycol, a potential anti-freeze agent. Lignin is an unused component of wood and has yet to be chemically defined. It has a higher fuel value than wood and may be the source of important soil conditioners. Lignin has recently been found to yield an ester that is effective in fighting certain virus diseases.

The potentials of hydrogenating wood are not fully known. By-products of the process have been used in small bombs, as an anti-knock material in gasoline, and as lubricants. An unknown awaiting research is a commercial glycerine-forming process.

4/ U.S.D.A., <u>Trees</u>, the yearbook of agriculture, Wash., D.C., pp.460, 1949.

Industries based on chemical conversion of wood offer great economic potentials. For example, one ton of wood in the tree valued at $5 will be worth about $2500 when converted into clothing.

Economics

The success of any business venture, whether agricultural or industrial, depends upon the financial return (percent earned) on the original investment. The forest industries of the state operate on this premise. The landowner and farmer must likewise be cognizant of this basic economic concept when comparing financial returns from one crop with returns on another.

Trees grown as a fiber crop, whether in the form of fence posts, pulpwood or sawlogs, frequently return more to the owner on certain lands than other cash crops. The average person frowns upon trees as a crop because of low financial returns. This is seldom the case. The return should be expressed as a percentage; the equivalent of interest earned had the investment been in a bank or stocks and bonds. The arithmetic is quite simple. It tells the actual story and serves as the only basis upon which the financial feasibility of a business venture can be computed. Only when the <u>net</u> annual return (income minus costs) is expressed as a percentage of the total invested, is the earning power of the venture determined. The forestry situation in Alabama can be realistically improved by a simple statement of these facts. Such a statement must be made for <u>each</u> crop the farmer grows. A comparison of the annual dollar value returned from an acre of improved pasture and an acre of trees is not a true picture of the economic soundness of the venture. Until the costs of producing this dollar value, including labor and supervision, have been subtracted and this <u>net</u> annual return expressed as a percentage of the total invested, sound advice cannot be given to the farmer.

The apparent low return can often be attributed to the hesitancy of the landowner to reinvest a portion of his forest income in the forest property. As a result of this, the forest acreage seldom yields a return in proportion to its capabilities. The progressive farmer will not hesitate to invest a portion of his income from a given crop to improve the yield and return from this crop the next year. The same philosophy applies to the production of wood. The reinvestment on a farm crop is generally for irrigation, improved seed, fertilizer and tillage, whereas the primary reinvestment on forest crops is in labor, and labor can be made seasonally available on most farms.

In order that the values of the farm woodlot be better understood and appreciated, a research project was developed and approved in November 1952 which will eventually bring all forested lands on agricultural holdings of the Experiment Station under a plan of management. Such a project has 3 major objectives. The plan will provide the respective person in charge of the land an inventory of material on hand and its proposed use. Second, it will provide areas showing approved forestry practices that meet farm needs. Finally, the study will yield research data on costs and returns. Technical work only will be carried by the project leader in cooperation with personnel provided by the experiment station unit on which the timber is located. Planning of this type has been done on the Camden Substation.

Managed woodlots such as these will enable more farmers to see good forestry as a part of diversified agricultural enterprises. The agriculturist will have at his disposal information on wood volume, cost of operation and derived income on his forested acres as well as on his other acreage. He will be able to answer the visitor's questions and also plan for his own timber needs.

SOYBEANS in ALABAMA .... R. D. Rouse
POSSIBILITIES, PRODUCTION PROBLEMS and RESEARCH PLANS

Last year the Director asked us to investigate the problems concerned with soybean production. Several of us have given considerable thought and study to the prospects of soybean production in Alabama and we have concluded that there is a good possibility that the crop has a much greater place in the agriculture of the State than is now realized. We believe that this conclusion is well founded and that an extensive research program is justified.

These questions need to be answered to arrive at a conclusion about the possibilities of soybeans as a crop for Alabama.

(1) Is the demand for soybeans likely to remain great enough to keep the price favorable for production?

(2) How much money can a farmer expect to make from the production of soybeans?

(3) How do soybeans fit into the cropping system of various types of farms?

All indications are that the future demand and thus the price will be favorable. Soybeans have become an important cash crop. They are the leading source of vegetable oil and the meal is in demand for many uses, especially as a high protein supplement for livestock. In gross dollar value soybeans rank eighth among harvested crops in the United States.

In Alabama the cotton seed oil industry is very much interested in soybeans. They requested a meeting with representatives of the Experiment Station last spring, to let us know how interested they are in the crop. They would like for us to find out how to produce soybeans in Alabama and help them promote the crop. Their interest is an indication that the local demand is good.

The question of how profitable soybean production in Alabama might be can be answered only as a calculated estimate since their production has not been adequately studied. Experience with soybeans in earlier years indicated that their production was not profitable. However, in recent years yields and farmer acceptance indicate that the soybean crop is profitable in certain areas. Acreage has increased from about 10,000 acres in 1940 to about 100,000 acres last year. The State average yield for the last few years has ranged from 17 to 20 bushels per acre. This compares closely with the yield in the soybean producing area of the United States. A survey in the Gulf Coast area by the Agricultural Economics Department in 1951 included 100 farms growing soybeans. It showed that 79% of these farms averaged 20 bushels or more and 17% averaged 30 bushels or more. I believe we would conclude that soybeans can be grown profitably in Baldwin county or there wouldn't be 50,000 acres planted in a county with less than 100,000 acres of cultivated land. The other area of soybean production in the State is around Jackson County. It is a popular crop with the farmer in that area. We have very little information on yields in the remainder of the State. The oil industry has been promoting soybeans in several areas but in general they report poor yields. The yield data that we have are from variety tests. Table 1 shows the yields obtained with 2 of the adapted varieties and one new variety that is to be multiplied in 1953 for release. The data from these locations in the State and the average yield for the Southeastern region indicate that good yields might be made in most of the State.

The data in Table 2, adapted from a North Carolina State College report, illustrate the profit that might be expected from soybeans compared to some other field crops. These data indicate that soybeans cannot compete with cotton and peanuts when yields are good, unless labor or acreage controls are a problem. However, it might be as good a source of income as corn. This would especially be true if grown in cropping systems with oats or other winter grazing crops. However, the net profit from a soybean yield of 26 bushels per acre would compare favorably with net profit from yields of 3/4 bale of cotton, 1000 lbs. of peanuts or 40 bushels of corn per acre.

It should be pointed out that soybeans have two outstanding advantages over corn: (1) they can be planted later, and (2) moisture is less critical after the crop is up to a good stand. This indicates that soybeans would be a good crop to divide the corn acreage with and thus another basket to put some eggs in, a basket that a lot of farmers could have used in 1952.

This brings us to the third question, "How do soybeans fit into the cropping system on various farms?" Soybeans can be considered as a major cash crop when plans are made to plant in May in central and north Alabama, or up to late June in the Gulf Coast area.

In most areas of the State, soybeans will produce a good yield if planted in June and weather conditions are favorable. This means that it may provide additional income when planted after oats for grain or legumes for seed. Another advantage of the crop is that it can be converted to a hay crop in September if hay is short and the value as hay might be more desirable than beans.

It appears that there is a place for a late planted, low labor requiring summer crop such as soybeans on many farms in the State. It is true that a combine must be available and therefore every farm cannot plant soybeans for beans, but I believe we must re-evaluate soybeans as a crop for Alabama. In dollar value to the farmer, it ranks 5th. among field crops in this State. Surely more research on soybeans is justified than we now have, even if the acreage does not increase.

<u>Production problems</u>

(1) Lime, fertilization and inoculation.
Work in other southern states indicates that the best yields cannot be expected on soils with low calcium and magnesium. If the soil has a pH value around 5 or below, it should be limed. Like peanuts, soybeans are heavy feeders on potash. A good crop will remove about 60 pounds K_2O and 30 pounds of P_2O_5 per acre. North Carolina has published data from several locations which show good responses to applications of both phosphate and potash when lime is not limiting. About 200 pounds of N are required for a good crop of soybeans. Therefore, it is essential that the crop be well inoculated with a good strain of soybean bacteria. With good inoculation a profitable response to applied nitrogen is seldom obtained. When soybeans are grown for the first time on some light sandy soils, a starter application of 15 to 20 pounds of N may be beneficial.

(2) Seed Variety

Obtaining a good stand is often listed as the number one problem in soybean production. Therefore, it is especially important to purchase good seed that are strongly viable and store them carefully until planted. The variety planted plays an important part in the yield harvested.

In addition to selecting a variety that yields well and has a high oil content, we want a plant that will make adequate growth to shade out grass and also set the beans high enough on the stalks for harvesting with a minumum of cutterbar loss. Nonshattering varieties are also desirable so that the period is extended over which combining can be carried out before loss by shattering occurs.

(3) Planting

Height growth of most soybean varieties is retarded when planted early and total growth is retarded when planted late. This characteristic varies with the maturity date of the variety and therefore, the best planting date for the varieties planted should be known.
Even with good seed, care must be taken to get up and maintain a good stand through the seedling state. A good seedbed should be prepared and seed planted at a rate to give about 1 seed per inch, after the soil is warm and when moisture is sufficient for the beans to germinate in two or three days. If the soil crusts over before the beans germinate, cultivate to break the crust. The question is often asked, "What should be done with the straw when beans follow a grain crop?" We do not have information on this, but it is our guess that if equipment is available that will enable the preparation of a good seed bed, it is probably advisable to broadcast nitrogen and turn the stubble, but if the equipment is not available, the straw will have to be removed.

(4) Cultivation

Weeds must be controlled early. If a good seedbed has been prepared, weeds can be controlled in the seedling stage with a rotary hoe or spiketooth harrow. This equipment should not damage plants less than 10 inches if the operation is carried out in the heat of the day. When planted in row, they may need standard cultivation until the leaves are almost lapped.

(5) Harvesting

Recent studies in Iowa show an average harvesting loss of 16% on all of the fields studies. About 75% of this was cutterbar loss, so a nonshattering variety that sets beans high on the stalk will eliminate most of the combining losses.

Soybean Research

In 1943, because of the increased demand for vegetable oil, the U. S. Regional Soybean Laboratory at Urbana, Illinois expanded its program to include the 12 southern states. Headquarters for the southern section are located at the Delta Experiment Station, Stoneville, Mississippi. Uniform variety tests have been conducted in Alabama and the Southern region since that time. The yield data that were presented in Table 1 were from these variety tests.

Last year date-of-planting tests were put out on four experiment fields and a fertility experiment at the Lower Coastal Plain Substation. In September we observed the condition of beans in the Gulf Coast area and collected plant and soil samples from various fields in that area to obtain some information on plant composition as related to soil fertility status.

We have made plans for 3 fertility experiments, 5 date-of-planting tests and a further study of farmer's fields for 1953. I believe that we should have a soybean experiment on every experiment field and substation for the next few years so that we can evaluate the possibilities of the present varieties over the entire State. Only then can we advise farmers in the various areas as to their possibilities.

Table 1. Yield of Soybeans (bushels per acre)

	Fairhope	Tallassee	Crossville	Belle Mina	Southeastern Region
			Ogden		
1946	11.8	15.8	44.6	15.2	33.5
1947	-	-	26.0	13.0	21.9
1948	29.4	32.2	31.6	9.8	21.5
1949	31.3	29.8	21.8	-	29.0
1950	20.4	30.0	-	-	31.7
1951	42.8	17.2	-	12.0	19.7
1952	22.9	29.8	-	30.0	-
Average	26.4	25.7	31.0	16.0	25.6
			Roanoke		
1946	9.9	19.3	36.5	15.7	30.2
1947	-	-	27.0	10.0	21.2
1948	27.1	32.2	34.3	10.3	26.4
1949	28.3	32.2	24.8	-	26.2
1950	23.7	27.3	-	-	26.5
1951	47.4	40.6	-	-	27.5
1952	24.8	46.1	-	-	
Average	26.9	33.9	30.7	12.0	26.9
			N47-3479		
1950	23.3	35.2	-	-	25.9
1951	48.6	35.6	-	-	26.7
1952	25.6	47.2	-	-	-
Average	32.5	39.3			26.3

Table 2. Estimated Cost and Returns of Field Crops, 1951

Crop	Man hours	Tractor hours	Direct cash expenses	Returns over direct cash expense	Net Returns
Cotton (1 bale)	117	9	$45	$162	$78
Peanuts (1200 lbs.)	31	10	33	109	61
Corn (50 bu.)	12	9	23	66	48
Oats (50 bu.)	9	6	23	32	19
Soybeans (26 bu.)	9	7	25	44	29
Oats (50 bu.) + Soybeans (26 bu.)	18	13	48	65	37

Adapted from Department of Agricultural Economics Report No. 29, North Carolina State College.

CONTROL of LIVESTOCK PESTS .... George H. Blake, Jr.

The most important livestock pests in Alabama are horn flies, horse flies, stable flies, screwworms, ticks, lice, and cattle grubs. Every year these pests cause considerable loss in beef and milk to the farmers of Alabama. House flies are a problem around dairy barns and other out-buildings; therefore, control of this insect should be considered. In order to realize more economical gains from our livestock, control of these pests should go hand in hand with herd and pasture improvement.

For the past two years studies on the control of some of these pests have been made. Experiments on control of horn flies, house flies, and cattle grubs have been conducted and will be discussed first, then controls for other pests will be given.

Horn Flies

In 1951 and 1952 experiments were conducted on control of horn flies to determine the relative effectiveness, both in initial kill and as residual deposits, of several insecticides. Only wettable powders of the insecticides were used in these tests.

At the Lower Coastal Plain Substation in 1951, DDT and chlordane were compared with an untreated check for control of horn flies. The cattle were sprayed with approximately one quart of spray per animal per application. The results of this experiment are presented in table 1.

After the first spray application, population counts revealed that chlordane did not control horn flies as well as DDT. Chlordane was equal to DDT 14 days after the second spraying, but after 28 days the chlordane was losing its effectiveness. It should be noted that the chlordane was applied at a concentration (0.5 per cent) one-third as great as the concentration of DDT (1.5 per cent). This difference in concentration was necessary, since repeated applications of chlordane at concentrations greater than 0.5 per cent are not safe for use on livestock.

In 1952 similar experiments using DDT, DDT-lindane, methoxchlor, and toxaphene were conducted cooperatively with farmers in Lowndes and Dallas Counties. Results of these experiments are presented in table 2. Each treatment was applied to three different herds, and three applications of the sprays, except DDT, were made. In table 2 results of three experiments have been combined to show the average number of flies per animal following each spray application.

All insecticidal treatments significantly lowered the fly populations on treated animals below those of the untreated check animals. The difference in number of flies on sprayed and unsprayed animals remained significant for 28 days after the first application, 37 days after the second application, and 14 days after the third application of spray. Twenty-eight days after the third spray application the population of flies was low on all animals due to cold weather.

Insecticides used in these tests are of about equal effectiveness for control of horn flies. All of them are safe at the concentrations used; however, toxaphene should be used with care. Concentrations of toxaphene greater than 0.5 per cent should not be used, particularly on calves.

Methoxychlor is the only insecticide of this group recommended for use on dairy cattle.

House Flies

One method of house fly control was investigated in 1952 at the Piedmont Substation. Baling twine was treated with 23 per cent dieldrin emulsion and allowed to dry. Lengths of this treated twine were suspended from the rafters of a milking shed and cut off approximately 6.5 feet from the floor, so that they would not interfere with personnel working in the shed. The dieldrin was used in this manner because it is not recommended for use in barns as a spray.

Fly counts were made at the time of installation of the strings and at irregular intervals afterwards, both in the shed containing the treatment and in an untreated shed. The last fly count was made October 13, 28 days after the experiment was begun. Population counts will be continued in 1953 when the flies are again numerous to determine the length of residual effectiveness of dieldrin when used in this manner.

All of the fly counts revealed that the treatment reduced the fly population, and dead and dying flies were found at each count. Despite the treatment, however, flies were still fairly numerous, and it was apparent that the flies were breeding faster than they were being killed. Control in this case was dependent upon the flies resting on the treated strings and, apparently, too few strings were used. In the next experiment treated strings will be placed not only in the milking shed but also in other sheds and barns near the breeding areas.

The following materials in the form of wettable powders are recommended for control of house flies: DDT, 50 per cent; methoxychlor, 50 per cent; chlordane, 40 per cent and; toxaphene, 40 per cent, each used at the rate of 50 pounds per 100 gallons of water; and lindane, 25 per cent, used at the rate of 8 pounds per 100 gallons of water. These materials should be applied as residual sprays to barns and other out-buildings.

Only lindane and methoxychlor are recommended for use in dairy barns.

Cattle Grubs

Two experiments on control of cattle grubs were conducted during the winter of 1951-52. One experiment, a comparison of sabadilla, pyrenone, lindane, rotenone, and an untreated check, was carried out at the Lower Coastal Plain Substation. The results of this experiment are presented in table 3. These data show rather conclusively that of the materials tested, only rotenone was an effective control for grubs.

The other experiment on control of cattle grubs was conducted at the Animal Breeding Unit, North Auburn. This investigation was made to determine the interval to use between spray applications for most effective control. Rotenone was used in all sprays, and sprays were applied at 400 pounds of pressure at 2, 3, 4, and 5-week intervals. There was no difference in the control obtained between the 2, 3, and 4-week intervals, but at 5-week intervals between sprays, some of the grubs emerged.

Another experiment to investigate various spray pressures to use for control of grubs was outlined, but sufficient numbers of grub-infested animals could not be found on any of the other substations. The Bureau of Entomology and Plant Quarantine, however, now recommends pressures from 200 to 400 pounds for control of cattle grubs.

Three applications of spray containing 7.5 pounds of 5 per cent rotenone per 100 gallons of water applied at from 200-400 pounds pressure and at monthly intervals are recommended for control of cattle grubs. The first spray application should be made after the grubs have cut through the skin of the animals, generally between December 15 and January 15.

Stable Flies and Mosquitoes

Stable flies and mosquitoes can be controlled in barns by use of the same materials as recommended for control of house flies, and on livestock they can be controlled with insecticides used for horn fly control.

Horse Flies

Horse flies, at certain times of the year, are extremely annoying to livestock. These insects not only consume considerable quantities of blood from the animals but also make wounds which are attractive to screwworm flies. When screwworms are abundant, the control of horse flies is of especial importance.

Undiluted pyrenone concentrate is the only material which has been found to be effective for horse fly control. This material when applied twice daily with automatic sprayers has given 98 per cent control of horse flies, and when applied semi-weekly has given 90 per cent control.

Screwworms

Screwworms, when abundant, are the most serious insect pests of livestock in Alabama. During periods of heavy screwworm infestation, very small wounds or drops of blood are attractive to the female flies. This means that all animals must be carefully observed at least once a week for screwworm infestations, and wounds should be treated as soon as possible.

EQ-335, a smear containing lindane, is the best material to use for control of screwworms. It not only kills the larvae in the wounds but also kills flies alighting on the wounds. The protection afforded by EQ-335 lasts approximately 7 days; therefore, it should be applied at weekly intervals until the wound is healed.

Smear 62 or 82 may also be used to kill the larvae, but these smears do not kill flies visiting the wounds to lay eggs.

Ticks

Attached ticks are very irritating to animals. These pests are a problem in many herds located in southwestern Alabama. Ticks injure animals by their feeding and cause wounds which may become infested with screwworms.

Ticks on beef cattle can be killed by spraying the animals with toxaphene, 1 pound of 40 per cent wettable per 10 gallons of water. Five pounds of 50 per cent wettable BHC, or 1 pound of 25 per cent wettable lindane, plus 20 pounds of 50 per cent wettable DDT per 100 gallons of water is also recommended.

Dairy cattle should be sprayed with pyrenone containing 0.1 per cent pyrethrins and 1 per cent piperonyl butoxide for tick control.

Lice

Lice can be controlled with either DDT, 1 pound of 50 per cent wettable powder per 4 gallons of water; lindane, 1 pound of 25 per cent wettable powder per 100 gallons of water; or methoxychlor, 1 pound of 50 per cent wettable powder per 4 gallons of water. Rotenone may also be used for control of lice and can be applied for louse control at the same time it is being used for cattle grub control.

Only methoxychlor and rotenone are recommended for use on dairy cattle.

Mange

Mange mites are common on hogs in Alabama and are sometimes found on cattle. Mange can be controlled by using 4.5 pounds of 25 per cent wettable lindane, or 10 pounds of 50 per cent wettable BHC (12 per cent gamma isomer) per 100 gallons of water.

On cattle only the infested or scab area should be sprayed.

Table 1. The effect on horn fly populations of various treatments applied to beef cattle.

	Average number of flies per animal following treatments			
	1st Spray		2nd Spray	
Treatment	13 days	21 days	14 days	28 days
	No.	No.	No.	No.
Untreated check	250	275	250	225
DDT, 1.5%	15	75	3	10
Chlordane, 0.5%	150	275	0	75

Table 2. The effect on horn fly populations of various treatments applied to beef cattle.

		Average number of flies/animal following treatments*							
		1st Spray			2nd Spray			3rd Spray	
Treatment	Conc.	14 days	28 days	42 days	14 days	37 days	51 days	14	28
		No.	No.	No.	No.	No.	No.	No.	No.
Untreated check	------	142	150	225	233	433	300	117	13
DDT	1.5%	---	---	---	7	63	250	1	1
DDT, lindane	1.2-0.03%	0	29	133	7	67	150	1	0
Methoxychlor	1.5%	1	4	108	10	67	216	1	1
Toxaphene	0.5%	0	54	160	14	170	175	2	1

*These numbers are averages of three experiments.

Table 3. The effect on cattle grub infestations of several treatments applied to beef cattle.

Treatment	Concentration	Per cent dead grubs after spraying*	
		1st spray	2nd spray
	%	%	%
Untreated		10	0
Sabadilla	0.47	45	63
Pyrenone	0.0047	36	42
Lindane	0.025	31	24
Rotenone	0.047	83	91

*Spray applications were made on December 5, 1951 and January 7, 1952.

CONTROL of PESTS of STORED GRAIN in ALABAMA .... W. G. Eden

The principal grains produced and stored in Alabama are corn, oats, and grain sorghum. Corn is by far the most important. The most important insect pests of stored grain are the rice weevil, the grain moths, and the cadelle. This talk will consist principally of the control of the rice weevil in corn; however, other corn insects, as well as insects of oats and grain sorghum, will be mentioned.

I. OATS

In general when oats are harvested, they are relatively free of stored grain pests. Damage to oats in storage comes from infestations that build up after the oats are stored. Most of this type of damage can be prevented by the following operations: (1) Clean bins thoroughly of refuse and waste from previous crops before filling them with oats. (2) Spray the entire inside of the bins with a 2.5 per cent DDT wettable powder suspension (2 pounds of 50 per cent wettable DDT in 5 gallons of water).

These operations are usually sufficient for insect control unless oats are to be stored for over 6 months. Stored oats should be examined at monthly intervals for insect damage. If populations of grain moths or rice weevil build up, fumigation may become necessary.

Any of several fumigants may be used. Probably one of the most readily available and best is a 3:1 mixture of ethylene dichloride and carbon tetrachloride. It should be used at the rate of 6 gallons per 1000 cubic feet in tight bins.

We do not have sufficient data on the use of protectant dusts on oats to recommend them at the present time.

II. GRAIN SORGHUM

When grain sorghum is harvested it is frequently infested with the grain moths and the rice weevil. Treatment against stored grain pests is almost a necessity.

The bins should be thoroughly cleaned and sprayed as I have indicated for oats. Since fumigation must be done, the bin should be made tight before the grain is stored. Unless bins are tight, they should be lined with light weight roofing felt or pasteboard.

The grain sorghum should be fumigated two weeks after storage. The ethylene-dichloride-carbon tetrachloride (3:1) mixture should be used at the same rate as prescribed for oats. A second fumigation in the spring is often necessary on grain sorghum.

Sufficient data on the use of protectant dusts on grain sorghum have not been obtained to recommend them at the present time.

III. CORN

Most of the research has been done on the control of stored grain pests, especially the rice weevil, in corn. This research will be discussed under three headings as follows: (A) variety and varietal characteristics, (B) production practices, and (C) storage.

A. Varieties and Varietal Characteristics

In the past several years a series of varietal characteristics have been investigated that were thought to have influence on the damage to corn by rice weevils.

1. HUSK COVER. Husk cover was one of the most important characteristics of varieties that was found to influence weevil damage. A method of measuring husk cover of corn was established. It consisted of ratings from 1 to 5 with 5 being the best. The husk cover ratings of some of the more common varieties and hybrids with the amount of weevil damage at harvest and after 8 months of storage without treatment are presented in table 1. Varieties with good husk covers, such as Dixie 18 and Dixie 11 have much lower weevil damage at harvest than those with poor husk cover, such as U.S. 13. This protection against weevils provided by the shuck also holds for corn in storage as can be seen in the last column of table 1.

2. HARDNESS. Hardness of the kernel is a factor that was found to be related to weevil damage. The hardness of a series of varieties was measured and the relationship of the hardness to weevil damage was determined. The data are presented in table 2. The harder corns, such as N. C. 1032 and Funks G-717, suffer less damage than the softer ones, such as Dixie 17.

3. THICKNESS OF THE PERICARP. Since a female weevil has to chew a hole through the pericarp to deposit her eggs, it was thought that perhaps the thickness of the pericarp might be related to the amount of weevil damage. The thickness of the pericarps of a series of varieties was measured and the relationship to weevil damage determined. These data are also presented in table 2. There was no relationship between the thickness of the pericarp and weevil damage.

4. LENGTH OF TIME REQUIRED FOR MATURITY. It is interesting that there is a relationship between the length of time required for a corn to mature and the weevil damage at harvest. The time required for maturity of a series of varieties with the weevil damage and husk cover ratings are presented in table 3. In general those varieties with a longer growing period suffer less damage than those requiring less time. La. 1031 and Dixie 18 requiring over 140 days to mature have low weevil damage. Hybrids requiring less than 130 days, such as P.A.G. 170 and U.S. 13, have much higher damage.

To the casual observer, this relationship might appear reversed. Obviously, the longer corn is in the field, the longer it is exposed to weevil attack. However, it is explained by the fact that hybrids requiring longer to mature have better husk covers, as is shown in table 3.

To bring you up to date on how the varieties rated for weevil damage in 1952, the data from variety tests at Auburn, Tallassee, and the Gulf Coast are presented in table 4. Dixie 18, Coker 811, and Woods S-210 had the least weevil damage. U.S. 13 and the Pioneer hybrids had the most weevil damage.

B. Production Practices

Certain production practices have been studied to see how they are related to weevil damage.

1. DATE OF PLANTING. Studies have been conducted in connection with the date of planting corn experiments at the Gulf Coast Substation. The weevil damage on five varieties planted at 7 dates (2-week intervals beginning February 15)

in 1949 is shown in table 5. The corn was all harvested at one time, which was after the last planting matured. Notice the mean of the damage on the five varieties. The damage was much higher on the earlier planted corn than on that planted in April and May. These data indicate the importance of harvesting corn as soon as it is mature.

2. FERTILIZER. Investigations have been conducted on the relationship between fertilizers applied to corn and the weevil damage at harvest.

a. Nitrogen. The effect of nitrogen fertilizer to corn on rice weevil damage has been studied for several years. There have been occasional indications that higher rates of nitrogen resulted in increased weevil damage; however, this has not been established. Most of the data look like those in table 6. There is no correlation between the rate of nitrogen and the amount of weevil damage.

b. Phosphorus. The weevil damage in corn grown at different rates of phosphatic fertilizers is shown in table 7. There was no relationship between the rate of phosphatic fertilizer and the weevil damage at harvest.

c. Potash. In table 8 are data on the rice weevil damage to corn grown at different rates of potash fertilizer. There was no definite correlation.

3. SPACING. The weevil damage in corn grown at different spacings at Tallassee are presented in table 9. There is a significant correlation between the two. The more stalks there were per acre, the less was the weevil damage. At 5,000 stalks per acre, the weevil damage was 27.43 per cent of the kernels, whereas at 20,000 stalks per acre, it was 17.88.

4. WORM CONTROL. The effect of holes made in corn shucks by worms on the rice weevil damage at harvest is presented in table 10. The holes made by earworms and fall armyworms made it easier for the weevils to get into the ears; this resulted in greater weevil damage. As shown in table 10, the ears with worm holes had 47 per cent of the kernels damaged while those without worm holes had only 13.8 per cent damaged.

5. HARVESTING. The longer corn is left in the field after it is mature, the more damage it will suffer from stored grain pests, not only the rice weevil but the grain moths and beetles as well. Therefore, as soon as corn is dry enough to store, it should be harvested.

Whether corn should be shucked at harvest depends on how it is to be stored and the treatment it is to receive. If corn is to be stored in slatted or open cribs and will receive no treatment for weevils, the shuck should be left on, even though it is obvious more weevils are brought into the crib from the field than if the corn was shucked. As shown in table 11, the shuck continues to offer protection against weevils in storage. There was an average of twice as much damage to shucked corn as unshucked corn after 9 months of storage without treatment.

If corn is to be treated for insect control, it can be done more efficiently if the shuck is off. If protectant dusts are used, they can be put right on the grain. If fumigants are used, the husk does not absorb the fumigant and prevent some of the gases from coming in contact with the insects.

C. Storage

As was mentioned in connection with storing oats and grain sorghum, the storage bins for corn should be thoroughly cleaned before the new crop of corn is stored. After the refuse from the previous crop is removed, a DDT-wettable powder spray (2 pounds of 50 per cent wettable to 5 gallons of water) should be applied to the entire inside of the crib. This will clean up the insects present in the crib.

If the corn is to be fumigated, the crib should be tightened before corn is put into it. As has already been indicated for grain sorghum, this can be done for open cribs with light-weight roofing felt.

1. GRAIN PROTECTANTS. Grain protectant formulations have been under study for two or three years. These protectants are dilute formulations of pyrethrins with an activator. The results of two years' work with pyrenone at Camp Hill are presented in table 12. The treatment of corn in the shuck prevented some weevil damage. The economics of treating corn in the shuck might be questioned. Although pyrenone did not absolutely stop weevil activity on the shucked and shelled corn, it is obvious that the treatment did a considerable amount of good.

In connection with pyrenone dusts, the results of an experiment conducted on wheat in Kansas by the U. S. Bureau of Entomology are presented in table 13. The pyrenone dust, as in our corn, did not absolutely prevent damage or a build-up of insects, but it did quite a little good there.

2. FUMIGATION. If corn is to be fumigated for stored grain pests, it should be done about two weeks after the corn is stored. This gives the corn time to go through any heating that may occur. The fumigation should be done at that time to kill the insects that are present before they do much more damage.

Fumigation of corn in the shuck is more difficult than when it is shucked. Unless the corn is to be used for seed, the longer the crib can remain closed after the fumigant is applied, the better will be the results. A longer period of fumigation gives the gases time to penetrate punctured kernels containing viable eggs. Seed corn should be aired out after 24 hours of fumigation to prevent possible injury to the germination.

Reinfestation or a gradual build-up of a few insects that escaped during the fall fumigation often makes a second fumigation necessary when the weather begins to warm up in the spring.

There are several good fumigants available. The 3:1 ethylene dichloride-carbon tetrachloride combination is widely used. It should be used at the rate of 6 gallons per 1000 cubic feet. Methyl bromide, another good fumigant, should be used at the rate of 1 pound per 1000 cubic feet. If the fumigation chambers are not tight, the dosage should be increased to compensate for leakage.

Table 1. Relationship of husk cover of corn to rice weevil damage at harvest and after eight months of storage.

Variety	Damage at harvest	Husk cover rating	Damage after 8 mo. of storage
	Per cent		Per cent
Dixie 18	2.2	4.67	14.2
Dixie 11	3.5	4.06	42.5
La. 1031	2.8	3.94	22.2
La. 521	3.3	3.91	41.0
Woods S-360	4.9	3.87	18.2
McCurdy 1010W	3.0	3.76	17.1
N.C. 27	4.6	3.75	21.7
McCurdy 1002	3.9	3.72	21.6
McCurdy 1001	5.5	3.59	28.4
Funks G-714	5.2	3.48	23.2
Paymaster	10.7	3.45	45.2
Tenn. 10	10.3	3.43	38.3
N.C. 26	8.2	3.43	29.8
Ga. 101	7.3	3.41	40.3
Funks G-737	4.0	3.36	23.9
Indian Chief	6.4	3.21	26.0
Mosby	16.4	3.20	55.5
Dixie 17	6.6	3.17	49.0
McCurdy 1005W	11.7	3.17	44.2
P.A.G. 630	5.8	3.14	47.8
Funks G-717	7.9	3.09	26.8
Tenn. 602	5.4	3.00	24.6
Dixie 44	11.0	2.84	31.4
N.C. 1032	5.2	2.76	29.0
P.A.G. 631W	18.6	2.66	56.8
P.A.G. 620	10.4	2.39	53.4
Funks G-711	17.1	2.07	62.6
P.A.G. 170	18.7	1.93	72.2
U.S. 13	26.1	1.81	81.9

Table 2. Rice Weevil damage to corn as related to hardness and thickness of the pericarp.

Variety	Weevil damage Per cent	Hardness Lb./Sq. in.	Thickness of pericarp Mircrons
North Carolina 1032	44.6	59.60	114.0
Funks G-717	44.9	54.52	114.9
McCurdy 1002	26.3	53.46	119.1
Funks G-714	46.3	51.96	97.8
Dixie 44	62.7	51.60	136.0
Dixie 18	44.6	51.26	95.8
P.A.G. 170	74.6	50.22	118.5
P.A.G. 630	68.5	49.82	102.9
North Carolina 26	37.1	49.38	102.5
Louisiana 521	27.0	48.76	95.6
Louisiana 1031	30.1	46.96	107.5
U.S. 13	87.1	46.88	118.4
North Carolina 27	32.9	46.34	120.0
Woods S-360	41.9	45.42	95.3
Mosby	43.2	43.98	97.1
Tennessee 10	53.9	42.62	105.4
Dixie 11	28.5	41.38	92.1
McCurdy 1005	57.9	40.54	106.3
Paymaster	61.7	39.90	115.2
Dixie 17	56.2	38.82	107.3

Table 3. Relation between length of time required for maturity of corn varieties and weevil damage.

Variety	Time required for maturity[1]	Weevil damage[2]	Husk cover rating
	Days	Per cent	
La. 1031	142.8	2.8	3.94
Woods S-360	140.9	4.9	3.87
Dixie 18	140.3	2.2	4.67
Mosby	140.2	16.4	3.20
Dixie 11	139.7	3.5	4.06
Funks G-737	139.3[3]	4.0	3.36
Funks G-714	139.1	5.2	3.48
Paymaster	139.1	10.7	3.45
La. 521	138.5	3.3	3.91
Indian Chief	138.3[3]	6.4	3.21
N.C. 1032	138.2	5.2	2.76
Tenn. 602	137.9[3]	5.4	3.00
N.C. 27	137.6	4.6	3.75
McCurdy 1005W	137.4	11.7	3.17
McCurdy 1002	137.2	3.9	3.72
McCurdy 1010W	137.1[3]	3.0	3.76
N.C. 26	137.1	8.2	3.43
Ga. 101	136.9[3]	7.3	3.41
Funks G-717	136.7	7.9	3.09
Dixie 17	136.7	6.6	3.17
Tenn. 10	136.4	10.3	3.43
McCurdy 1001	136.1[3]	5.5	3.59
Funks G-711	133.9[3]	17.1	2.07
P.A.G. 620	132.5[3]	10.4	2.39
P.A.G. 630	132.3	5.8	3.14
Dixie 44	131.9	11.0	2.84
P.A.G. 631W	130.8[3]	18.6	2.66
P.A.G. 170	127.4	18.7	1.93
U.S. 13	126.5	26.1	1.81

1/ Average of two years' observations at several stations

2/ Determined as the corn matured

3/ Results of only one year's observations

Table 4. Weevil damage to corn by varieties and locations, 1952.

Variety	Damage at harvest		
	Auburn	Tallassee	Gulf Coast
	Per cent	Per cent	Per cent
N.C. 27	3.46	9.14	3.15
Coker 811	5.19	6.22	4.30
Dixie 18 (Reimer)	5.45	5.94	3.87
Dixie 18	7.11	4.31	
Woods S-210	7.24	15.13	5.46
Funks G-785W	8.08	9.91	3.29
Dixie 22	8.26	14.52	3.94
Pfister 7604	8.48	20.10	
La. 521	8.55	7.79	3.88
Coker 911	9.00	11.62	4.39
Dixie 11	9.36	5.90	4.19
Ga. 101	10.50	22.30	5.21
Mosby	11.03	16.60	6.39
Dixie 17	11.67	18.79	8.00
Dixie 33	12.03	18.63	7.40
Tenn. 10	13.33	22.69	
Paymaster	14.15	17.44	6.81
Pfister 631	14.41	9.74	
McCurdy 1005W	16.87	23.37	
Pfister 6001	18.15	5.40	
Pfister 620	18.62	9.73	
Pioneer 510	19.35	20.05	
Funk G-704	25.49	23.08	
Pioneer 309	28.10	8.17	8.06
Pioneer 302	28.60	18.36	
U.S. 13		21.83	
Dixie 18 (Robinson)			2.28

Table 5. Effect of date of planting of five varieties of corn on rice weevil damage at harvest. Gulf Coast, 1949.

Date of planting	Weevil damage at harvest					
	Dixie 11	NC 1032	Funks G-714	La. 468	Pollittee	Average
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Feb. 15	64.6	87.6	60.6	72.1	41.5	65.3
Mar. 1	59.4	73.1	68.1	36.1	43.1	56.0
Mar. 15	44.9	80.3	71.3	16.1	59.3	54.4
Apr. 4	23.0	13.7	14.0	10.6	17.0	15.7
Apr. 15	17.1	12.9	9.7	8.6	4.4	10.5
May 4	16.7	18.4	13.3	19.3	21.1	17.8
May 15	17.9	10.0	17.0	13.2	26.6	16.9

Table 6. Effect of rates of nitrogen fertilizer on rice weevil damage to corn. Tallassee, 1949.

Rate of nitrogen	Weevil damage at harvest	
	5,000 plants per acre	20,000 plants per acre
Lb.	Per cent	Per cent
50	21.5	23.3
100	23.7	13.2
150	29.5	20.1
200	25.2	17.6

Table 7. Effect of rate of phosphatic fertilizer on weevil damage to Dixie 11 hybrid corn at harvest. Gulf Coast, 1949.

P_2O_5 per acre	Weevil damage at harvest
Lb.	Per cent
0	6.4
20	7.0
40	6.7
60	9.6
80	6.3
120	3.3

Table 8. Effect of rate of potassium fertilizer on weevil damage to Dixie 11 hybrid corn. Gulf Coast, 1949.

KCl per acre	Weevil damage at harvest
Lb.	Per cent
0	5.8
20	4.1
40	3.0
60	9.6
80	6.3

Table 9. Effect of drill spacing of corn on rice weevil damage. Tallassee, 1949.

Plants per acre	Weevil damage at harvest
No.	Per cent
5,000	27.43
10,000	22.43
15,000	24.05
20,000	17.88

Table 10. Relation between fall armyworm and rice weevil damage to corn.

	Weevil damage at harvest			
	Ears with worm holes		Ears without worm holes	
Sample	Ears damaged	Kernels damaged	Ears damaged	Kernels damaged
	Per cent	Per cent	Per cent	Per cent
La. 1031	68.6	47.7	24.5	10.5
Mixed variety	76.0	46.3	24.4	17.0
Mean	72.3	47.0	24.4	13.8

Table 11. Weevil damage to corn when stored for 9 months with no treatment. Camp Hill.

Storage condition	Kernels damaged after 9 months		
	1951	1952	Average
	Per cent	Per cent	Per cent
Shelled	73.75	98.42	86.09
Shucked	43.63	98.89	71.26
Not shucked	31.21	40.25	35.73

Table 12. Effect on damage by stored grain pests of treating stored corn in various ways with pyrenone dust. Camp Hill, 1951 and 1952.

Treatment[1]	Kernels damaged after 9 months of storage[2]
	Per cent
Corn in shuck:	
No treatment	35.73
Treated	25.10
Shucked corn:	
No treatment	71.26
Treated	20.76
Shelled corn:	
No treatment	86.09
Treated	13.14

[1] Pyrenone dust was used at approximately 1 pound per 10 bushels of corn.
[2] The corn averaged 5.10 per cent of kernels damaged when the experiments were started.

Table 13. Average moisture content and numbers of insects found in wheat stored in wooden farm bins in experimental series, Reno, County, Kans., 1951.[1]

Series	Treatment	Moisture	Number of insects per 1,000 grams of wheat in-- July	August	September	October
		Per cent				
1	None (controls)	13.0	4.6	14.5	41.4	--
2	Fumigation in August	12.0	0	2.7[2]	0.5	--
3	DDT spray on walls	12.9	0.1	2.2	6.1	--
4	Synergized pyrethrum syray on walls	12.2	.1	12.1	16.4	--
5	Synergized pyrethrum dust in wheat	12.3	0	0.3	2.6	--
6	Synergized pyrethrum spray on walls; synergized pyrethrum dust in wheat	11.6	0	.1	2.4	4.0

[1] From U.S.D.A., Bur. Ent. & P.Q. [2] Before fumigation

HUMAN NUTRITION RESEARCH .... Ernestine I. Frazier

The research program in Human Nutrition is concerned with the interrelationships of nutrients. Therefore, we will agree in the beginning that it is fundamental in nature. I shall attempt to point out in this discussion the implications of the findings in relation to improvement of family dietaries, economy of food use, and the planning for adequate food supply.

The studies in progress were designed (1) to determine more specifically the human requirement for niacin, (2) the availability to the body of this vitamin from common food sources, and (3) the effect of protein from different sources on its utilization and requirement.

The significance of these studies can best be seen in the light of the progress in nutrition research and the application of available knowledge in educational and action programs. Perhaps in no other field of nutrition research has there been more vigorous activity than in the one under discussion.

Pellagra was the first dietary deficiency disease to be designated a no. 1 public health problem in the thirteen Southern states, known as the "deep South". From the time of its discovery in the United States by Dr. Searcy at Mount Vernon, Alabama in 1908 the incidence of this disease rose steadily until a peak was reached in 1928. At that time 22.4 persons out of every 100,000 of the population died of pellagra. Since then the number of deaths from this cause has declined steadily.

Dr. Russell Wilder gave the vital statistics of the present situation in his address to the National Nutrition Institute in Washington last month. "Up thru 1941 approximately 9,000 cases (of pellagra) had been reported every year. From then until 1948, with the exception of 1946, the figure ranged from 900 to 1500 (in 1946 the number was about 4000). From 1949 up to the present, the rate dropped rapidly to a low of 141 in 1951."

However, statistics are not necessary for us here in Alabama to know and be proud of the fact that we have progressed far since the 1920's and 30's in the control of not only pellagra but other debilitating diseases such as rickets, anemia, ariboflavonius, and thiamine deficiency. Many factors are responsible for this progress - as I indicated earlier. In addition to the advancement of knowledge as a result of nutrition research, progress in food technology and long range educational efforts have developed concurrently to improve our present day dietary practices. Action programs in the form of Federal and State legislation on flour and cornmeal enrichment has helped to improve the diets of everyone.

Although we no longer encounter frank nutritional diseases among our population we are aware that everyone does not enjoy optimal health -- nutritional speaking, as indicated by lack of vigor, retarded growth of children, low resistence to infection, early signs of old age, and shall we mention it? - obesity. All of which decrease the productivity of our population due to lack of physical stamina and mental alertness.

In view of these facts research in Human Nutrition can probably make its best contribution by attempting to define more specifically what combination of foods, and how much of each should be included in the daily meal pattern in order to insure optimal physical and mental vigor of which nutritionist speak. It is important to know optimal levels of intake of the various nutrients such as calories, proteins, the minerals and vitamins. We have some information of the nutrient content of our common foods, but very little is known of the availibility to the body after the food is eaten. We are just beginning to learn something of how the intake of one nutrient effects the utilization of other nutrients.

There is less scientific information available on the human requirement for nicotinic acid than the other major B vitamins. The NRC's recommended allowance is 10 mg. per day. The main evidences supporting this recommendation are the results of animal research and the very dubious observation that niacin occurs in foods in amounts roughly 10 times that of thiamine. The recommended allowance for thiamine is 1 mg. per day. This latter seems to me to be stretching the natural course of events a little far.

In 1937, the Wisconsin group first presented scientific evidence that niacin (or nicotinic acid) was the antipellagra vitamin. Soon afterwards, in 1945, this same group of investigators were able to relieve growth depression in rats maintained on a corn diet which was deficient in nicotinic acid by feeding either tryptophan or niacin. The very nature of the concept of the interrelation of a vitamin and an amino acid was a challenge to research workers and since that time the problem has been pursued with vigor in many laboratories; from many different approaches; using the whole array of laboratory techniques. Studies have been made on the rat, mice, cats, dogs, pigs, chickens, calf, cow, sheep, horse, mink, fox, rhesus monkey, and <u>even</u> the human being. The use of radio-active isotopes and mutant strains of the <u>Neurospora</u> has confirmed the conversion of tryptophan to nicotinic acid in the intact orgainism and has partially at least clarified the mechanism of the conversion.

When we began our studies in 1949 it was thought that one approach to the problem of human requirement of this vitamin from dietary sources was to determine the amount of niacin intake which was necessary in order to prevent the use of tryptophan as a source of the vitamin. This assumed that in the presence of an abundance of the vitamin, the amino acid would be used first for other body needs, namely, replace or growth of body tissue. This hypothesis is no longer tentable as will be seen from the results presented, as well as the work of others.

The method of study of human nutrition is similar to that of animal studies. There is one important difference, however, human beings can not be enclosed in a cage and given a diet and told to eat it or else.

A selected group of subjects as near homogenous as possible eat a weighed diet providing a known amount of the nutrient or nutrients being investigated. Quantitative collections of excreta are made, height-weight records are made weekly, and blood samples are analyzed as indicated. Intake and excretion are determined by chemical analysis, and by use of the balance technique an effort is made to determine whether intake is suffient, as well as how the body uses the nutrient in relations to other components of the diet.

In the present studies it was first necessary to plan a basal diet with the following characteristics:

1. Providing all dietary essentials except niacin in amounts approximating the recommended allowances.

2. Providing a minimum level of nicotinic acid from dietary sources (7.0 mg in order that supplements of the vitamin could be made in pure form and from dietary sources to reasonable daily intake levels.

3. Be acceptable to human subjects over sufficient lengths of time to obtain biochemical data.

This was accomplished by using foods low in nicotinic acid, namely, corn, skim milk, and cottage cheese with a selected group of fruits and vegetables.

This diet when fed in average servings provides approximately 2000 calories, 56 grams of proteins, approximately 600 mg. of tryptophan, 7.0 mg. of nicotinic acid, and amounts of other nutrients approximating the recommended allowances. The satity value is high. I have only had complaint from one of the nineteen girls who have eaten this diet for periods from 21 to 28 days. Further, two girls have volunteered to be subjects on a second series of studies.

Nineteen young adult women ranging in age from 19 to 25 years have been studied to date. Four of the nineteen were subjects on a study of the availability of nicotinic acid from peanuts (raw and processed). This is Alabama's supporting project to the Southern Regional Cooperative Study on Nutritional Status, S-15.

From the mass of data collected I have selected some on a few subjects which are representative of all the girls studied.

The first slide shows the mechanism of the conversion of tryptophan to nicotinic acid proposed by Bonner, *et al*, as a result of a series of studies with mutant strains of *Neurospora*. Although some of the steps in the conversion are based upon indirect evidence it is presented here to emphasize the significance of the data to be presented on human subjects.

In 1949 Henderson observed that quinolinic acid, 1,2,dicarboxylic acid of pyridine, was excreted by the rat and that the amount excreted increased with adminstration of tryptophan or 3-hydroxyanthranlic acid. The significance of this compound in the study of the interrelationship of tryptophan and nicotinic acid became apparant after Henderson found that autoclaving samples of urine under non-hydrolytic procedures resulted in decarboxylation to nicotinic acid. Quantitative assay was then made possible by microbiological techniques. The facts that quinolinic acid can substitute for growth in niacinless strains of the *Neurospora*, that it relieves niacin deficiency in the rat, and finally that human subjects excrete increased amounts after tryptophan ingestion suggest a definite role of this compound in the interconversion of tryptophan to niacin. An aliphatic intermediate has been proposed by Bonner, *et al*, to account for its low-activity as compared with the vitamin or 3-hydroxyanthranlic acid and has suggested that niacin is the immediate product of ring closure after decarboxylation. However, if decarboxylation is prevented ring closure results in accumulation of quinolinic acid. This latter would account for the relative constant level of excretion of this compound as shown in Table I.

This table presents the metabolic data on 5 subjects maintained on a control diet planned from a variety of food sources and providing all the known dietary essentials according to the recommended allowances. Data are also included for these same subjects on the basal diet supplemented with nicotinamide to a level of 18.5 mg. per day.

On nitrogen intakes of approximately 10 grams per day all the subjects stored nitrogen. The slightly lower intake of nitrogen on the basal diet resulted in a loss of nitrogen by 2 of the 4 subjects for which the balance data are complete. The intake of tryptophan is approximate only since it was arrived at by analysis of homogenates multiplied by the factor 1.47 found by Reynolds, Bauman, and associates to correct for losses of tryptophan resulting from the autoclaving in the presence of carbohydrates. The tryptophan excretion was fairly constant for all subjects studied on both the control and basal supplemented diets. The total average tryptophan excretion was slightly higher on the control diet, a difference of 3 mg. per day. The level of excretion of the free form of this amino acid remained fairly constant for each subject between experimental periods. Any variations in total amount excreted was in the form of the polypeptide, or the bound form.

The significant data in this table in relation to this discussion is the relatively constant level of quinolinic acid excreted by these subjects as compared with the level of excretion of N^1methylnicotinamide, one of the main derivatives of nicotinic acid. The total average excretion of five subjects on the control diet containing an average of 12.5 mgs. of nicotinic acid was 3.19 mgs. per day as compared with an average of 3.27 mgs. on the basal diet which furnished 18.5 mgs. of the vitamin.

This observation suggested a relationship between quinolinic acid excretion and endogenous nitrogen metabolism. Accordingly, the data were recalculated on the basis of body weight in kilograms. The results are presented in Table II. When all the subjects were storing nitrogen, as was the case on the control diet, there was a linear relationship between the nitrogen stored per kilogram of body weight in miligrams and the excretion of quinolinic acid. This same relationship holds in the cases of positive nitrogen balances on the basal diet.

This linear relationship is shown graphically in Figure 1 where data on the quinolinic acid excretion of 12 subjects have been plotted in a scatter diagram against nitrogen storage in kilograms of body weight. That metabolic patterns vary between individuals is shown in this diagram by the lack of conformity of the data on L.W. with the other 11 subjects.

That there is a relatively constant level of excretion of quinolinic acid by human subjects regardless of level of intake of niacin is shown in Table III which gives the result of a 50 mg. test dose of nicotinamide. The quinolinic acid excretion during the four hour test period was approximately the same as during a similar four hour control period. There was on the other hand a considerable increase in the excretion of N^1me., as was to be expected.

The data presented here does not preclude the fact that on suboptimal levels of intake of tryptophan and nicotinic acid as occurs in pellagra producing diets competitive mechanisms might arise within the body to alter the seemingly major role of tryptophan as a precursor of the vitamin. (Experimental pellagra has been produced in human subjects on 6.8 mgs. or less of nicotinic acid and 48 grams of protein, 7.5 of which were from animal sources.) However, it does increase the problem of determining quantitatively the human requirement of the vitamin <u>per se</u> from dietary sources as have been done in the case of some of the other vitamins.

The significance of these findings in terms of practical nutrition are, to be sure, involved but none the less important. If the conversion of tryptophan to nicotinic acid is a normal biochemical route of metabolism of this essential amino acid as has been postulated by Elvehjem and others and as these data seem to indicate, the planning of dietaries from the standpoint of a good assortment of amino acids becomes more important.

Rose has shown that an assortment of eight essential amino acids including 250 mgs. of tryptophan will maintain nitrogen equilibrium in young adult male subjects. He recommends 500 mgs. as the daily requirement. The average American diet provides this amount or more and the recommended allowance of nicotinic acid (10-15 mgs.).

The "average" as we know does not mean <u>everyone</u>. The protein foods of high biological value (meaning a good assortment of amino acids) are the expensive foods - meat, milk, eggs, poultry, and fish. If these foods serve as a source of the most important vitamin in the South's nutritional history, economy in their distribution and use should not be left to chance. Economics, ignorance, and food eccentricies are the main causes of poor nutrition, with low purchasing power ranking first. Thus families with low incomes are the more likely to have imbalanced diets. Another factor has just been revealed in the series of studies on nutritional status in North Central region; namely, if the overall family food supply is not quite adequate there is unequal distribution of food intake among family members with "Papa" getting his full share of the protein foods - meat, milk, and eggs - and "Mamma" and the adolescent girl getting the least. Records show that the highest incidences of pellagra has been among women during the reproductive years from 20 to 45 years. There is evidence that the requirement for this vitamin is increased during pregnancy. Thus, in the case of marginal diets with an unequal distribution of the available foods among family members segments of our population are likely to develop sub-clinical lesions of malnutrition.

To bring the problem a little closer home the Regional Bulletin No. 20, "Family Food Consumption in Three Type Farming Areas in the South" which has just been released includes data on 300 farm families in the cotton belts of Mississippi and Arkansas. The food intakes of families in these areas are probably typical of similar areas in Alabama. The overall food consumption pattern was good with respect to the nutrients under discussion, i.e. proteins and niacin. Eight out of ten families met the recommended allowance of niacin; 84% had enough protein. However, 56% of the diets of the colored families in the cotton area failed to meet the recommended allowance of protein; of this number 14% had less than 20 grams per day of a good quality protein. A study of the individual family food records would probably reveal that the two out of every ten families failing to get the recommended allowance of nicotinic acid were among those with low protein intakes.

More studies similar to the one reported here are needed before we can say with certainty how much of each dietary component is needed daily in order that everyone may enjoy the benefits derived from optimal nutrition.

Table I

The Nitrogen, Tryptophan, and Nicotinic Acid Metabolism of Young Adult Women on Control and Basal Diets

A. Control

Subject	Nitrogen (gms.)		Tryptophan (mgs.)				Quinolinic Acid, excretion, (mgs.)	Nicotinic Acid (mgs.)		
	Intake	Balance	Intake	Excretion				Intake	Excretion	
				Total	Free	Bound			Free NA	N^1me.
DK	10.00	+ 1.46	947	28.0	9.9	18.1	3.3	11.5	0.03	3.75
BS	10.00	+ 1.22	947	25.0	9.8	15.2	2.92	11.5	0.00	4.14
LW	9.5	+ 1.62	795	27.4	8.3	19.1	4.08	16.7	0.00	3.63
MJT	10.00	+ 0.77	947	29.8	11.3	18.5	2.81	11.5	0.34	3.55
GDe	10.00	+ 0.89	947	30.5	11.8	18.7	2.83	11.5	0.00	3.57
Avg.	9.90	+ 1.19	917	28.1	10.2	17.9	3.19	12.5	0.07	3.73

B. Basal

Subject	Nitrogen Intake	Nitrogen Balance	Tryptophan Intake	Total	Free	Bound	Quinolinic Acid	NA Intake	Free NA	N^1me.
DK	7.38	- 0.67	620	22.7	11.1	11.6	3.85	7.5 + 11.0	0.19	4.82
BS	7.38	+ 0.08	620	23.3	10.3	13.0	3.07	7.5 + 11.0	0.13	4.88
LW	7.38	- 0.78	620	23.4	9.7	13.7	3.57	7.5 + 11.0	0.16	3.96
MJT	8.05	+ 0.50	660	25.9	15.6	10.3	2.80	7.4 + 11.0	0.38	5.82
GDe	8.05		660	30.5	13.3	17.2	2.92	7.4 + 11.0	0.16	3.92
Avg.	7.62		636	25.1	11.9	13.2	3.27	7.5 + 11.0	0.20	4.65

Table II

The Nitrogen and Tryptophan Metabolism per Kilogram of Body Weight of Young Adult Women on Control and Basal Diets.

A. Control

Subject	Weight kilo.	Nitrogen Absorbed gms.	Nitrogen Absorbed per Kilo. mg.	Tryptophan absorbed mg./kilo.	Nitrogen Balance mg./kilo.	Quinolinic excreted mcg./kilo.
LW	54.0	8.74	160.7	13.67	+ 30.0	75
DK	51.4	9.07	176.4	17.47	+ 28.4	64
BS	50.2	8.71	173.5	16.45	+ 24.3	58
MJT	55.4	8.66	156.3	14.85	+ 16.0	50
GDe	65.1	8.63	137.9	12.96	+ 13.9	44

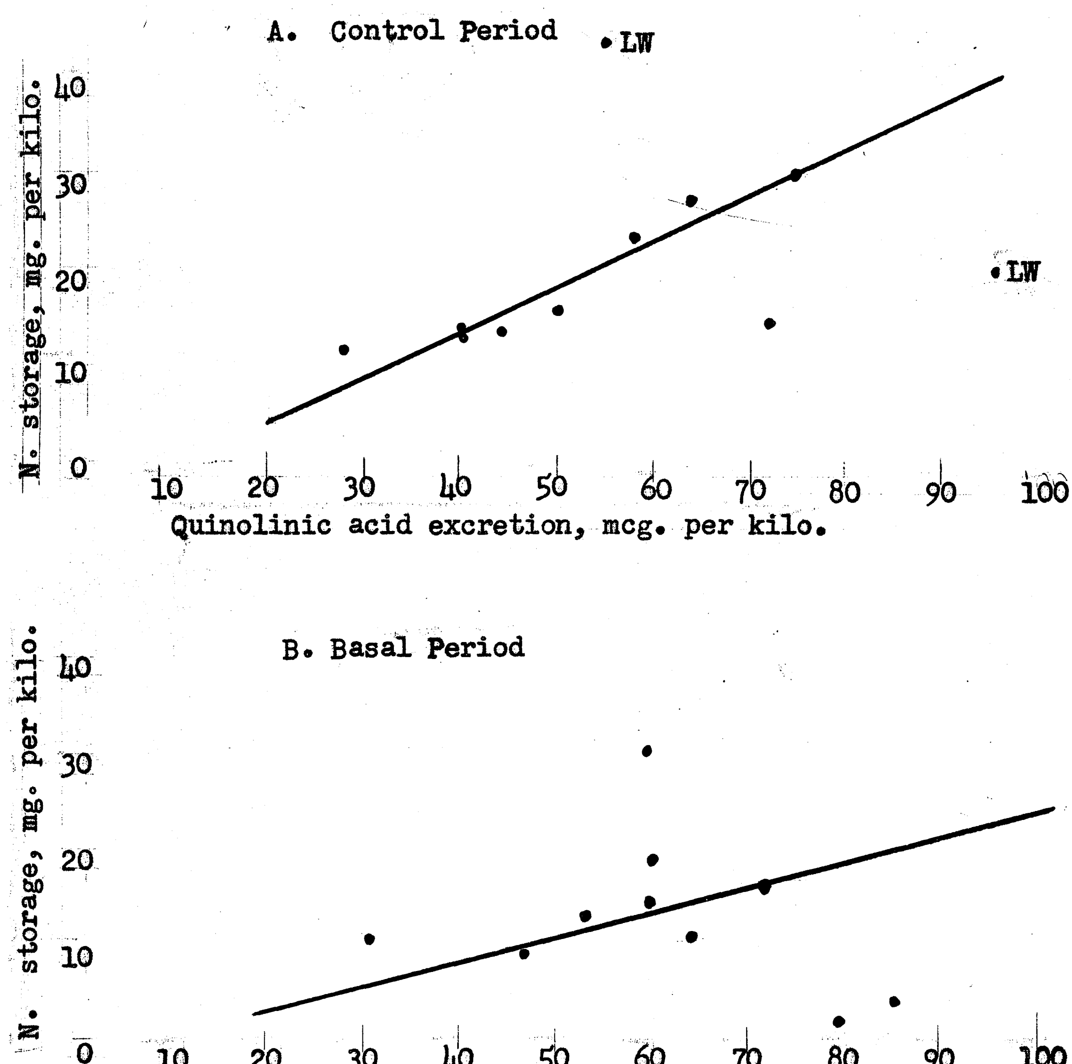
B. Basal

Subject	Weight kilo.	Nitrogen Absorbed gms.	Nitrogen Absorbed per Kilo. mg.	Tryptophan absorbed mg./kilo.	Nitrogen Balance mg./kilo.	Quinolinic excreted mcg./kilo.
LW	54.0	6.12	113.3	9.57	+ 14.4	61
		6.76	125.2	10.42	- 4.0	65
DK	51.4	5.58	108.6	9.16	- 13.0	64
		7.09	137.9	11.48	+ 15.9	72
BS	50.2	5.71	103.0	8.70	0.0	59
		7.23	144.0	11.92	+ 19.5	61
MJT	55.4	6.60	119.1	9.87	+ 9.0	48
GDe	64.1					52

Table III

The excretion of quinolinic acid and N^1me. during 4 hour control period and after 50 mg. test dose of nicotinamide.

Subject	Time of Test Dose	Quinolinic Acid		N^1me.	
		Control mg.	Test Dose mg.	Control mg.	Test Dose mg.
EP	1. Beginning of control diet	0.49	0.58	1.3	4.78
	2. After 12 days on supplemented diet	0.45	0.76	1.2	9.65
	3. After 17 days on supplemented diet			1.3	13.19
BW	1. Beginning of control diet	0.65	0.70	2.2	4.24
	2. After 12 days on supplemented diet	0.68	0.94	1.6	10.12
	3. After 17 days on supplemented diet			2.6	6.74
MH	1. Beginning of basal period	1.02	1.05	1.70	8.18
	2. After 18 days on supplemented diet	0.64	0.84	0.96	9.79
KP	1. Beginning of basal period	0.85	0.53	0.84	5.21
	2. After 18 days on supplemented diet	0.73	0.72	0.84	5.38



Quinolinic acid excretion as a function of nitrogen storage.

COTTON-DAIRY-HOG FARM MANAGEMENT UNIT
UPPER COASTAL PLAIN SUBSTATION .... W. W. Cotney

Three-Year Report - 1949-51

A farmer has the products from the use of his land and from his labor to sell each year. The more efficiently each can be used, the greater the amount of products for sale. This fundamental principle is applied in the operation of the cotton-dairy-hog farm management unit at the Upper Coastal Plain Substation.

The unit was established January 1, 1949, to determine dollars and cents income when recommended practices are applied on a whole-farm basis and to determine managerial problems and possible solutions from the application of such practices.

The unit contains 140 acres of land, of which 106 are in crops. Approximately the same percentage of cropland is planted to cotton as on average farms in the area. The remainder is used to produce feed and forage.

For 2 years this farm was operated as a cotton-dairy unit. The use of legumes and other soil-improving practices increased grain yields to the extent that a surplus resulted. Hogs were added in the third year as a method of marketing the surplus grain.

Two 2-year rotations are used on the land in annual crops. One is a cotton-winter legume-corn rotation; the other is an oat-crimson clover-grain sorghum rotation. The other open land, in the main, is planted to sericea, alfalfa, and kudzu.

Two families live on this unit -- one man employed full time and one approximately half-time. Day labor is hired as needed. A tractor and tractor equipment is used in the unit operation. A used combine was owned by the unit the first two years, but combining is done now on a custom basis. An electric milker is used for milking.

Twelve grade Jersey cows bought in 1948 were placed on the unit when operations were begun in 1949. Replacement heifers are grown out on the unit. Animals not needed for replacements are sold at an early age. Feeder shoats were bought in 1951. Three brood sows are now maintained for production of pigs to consume surplus grain. Numbers of all animals will be increased or decreased to reasonably balance with feed and forage production.

Grazing program for dairy cows. Approximately 1 acre of oats and 1 acre of crimson clover is provided per cow for winter grazing. In addition, ryegrass and crimson clover planted on sericea sod furnish grazing from February into the spring. The cows are taken off the oats (last of February) and crimson clover (April 1-10) to permit grain and seed production.

About April 15 the sericea begins to grow and is grazed throughout the spring, summer, and fall. About $1\frac{1}{2}$ acres of sericea is provided per cow. Any surplus growth is cut one time for hay for winter use. In addition, approximately one-half acre of alfalfa or kudzu has been used per cow for supplementary grazing during summer dry periods. A minimum amount of concentrate feed (crushed grain or crushed grain and cottonseed meal) is fed at milking time. Except in unusually dry periods or bad weather, only enough is fed to attract the cows to the barn at milking time.

Grazing program for hogs. Alfalfa for spring, summer, and fall grazing and crimson clover for late fall, winter, and spring grazing have proved adequate for year round grazing for hogs. One good acre of each is adequate for a sow and her two litters of pigs per year. Surplus growth from alfalfa is cut for hay. Corn and grain sorghum are used to finish the hogs to market size. Protein supplement is bought for sows and pigs (up to 60 to 80 pound size), but not for larger shoats unless grazing is inadequate.

Why such a unit? This question is timely. Most farmers in the Upper Coastal Plain Area have been (and still are, but to a lesser degree) dependent on cotton for a large part of their cash income. Most farms are comparatively small, contain some good, and some poor and/or idle land that will produce forage for livestock more efficiently than other crops. Also most farms contain some better land capable of producing high yields of cotton and grain. Too, on most farms in the area, there is ample family labor to produce one or more livestock enterprises to add to cotton.

The first three years operation of this unit is given in the following tables:

Table 1. Crop Acreages, Cotton-Dairy-Hog Unit, Upper Coastal Plain Substation

Crops	1949 acres	1950 acres	1951 acres	3-yr. average acres
Cotton	13.2	11.8	13.2	12.7
Corn	17.1	13.2	11.8	14.0
Oats	16.9	15.1	10.8	14.3
Alfalfa	2.7	7.2	7.2	5.7
Sericea (alone and overseeded)	29.8	33.8	34.8	32.8
Crimson clover (alone and mixture)	9.8	15.9	20.2	15.3
Kudzu	7.0	7.0	7.0	7.0
Garden	1.2	1.2	1.2	1.2
Vetch (double cropped)	(17.1)	(11.8)	(13.2)	(14.0)
Grain sorghum (double cropped)	(9.8)	(10.8)	(15.1)	(11.9)
Other-woodland, roads, etc.	42.3	34.8	33.8	37.0
Total land	140.0	140.0	140.0	140.0

Table 2. Production of Cotton-Dairy-Hog Unit, Upper Coastal Plain Substation

Production	1949	1950	1951	3-yr. average
Milk pounds per year	57,561	52,356	72,185	60,701
Milk per cow per year*	4,605	3,611	4,812	4,343
Cotton pounds lint	4,351	5,446	4,110	4,636
Cotton pounds lint per acre	330	462	311	368
Cotton seed-pounds	6,997	10,317	7,509	8,274
Corn bushels produced	983	766	644	798
Corn bushels per acre	58	58	55	57
Grain sorghum bushels produced	223	500	239	321
Grain sorghum bushels per acre	23	46	16	28
Oats bushels produced	808	509	632	650
Oats bushels per acre	48	34	58	47
Hogs produced pounds	0	0	9,115	---

*Cows milked

Table 3. Cash Expenses, Cotton-Dairy-Hog Unit, Upper Coastal Plain Substation

Items	1949	1950	1951	3-yr. average
Fertilizer	$ 1,114.93	$ 1,166.60	$ 1,282.05	$ 1,187.86
Poison	136.75	165.48	94.50	132.24
Seed	599.60	478.50	201.40	426.50
Feed and feed crushing	320.15	355.97	190.20	288.77
Extra labor	399.59	620.74	468.77	496.37
Repairs and replacements	128.65	126.50	67.41	107.52
Tractor gas, oil, grease	221.46	145.85	122.31	163.21
Hauling milk	155.28	212.67	329.56	232.50
Miscellaneous	197.93	300.54	1,565.18 1/	687.88
Taxes and Insurance	50.88	50.88	50.88	50.88
Total	$ 3,325.22	$ 3,623.73	$ 4,372.26	$ 3,773.73

1/ Includes shoats $712, hired machinery $434, utilities, etc.

Table 4. Cash Receipts, Cotton-Dairy-Hog Unit, Upper Coastal Plain Substation

Receipts	1949	1950	1951	3-yr. average
Milk	$ 1,625.70	$ 1,658.54	$ 2,838.61	$ 2,040.95
Cotton and cotton seed	1,412.21	2,713.16	2,006.01	2,043.80
Sericea seed	159.60	255.30	297.00	237.30
Crimson clover seed	---	796.00	262.80	352.93
Oats	588.00	636.25	342.50	522.25
Corn	275.00	363.13	---	212.71
Hay	---	116.50	---	38.83
Grain Sorghum	200.70	---	202.00	134.23
Timber and logs	130.00	100.00	82.00	104.00
Tractor work	45.00	263.25	74.25	127.50
Hogs	---	---	1,907.71	635.91
Cattle and calves	455.70	768.00	1,606.86	943.52
Misc. and capital goods	---	531.23	26.00	185.74
Total receipts	$ 4,891.91	$ 8,201.36	$ 9,645.74	$ 7,579.67

Table 5. Financial Summary, Cotton-Dairy-Hog Unit, Upper Coastal Plain Substation

Items	1949	1950	1951	3-yr. average
Cash receipts	$ 4,891.91	$ 8,201.36	$ 9,645.74	$ 7,579.67
Cash expenses	3,325.22	3,623.73	4,372.26	3,773.73
Net cash income	1,566.69	4,577.63	5,273.48	3,805.94
Current capital outlay	1,377.72	1,336.38	413.18	1,042.43
Inventory change	864.65	1,455.20	303.72	672.04
Income to capital and regular labor	1,053.62	4,696.45	4,556.58	3,435.55
Income to regular labor	148.61	3,426.64	3,252.23	2,176.75
Labor income per regular adult farm worker	74.30	2,284.43	2,168.15	1,459.43
Labor income per regular adult farm worker (includes family used products)	120.56	2,516.98	2,429.07	1,688.87

Table 6. Livestock Inventory, January 1 each year, Cotton-Dairy-Hog Unit Upper Coastal Plain Substation

Livestock	1949	1950	1951
Milk cows	12	13	16
Heifers	1	3	3
Calves	1	8	12
Bulls	0	1	1
Sows	0	0	3
Total animal units	12.8	17.5	24.5
Grazing area per A. U., acres 1/	2.7	2.7	2.2
Grazing area per milk cow	3.3	3.9	3.3
Feed crop per A. U., acres 1/	4.5	3.8	3.3

1/ Part of the acreages double cropped each year.

Table 7. Investment, January 1 each year, Cotton-Dairy-Hog Unit, Upper Coastal Plain Substation

Items	1949	1950	1951
Land	$7,500.00	$7,500.00	$7,500.00
Buildings	7,330.00	7,367.00	7,106.00
Machinery, equipment, etc.	2,828.00	3,044.00	2,923.00
Livestock	1,600.00	1,995.00	3,035.00
Crops and supplies	347.00	564.00	1,327.00
Total	$19,605.00	$20,470.00	$21,891.00

Some results and observations to date.

1. Efficient use of land in a balanced production program of cotton, processing plant milk, and market hogs has been profitable at prices received during the 1941-1951 period.

2. The use of legumes, adequate fertilization, and other recommended practices will maintain relatively good crop yields on land previously not too productive.

3. Much poor and idle land (acreage in sericea was formerly broom sedge hillsides) in the Upper Coastal Plain Area can be efficiently used in a cattle program.

4. Sericea grazing alone will not maintain good milk production during summer dry periods. Supplementary grazing crops are needed.

5. Only good producing cows should be added to a dairy herd. Average grade Jersey cows were purchased to start this unit. Over 50 percent of the original cows have already been replaced. Most of the replacement heifers raised and added to this herd are producing more milk with first calves than their dams as mature cows.

6. Seeds are a by-product of a good grazing program. Their harvest and sale can add to the cash income.

7. The investment in land, buildings, livestock, and equipment to operate efficiently is relatively high.

8. Operating capital required is also relatively high.

Future possibilities.

1. Increased milk production per cow may be expected as better bred heifers are grown and added to the herd.

2. Increased summer milk production may be obtained by using 9 acres previously in sericea and 3 acres in kudzu for sudan grass in summer and rye-grass-crimson clover in winter. Also, 4 acres of coastal Bermuda has been added for summer grazing.

3. Increased yield of cotton per acre may be expected as rotations are shifted to allow cotton to be planted on land less subject to damage from droughts such as those of 1951 and 1952.

4. Alfalfa yields may be increased 15 to 20 percent by heavier applications of lime as indicated by plot work on other areas of the Substation.

5. Corn and grain sorghum yields may be increased slightly from continued use of legumes.

VALUE of GOOD PRACTICES in VEGETABLE CROP PRODUCTION .... L. M. Ware

To fulfill its purpose, research results must ultimately find expression in increased returns to people. Horticultural enterprises, whether considered on a state or community level or on level of individual farms, are important because they offer possibilities of high returns on limited acres. Research pays greatest dividends when methods are found by which yields may be increased 4 to 6 to 10 times. Data and a brief discussion are given on results of long-time studies from use of broad practices that offer the possibility of increasing the value per acre of crops many times. The practices studied have been concerned largely with fertilizer rates, organic materials, and irrigation. Results also are given of studies for the very dry year, 1952, using prices for this year. Only a few selected data can be given in the allotted time.

Preliminary Statement

To assure maximum effectiveness of the selected treatments under study, it is essential that none of the other practices standard for all treatments limit production. These include such practices as the use of the best varieties, adequate stands, correct timing of all operations, and control of pests below and above ground. Maximum yields can come only when all of these factors are favorable. In these studies an effort has been made to provide standard practices favorable to highest production.

Value of Extra Fertilizer, Organic Materials, and Irrigation

The results in Table 1 represent a summary of a long-time experiment. The data show increases in value of a large number of vegetable crops from the use of an additional amount of fertilizer and from the use of organic materials and irrigation. Values are given when each treatment was used without the other two treatments and when each was used with the other two treatments. Since two crops were grown in succession on the same land each year, values per acre per year were obtained by multiplying the average values per crop by two, or by adding the values of the spring and fall crops. The increased values resulting from an increase in fertilizer application from 500 to 1,000 pounds per acre ranged from $158 to $256 per acre per year. The lowest increase was for all years, all seasons, and all crops when the increased fertilizer rate was used without organic materials and irrigation. The highest increase was obtained for the spring and fall crop combination when the increased rate of fertilizer was used in combination with organic materials and irrigation. The corresponding increases in value from the use of organic materials ranged from $279 to $387 per acre. Irrigation increased the value of crops $84 per acre per year for all years, all seasons, and all crops when it was used without the higher fertilizer rate and without organic materials. When used with these two practices, irrigation increased the value of spring and fall crops $266 per acre.

Returns from Irrigation in Years of Unfavorable Rainfall

Irrigation has shown little or no benefits during periods of favorable rainfall. Substantial benefits from irrigation have usually resulted during years of unfavorable rainfall. Data in Table 2 show increases in value for all years and all crops for all seasons and for seasons of unfavorable rainfall. The increases in value from irrigation for all years, all seasons, and all crops were $126 per acre per year when used without organic materials and $158 when used with organic materials. The increases in value from irrigation for all years and all crops for the seasons of unfavorable rainfall were $253 per acre per year when used without organic materials and $296 when used with organic materials.

Value of Animal Manure

Data in Table 3 from a long-time experiment show high values for stable manure. Stable manure at the rates of 6, 12, and 18 tons per acre was applied annually for a period of 8 years. Yields were obtained for the 8-year period of application and for a 3-year residual period. The increases in value of crops produced from each ton of manure used were $72.66 at the 6-ton rate, $50.76 at the 12-ton rate, and $43.77 at the 18-ton rate. Since one cow will produce the equivalent of 10 to 15 tons of stable manure per year, it is obvious, if one-half of the manure produced could be saved, that this amount used on vegetable crops would have a value comparing favorably with values from the livestock or livestock products. If all manure were saved and used on vegetable crops, the value would exceed considerably the value of the livestock. Some market gardeners are adding livestock for the purpose of providing manure.

Value of Manure After Adequate Fertilizers Have Been Added

It is of practical importance to know if manures will increase yields after adequate amounts of fertilizers have been applied. Some information on this point is given by data in Table 4. These data are from long-time experiments. After 1,500 pounds per acre of a 6-10-6 fertilizer had been added, the application of an additional 500 pounds of fertilizer resulted in an increase in value of only $9, whereas the addition of 12 tons of stable manure after 1,500 pounds of fertilizer had been added resulted in an increase in value of $531.

The turning of cowpeas resulted in a corresponding increase in value of $229. These results do not necessarily prove that inadequate quantities of fertilizer were applied for maximum production. They do show that the amounts added did not supply plant food in the quantities needed and at the time needed by the crop or that the organic materials produced other effects favoring high production.

All data presented above are from long-time experiments involving many crops over a period of many years. The data given below apply to studies in 1952, an extremely dry year, when many crops failed and yields of other crops were greatly reduced. These results are not presented to show what might be expected over a period of years. They are given to show what yields were obtained from good treatments in a very dry year and the value of these yields for this particular year.

Yields and Returns from Sweetpotatoes in a Very Unfavorable Year

Data in Table 5 show total yields of sweetpotatoes including all grades, marketable and culls, for L-240, a new, high-yielding variety with good quality and considerable resistance to disease. The yield for the best treatments was 779 bushels per acre. This treatment consisted of 1,000 pounds per acre of a 6-10-7 fertilizer, organic materials, and irrigation. Total yields of the Porto Rico variety in the same experiment but not shown in the table, reached 712 bushels and of the Goldrush variety 643 bushels. The yields of marketable 1's and 2's were 525 bushels for the Goldrush variety, 367 for the Porto Rico variety, and 515 for the L-240 selection. The indicated yield of sweetpotatoes for Alabama this year is 65 bushels. When sweetpotatoes in Alabama were failing, yields valued at $2,346 per acre were being produced at Auburn (Table 6). Values were determined on a basis of $4 per bushel for marketable 1's and 2's and $3 for sound jumbos. Sweetpotatoes on the Atlanta market are currently quoted from $4 to $5.50 per bushel, and a trial load of jumbo potatoes were sold on the Atlanta market at $3.25 per bushel.

Return Possibilities from Good Practices in Unfavorable Years

During the past year in one set of studies, cantaloupes were used as a summer crop and green onions as a fall crop. Selected data are given in Table 7. Values were determined by average prices received for the two crops. Cantaloupes were valued at 4-1/2 cents per pound and green onions at $1 per dozen bunches weighing 8 pounds. There was an active demand for the crops.

Returns from cantaloupes ranged from $1,017 to $2,396 per acre. Highest returns from any combination of treatments without irrigation were $1,775; the highest returns with irrigation were $2,396. Irrigation, therefore, had a value in 1952 of $621 per acre for cantaloupes. Values from the bunched onions ranged from $2,560 to $7,106. The highest value for a given treatment for the two crops was $9,477 per acre. This value was obtained by use of 2,000 pounds per acre of a 6-10-7 fertilizer, 12 tons of manure, vetch, and irrigation. On a basis of three comparisons irrigation in 1952 increased the value of the two crops an average of $1,341 per acre per year. On a basis of two comparisons the 12 tons of manure increased the value of the crop $1,857. Increasing the fertilizer rate from 1,000 to 1,500 pounds per acre increased the value of the crops $772 per acre, and increasing the rate from 1,500 to 2,000 pounds increased the value $1,058.

It might be pointed out that the gross value of the crops produced per acre per year in the above study was about four times the average gross value per farm in Alabama of crops and livestock sold and used on the farm.

Table 1. Increases in Value Per Acre Per Year (2 crops) from Increased Fertilizer Rate, Organic Materials, and Irrigation

Treatments[1]	Increased values from each treatment without other two treatments[2]: All years, all seasons, all crops x 2[3]	Increased values from each treatment without other two treatments[2]: All years, spring and fall crops[4]	Increased values from each treatment when used with other two treatments[2]: All years, all seasons, all crops x 2[3]	Increased values from each treatment when used with other two treatments[2]: All years, spring and fall[4]
	Dollars	Dollars	Dollars	Dollars
Extra 500 lb. fertilizer[1]	158	174	188	256
Organic materials........	279	297	299	387
Irrigation..............	84	103	165	266

[1]Fertilizer increased from 500 to 1,000 pounds of 6-10-4; organic materials consisted of 2 tons of lespedeza straw and 6 tons green crotalaria; irrigation consisted of 1 inch water per week added when rainfall previous week less than this amount.

[2]Values based on an average price of 3 cents per pound for produce.

[3]Years 11, crops 11.

[4]Years 11, crops 7.

Table 2. Increases in Value Per Acre Per Year (2 crops) from Organic materials and Irrigation for All Seasons and for Seasons of Unfavorable Rainfall

Treatments[1]	Increases in value per acre per year[2]					
	All years, all seasons, all crops x 2[3]		All years, spring + fall crops[4]		All years, all crops, seasons of unfavorable rainfall	
	Each without other	Each with other	Each without other	Each with other	Each without other	Each with other
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Irrigation..........	126	158	125	253	253	296
Organic materials....	320	352	268	396	342	385

[1]All treatments received 1,000 pounds per acre of 6-10-4 grade fertilizer; organic materials consisted of 2 tons lespedeza straw and 6 tons crotalaria; irrigation consisted of 1 inch water per acre added when rainfall the previous week was less than this amount.

[2]Values based on individual crop prices.

[3]Years 11, crops 11.

[4]Years 11, crops 7.

Table 3. Value of Animal Manures

Animal manure[1]		Increases over the 8-year application period and a 3-year residual period[2]		Value per ton of manure[3]
Annual rate	Applied	Total yield increase per acre	Yield increases per ton of manure	
Tons/acre		Pounds	Pounds	Dollars
6	48	116,273	2,422	72.66
12	96	162,551	1,693	50.76
18	144	210,000	1,458	43.77

[1]Manure applied 8 years; residual effects measured over 3-year period.
[2]Yield of spring and fall crops.
[3]Values based on average price of 3 cents per pound for produce.

Table 4. Value of Manures After Adequate Commercial Fertilizers Added

Fertilizer rate 6-10-6[1]	Value of crops produced					
	Animal manures			Green manure		
	No manure	Manure[3]	Difference	No manure	Cowpeas[4]	Difference
Lb/acre	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
1,000	369	738		369	608	
1,500	469*	1,000*	531*[5]	469*	698*	229*[5]
2,000	478*	1,159		478*	686	
Difference	9*[5]			9*[4]		

[1]Amount each to a spring and to a fall crop.
[2]Values based on average price of 3 cents per pound for produce.
[3]At 1,000-pound fertilizer rate, 6 tons animal manure applied; at 1,500-pound fertilizer rate, 12 tons; at 2,000-pound fertilizer rate, 18 tons.
[4]Cowpeas grown and turned under.
[5]Difference between starred numbers.

Table 5. Total Yields of Sweetpotatoes in Dry Year of 1952
from Different Treatment - L-240 Variety

Fertilizer rate 6-10-7[1]	Yield all grades, jumbos and culls			
	No manure no irrigation	Manure[2], no irrigation	No manure, irrigation[3]	Manure, irrigation
	Bu/acre	Bu/acre	Bu/acre	Bu/acre
400	446	649	570	747
800	559	677	606	779
1,200	644	663	672	778

[1]Applied as 4-10-7 at planting time with additional 2 per cent of nitrogen as side application.
[2]In past years 6 tons animal manure; in 1952, 2 tons sericea straw and 6 tons green rye.
[3]Irrigation consisted of 1 inch of water per week when rainfall the previous week less than this amount.

Table 6. Value of Sweetpotatoes from Different Rates of Fertilizer, Organic Materials, and Irrigation in the Very Dry Year, 1952, Goldrush Variety

Fertilizer rate 6-10-7[1]	Value of marketable No. 1's, 2's, and sound jumbos[2]			
	No manure No irrigation	Manure[3] No irrigation	No manure Irrigation[4]	Manure[3] Irrigation[4]
	Dollars	Dollars	Dollars	Dollars
400	1,002	1,517	1,341	2,214
800	1,342	1,761	1,398	2,164
1,200	1,357	1,940	1,908	2,346

[1]Applied as 4-10-7 at planting time with additional 2 per cent of nitrogen as side application.

[2]Values based on marketable 1's and 2's at $4 per bushel and sound jumbos at $3 per bushel.

[3]In past years 6 tons animal manure; in 1952, 2 tons sericea straw and 6 tons green rye.

[4]Irrigation consisted of 1 inch per week of water when rainfall previous week was less than this amount.

Table 7. Returns in the Dry Year, 1952, from Two-Crop Succession from Additive Treatments

Treatments				Gross value per acre[2]		
Fertilizer[1]	Manure	Vetch	Irrigation[3]	Cantaloupe	Green onions	Total
	Tons			Dollars	Dollars	Dollars
1,000	0	0	0	1,088	2,560	3,648
1,000	0	0	1	1,017	3,278	4,295
1,000	12	0	0	1,775	3,534	5,309
1,000	12	0	1	1,987	4,361	6,348
1,000	12	v	0	1,398	3,907	5,305
1,000	12	v	1	2,396	5,251	7,647
1,500	12	v	1	2,096	6,323	8,419
2,000	12	v	1	2,371	7,106	9,477

[1]Fertilizer consisted of 6-10-7 grade applied in 2 equal applications of a 4-10-7 grade and a side application of 2 per cent nitrogen.

[2]Values based on 4.5 cents per pound for cantaloupes and $1 per dozen bunches of 8 pounds for onions.

[3]Irrigation consisted of adding 1 inch water each week rain did not provide this amount.

IRRIGATION of COTTON and CORN .... M. W. LOUPO and A. W. COOPER

The primary objectives of this experiment were to determine the effects of irrigation on the yields of cotton and corn, and to determine the consumptive-use of water for cotton and corn under irrigated conditions. Plans were made to determine the effect of the final date of irrigation on the yield of cotton. Three treatments were set up with irrigation to be discontinued on August 1, August 22, and September 12. The rains in August and September, however, prevented these plans from being carried out, and there were actually only two irrigated treatments, one treatment receiving one more irrigation than the other. The August rains followed this last irrigation so closely that no effects resulted from it.

Cotton

Treatment: The only difference between the treatment of the irrigated and non-irrigated cotton was the supplemental water applied. All cotton was planted on April 30, and later thinned to about 52,000 plants per acre. At planting, fertilizer was applied at the rate of 800 pounds of 6-8-8 per acre, and on June 12 anhydrous ammonia was applied at the rate of 40 pounds of N per acre. Conventional tractor-mounted equipment was used for cultivation. During the season, the cotton was sprayed eight times with toxaphene for insect control. All cotton was defoliated on September 19.

The total rainfall from April 30 through September 30 was 20.80 inches. After deduction of runoff, deep seepage, and evaporation, the calculated effective rainfall was 11.5 inches. In one treatment the cotton was irrigated four times with a total of 5.2 inches of water being pumped. Evaporation losses reduced this total to a calculated effective amount of 4.2 inches. The other treatment was irrigated three times, with a total of 3.6 inches of water pumped for an effective 3.3 inches.

Yield Results: The average yield of cotton on all of the irrigated plots was 2,538 pounds of seed cotton per acre. The average yield on the non-irrigated plots was 1,449 pounds of seed cotton per acre.

Corn

Treatment: The only difference between the treatment of the irrigated and non-irrigated corn was the supplemental water applied. The corn was planted on May 7 to a stand of approximately 13,000 plants per acre. A 6-8-8 fertilizer was applied at the rate of 800 pounds per acre at planting time, and on June 12, nitrogen was applied at the rate of 100 pounds of N per acre in the form of anhydrous ammonia. Conventional tractor-mounted equipment was used for cultivation.

The total effective rainfall after the deduction of runoff, deep seepage, and evaporation was 13.2 inches. The corn was irrigated five times with a total of 8.6 inches of water being pumped. The total calculated effective water from irrigation after deduction for evaporation losses was 6.9 inches.

Yield Results: The average yield of corn on the irrigated plots was 54 bushels per acre, and the yield on the non-irrigated plots was 1 bushel per acre. This yield is considered low for corn under irrigation. It is believed that the yield could have been increased if more soil moisture had been available during the peak water-use period. Throughout the season there was sufficient water available in the top 24 inches of soil for optimum growth, but the majority of the corn roots were concentrated in the top 12 inches of soil.

During the peak-use period the soil moisture in the top 12 inches of soil dropped lower than the recommended level. The limitations of the equipment and the slow infiltration rate of the soil prevented a satisfactory correction of this condition.

Moisture Use

The soil moisture level was followed during the growing season by taking triplicate soil samples in each plot to a depth of 24 inches by six-inch increments. Tables 1 and 2 show a comparison between actual moisture use and calculated moisture use. The calculated values were determined by the Blaney-Criddle[1/] method of calculating consumptive use. The actual moisture-use values are average values from the irrigated plots as determined from soil samples during the specific month. Since the calculated values are based on average climatic conditions over a number of years, it is possible for the actual moisture-use values to vary slightly from them for any month or any year.

Furrow Irrigation

Considerable interest has been shown in furrow irrigation from some areas of the state. These tests were conducted in the Piedmont where irrigation by the furrow method is limited because of topography. However, the same basic relations between infiltration rate, row grade, length of row, and rate of delivery of water to the furrow for efficient furrow irrigation should apply to any area. With this fact in mind, an exploratory test was set up in an effort to determine these relations. At the beginning of the season, the plots were graded as uniformly as possible to 1/2 inch per 100 feet. Later in the season, however, settling of the soil in the filled places caused variations in grade up to as much as 4 inches per 100 feet. This fact resulted in a very inefficient application of water. Yield results bear this out.

Yield Results on Furrow Irrigation: The treatments were duplicated in the furrow irrigated cotton and corn tests. One of the irrigated cotton plots had a yield of 2,050 pounds per acre; and the other, which had a poorer distribution of water in the furrow, yielded 1,536 pounds per acre. The non-irrigated plots yielded 882 and 834 pounds per acre.

One of the irrigated corn plots had a yield of 52 bushels per acre, and the other, which had poorer distribution of water, yielded 26 bushels per acre. The non-irrigated plots yielded 2 and 6 bushels per acre.

1/
Harry F. Blaney and Wayne D. Criddle, "Determining Water Requirements in Irrigated Areas from Climatological and Irrigation Data", SCS - TP - 96, August, 1950.

Table 1. MOISTURE USE OF IRRIGATED COTTON

	May	June	July	August	September
Average actual use (inches per day)	.090	.120	.128	.096	.113
Calculated use (inches per day)	.125	.138	.143	.132	.115
Total rainfall (inches)	7.47	2.23	0.47	6.36	4.27
Total irrigation (inches)	0.00	1.20	4.00	0.00	0.00

Table 2. MOISTURE USE OF IRRIGATED CORN

	May	June	July	August	September
Average actual use (inches per day)	.145	.154	.169	.154	.134
Calculated use (inches per day)	.159	.175	.181	.168	.146
Total rainfall (inches)	7.47	2.23	0.47	6.36	4.27
Total irrigation (inches)	0.00	1.20	4.80	2.60	0.00

IRRIGATION and WATER-USE STUDIES with CORN and SUDANGRASS ..... R. W. Pearson

Corn Experiment. - A cooperative experiment between the A. P. I. Departments of Agronomy and Soils and Agricultural Engineering and the Bureau of Plant Industry to study the effect of irrigation, plant population, and rates of nitrogen fertilization on yield and growth habits of corn was conducted during 1949 and 1950 at the Tallassee Plant Breeding Unit. Four plant populations, 4,000, 8,000, 12,000, and 16,000 plants per acre, and four nitrogen levels, 0, 50, 100, and 200 lbs. per acre in all combinations irrigated and non-irrigated, were used. A prolific hybrid corn, North Carolina 1032, was the variety planted. No increase in yield of corn was found in 1949 for irrigation even though there were two periods of about two weeks each during the growing season in which the corn showed signs of moisture stress. During 1950, rainfall was less favorable and a maximum increase in yield of 21 bushels resulted from irrigation, as is shown in table 1. The results listed in table 1 also show that the maximum returns from irrigation can only be realized if a sufficiently large number of plants per acre are used. In this experiment 12,000 plants per acre did not appear to have been high enough. It should be pointed out in this discussion that nitrogen has been removed as a factor by the selection of plant population and nitrogen combinations to give approximately the same amount of nitrogen per plant regardless of the population level being discussed. In each case approximately .02 pounds of nitrogen per plant was used.

Irrigation and plant population levels had other important effects in addition to yield. For example, the data in table 2 show that irrigation resulted in a considerably faster rate of maturity than in the non-irrigated treatments. Increasing the plant population also had an effect under both irrigated and non-irrigated conditions in that fewer plants were tasselled on the date of examination at the higher population levels than where fewer plants were used.

Irrigation also resulted in fewer plants lodged at all population levels (Table 3). The effect was especially noticeable at the highest population where approximately half as many plants were lodged in the irrigated as in the non-irrigated treatments.

This experiment afforded an excellent opportunity to learn whether evapotranspiration (total soil moisture loss by evaporation and by transpiration) is appreciably influenced by plant population level. Some of the results of this phase of the study are shown in Table 4. Four-day periods were selected during the growing season when no rain occurred and when it was not necessary to apply irrigation. Since a continuous record was made of soil moisture throughout the root zone, the difference in soil moisture at the beginning and at the end of these periods was used as a measure of evapotranspiration for that period. The total dry matter produced was determined by harvesting and weighing of whole plants. As shown in Table 4 the pounds of water required to produce one pound of dry matter varied tremendously from one period to another as would be expected; in all but the last period, however, considerably less water was required to produce a pound of dry matter at the 20,000 plant population than at the 10,000 level. As an average for the season, 265 pounds of water was required to produce one pound of dry matter at the high population level, as compared to 385 pounds for the low population. This simply means that where 20,000 plants per acre were present the available water was used one and one-half times more efficiently than where there were only 10,000 plants per acre. The same relationship holds with regard to the pounds of grain produced per unit of water used.

Using the total amount of water lost by evapotranspiration during the growing season 936 pounds of water was required to produce one pound of grain with 10,000 plants, but only 563 pounds were required for a pound of grain produced with 20,000 plants. We should be careful, however, in extending these results to dry conditions. Under conditions where soil moisture is seriously limiting, vegetative growth at high populations may deplete the available moisture to such an extent as to seriously depress grain formation.

<u>Sudangrass Experiment</u>. - Probably the most difficult question facing both experimental workers and farmers who wish to use supplemental irrigation in the production of crops is the question of how to determine when and how much water to add to the soil. This question can be answered accurately by taking soil samples from different depths at various times and determining the moisture content or by installing available types of moisture tension measuring devices. Such methods, however, require expensive equipment and/or a great deal of time and are thus often not practicable. It has been proposed by some research workers that the total water lost from the soil by evaporation plus transpiration depends only upon certain climatic factors such as temperature, wind velocity, and relative humidity, while others have recognized that plant species is also a factor. On this basis it has been claimed that, knowing these climatic factors from long-time weather records, the water-holding capacity of the soil and the rainfall day by day, one can, by a simple bookkeeping system, calculate the daily loss and gains of water and thus theoretically arrive at the time required for irrigation and the amount of water to add. Although these schemes may be fairly dependable for determining times and amounts of irrigation, we need to know to what extent factors other than climatic affect these calculated values in order to determine to what extent they can be depended upon.

With these questions in mind, an experiment was planned and carried out to study the effect of rate of fertilization and plant population level of Sudangrass on the total evapotranspiration and on the efficiency of water use. Some of the results of this study are listed in table 5. Statistical examination of data show that there was a significant increase in the total evapotranspiration as both the plant population and the nitrogen application increased. Although the differences appear to be relatively small, only about one-half inch, they occurred during a one-week period when the plants were in their grand period of growth. During this short time interval a difference of one-half inch could constitute an error in determining time to irrigate.

There are interesting differences in evapotranspiration with stage of growth that show up when the data of table 5 are broken down into 1-week periods. Less than .5 inch was lost during the first period when the plants were about 6" high, as compared to nearly 2 inches during the week of maximum growth. This variation in evapotranspiration with stage of growth is another source of error not presently considered in the procedures for calculating when to irrigate.

The differences in efficiency of utilization of water, $\frac{E}{DM}$, are striking. Nitrogen fertilization caused a marked decrease in the amount of water evapotranspired per pound of dry matter produced. Although there was no difference in the water requirements of the crop between low and high plant population levels on the unfertilized plots, there was a significant difference where nitrogen was added. A modified version of this experiment will probably be run next year using corn instead of Sudangrass in order to follow up these points in more detail

SUMMARY

As a result of recent studies of water use requirements of corn and Sudangrass the following tentative conclusions can be drawn:

1. The most efficient use of irrigation water by corn requires that relatively high levels of plant population and nitrogen fertilization be used.

2. Irrigation hastens maturity of corn to a considerable extent.

3. Irrigation resulted in more than a 50% reduction in lodging at the thickest stand used.

4. Both corn and Sudangrass can produce more pounds of dry matter per unit of water used at thick stands than at thin stands. There is a real, though small, difference in the total amount of water lost by evapotranspiration, depending upon the stand of Sudangrass.

Table 1. Effect of irrigation and plant population on yield of corn. Tallassee. 1950

Population	Yield - bushels per acre 1/	
Plants per acre	Irrigated	Non-irrigated
4,000	52	45
8,000	79	65
12,000	88	77
16,000	104	83

1/ At 15.5% moisture

Table 2. Effect of irrigation and plant population on maturity of corn. Tallassee. 1950

Population	Plants tasselled on July 7	
	Irrigated	Non-irrigated
plants/acre	%	%
4,000	67	17
8,000	55	30
12,000	40	16
16,000	38	12

Table 3. Effect of irrigation and plant population on lodging of corn. Tallassee. 1950

Population	Plants lodged on Sept. 6 Irrigated	Non-irrigated
plants/acre	%	%
4,000	4	13
8,000	16	27
12,000	37	43
16,000	32	65

Table 4. Water use efficiency of corn at two plant population levels. Tallassee. 1949.

Population:[1] plants/a.	Lbs. of water lost through evapotranspiration /lb. dry matter produced June 25-29	July 1-5	July 25-29	August 2-6	Average
10,000	276	560	496	207	385
20,000	112	344	372	233	265

1/ In 1949 the population levels used were 5,000, 10,000, 15,000 and 20,000 plants per acre.

Table 5. Effect of plant population and nitrogen level on evapotranspiration and water use efficiency of Sudangrass for the period July 3-30. Auburn. 1952.

Treatment[1]	E[2]	$\frac{E}{DM}$[3]
	in.	lb./lb.
D1N1	4.97	639
D_1N_2	4.98	403
D_2N_1	5.32	628
D_2N_2	5.49	374

1/ Irrigated to maintain 50% of available water.
D1 - 44,000 plants /a.
D_2 132,000 " "
N_1 - No nitrogen
N_2 - 100 lbs. N/a. sidedressed at seedling stage.

2/ E - Evapotranspiration

3/ $\frac{E}{DM}$ - $\frac{\text{lbs. } H_2O \text{ evapotranspired}}{\text{lbs. dry matter produced}}$

RESEARCH PROBLEMS in IRRIGATION .... F. A. Kummer

It is my considered opinion that during the next ten years some of the most spectacular developments in crop production in Alabama will be the direct result of greater utilization of our water resources through irrigation. Before anything of such a nature can be accomplished, however, many answers to unsolved problems for this area must be found.

At this meeting a year ago, I tried to point out some of the major difficulties encountered in irrigation design and the dangers involved in making general and across-the-board recommendations for all sections of the state.

Perhaps the most perplexing question that can be asked of you as substation superintendents or subject matter specialists is whether or not an irrigation system will work and pay in a given area.

Let us take the Black Belt Substation for an example. Mr. Kelley has been considering the possibilities of supplemental irrigation for his station for quite sometime. He, I believe, would be the first to admit that irrigation might have paid him last summer and the summer before. His main problem, however, is a satisfactory source of water. A survey of the station property at Marion Junction revealed that surface impoundment of water was not practical because of the flat topography of the area which permits only very shallow pond sites with little water storage capacity. The same limitations apply also to the Wiregrass Substations except for a different reason. There, underground seepage losses make ponds unsatisfactory reservoirs. The number of good pond sites is also limited in the Upper Coastal Plain and Tennessee Valley because of unsuitable subsurface soil materials.

From geological information available for the state it appears that ground water supplies are reasonably adequate in the western part of the Black Belt, in the Wiregrass section, and in the lower part of the Lower Coastal Plain all across the state. The question still unanswered, however, is at what depth these deep water tables may be tapped and what flows may be expected.

Immediately, another question arises as to what the cost might be to pump water from such deep underground sources. It is apparent, then that we need information on ground water supplies, surface impoundment possibilities, potential development of streams and rivers in all sections of the state before we can advise farmers on the practicability of irrigation.

Another problem equally serious and for which only meager information is available is that of watershed yields and seepage and evaporation losses from ponds to determine the reliability of pond water sources.

It is assumed that by this time you are reasonably convinced that specific soils information is a must for any irrigation installation. We are making progress in mapping the major soil types on the basis of their infiltration rate and available water-holding capacities. How else would we be able to determine the rate at which water should be applied and how much of it at any given irrigation period? Much remains yet to be done to establish this design prerequisite for all areas of the state.

Further, we know that many of our difficulties lie in the fact that in some soils we are simply unable to get sufficient water into the soil because of surface or subsurface conditions. We need more information on how we may increase the water intake in our fine textured soils as found in the Black Belt and Piedmont areas, how to eliminate the effects of mechanically produced plow soles which prevent water from entering the root zone in sufficient amounts, how to prevent surface sealing as a result of mechanical dispersion caused by the impact of raindrops, and compaction by animals. Perhaps there is a possibility of increasing the rate of intake in our fine-textured soils by letting them dry enough to crack before applying irrigation water. Otherwise, it will be necessary to apply very small amounts of water more frequently. There is also the possibility of increasing the intake rate by mechanical or vegetative means, by eliminating hard pans and plow soles mechanically, preventing surface sealing by crop rotation methods, or through the use of crop residues and soil additives. Another possibility which has proven of merit in other sections of the country is the practice of rotational grazing with irrigation whereby alternate periods of grazing and irrigating are used.

Very little information is available for this area on the rooting habits of our plants with regard to root zone depths in various soil types and root development under irrigation, the cost of and returns from irrigation under management conditions, fertilization with irrigation, and the most profitable crops, singly or in combinations, to be grown with irrigation.

Our present recommendations with regard to fertilizer, plant spacing, varieties, and management are based on natural rainfall only It is entirely possible that any or all of these recommendations will have to be changed or modified when we supplement the natural rainfall with irrigation. For example, if irrigation is used, breeding for drought resistance would no longer be a factor, but at the same time there may arise many new problems which are not now serious such as disease and insect problems, excessive leaching of plant nutrients, and deposition of undesirable minerals as a result of using water with a high salt content. Many farmers have already accepted supplemental irrigation in spite of the many unknown quantities. Is it not our responsibility to anticipate their problems and attempt to obtain the answers to them before the situation becomes acute?

The FERTILIZER SITUATION in ALABAMA .... Howard T. Rogers

It has been estimated by agronomists of the state experiment stations that fertilizers account for about 25 per cent of the total agricultural production of this country. Certainly in Alabama farming of any kind would be at less than a subsistence level without fertilizers. Economists tell us that the Alabama farmer spends about one dollar out of every five of his cash farm expenditures for fertilizers.

A great deal has been said about the fifth plate at the dinner table which will have to be provided by 1975. It is difficult to visualize any greater opportunity for providing food for the increasing population of this country than through efficient use of lime and fertilizers in adequate quantities. Recognizing this fact, there is a national effort underway to stimulate research and educational work by various state and federal agencies toward the objective of using effectively for crop production much larger quantities of fertilizer than have been used in the past.

It is generally agreed today that the 1950-60 decade will record more drastic and far-reaching changes in the fertilizer industry than any similar period in its history. This is not restricted to the large quantities of fertilizers which are being produced but far more significant are the changes taking place in the structure of the industry itself. Some of these changes have definite implications so far as our research work is concerned.

Developments in Alabama during 1951-52

The phosphate shortage was reflected in the sales of superphosphate and PK mixtures in Alabama as follows:

	Tons (000)		
	1949-50	1950-51	1951-52
Superphosphate	98	80	41
0-14-10	86	65	-
0-14-14	0	37	74
0-12-20	-	18	15
0-16-8	0	3	4

These statistics show a drastic reduction in superphosphate consumption and lowering of the phosphate to potash ratio in the PK mixtures. These trends are not in keeping with the needs of our crops and soils as shown by experimental data.

The tremendous increase in fertilizer consumption in the state since 1950 is shown below:

	Tons (000)		
	N	P_2O_5	K_2O
1940	33	45	23
1951	67	97	65
1952	73	96	71
1951*	163	270	168

* If the Station's recommendations had been followed on the acreage planted in 1951.

Two new grades of fertilizer were approved by the State Board of Agriculture for sale during 1952-53. These grades are 4-12-12 and 0-28-14. The 1-3-3 ratio was recommended by the Station for use on cotton and corn on the light-textured soils of the state, particularly for Central and South Alabama where it is not advisable to place much of the nitrogen under the corn and cotton at planting.

The 0-28-14 was recommended for legumes and perennial grass-legume pastures. This is a high analysis mixture of the type which can be formulated using mostly concentrated super with some ordinary super to supply sulfur.

1952-53 Outlook

USDA estimates for 1952-53 fertilizer supplies show the following increase over 1951-52:

Nitrogen - up 11%

P_2O_5 - up 10%

K_2O - up 17%

Supplies of individual nitrogenous materials are all predicted to increase in 1953 except the natural organics. The most significant change is a big increase in anhydrous ammonia for direction application (46 per cent). Two hundred fifty thousand tons of N will be available for this purpose.

In the supply of phosphates the only major change is a 55 per cent increase in concentrated superphosphate. About one-half million tons of P_2O_5 in this form are scheduled for production in 1953.

The serious sulfur shortage which was experienced last year has been relieved, temporarily at least, by increased production of brimstone sulfur and recovery of sulfur from natural, refinery and smelter gases. Higher-priced sulfur, however, has been a factor in stimulating major changes in the phosphate fertilizer industry.

Production Goals for 1955

National consumption of fertilizers in 1939-40 and 1951-52 and USDA goals for 1954-55 follow:

	Tons (000) of Plant Nutrients		Goals for 1954-55	
	Consumption 1939-40	Consumption 1951-52	Tons (000)	Increase Over 1951, %
Nitrogen	419	1,425	2,185	53
P_2O_5	912	2,235	3,485	56
K_2O	435	1,585	2,185	38

The tremendous expansion in fertilizer production and consumption during the past decade as shown above has been a major factor in the increased production of food, feed and fiber in this country.

Changes in Types of Materials

From a research standpoint some of the changes in types of fertilizer materials which will be offered in the years ahead are probably more significant than the increases in total supplies. Some of these developments are:

1. Anhydrous ammonia and solutions for direct application

The big increase in supplies of anhydrous ammonia available for direct application is pushing this form of nitrogen into areas not formerly considered suitable for this product. The direct application of nitrogen solutions is also a spreading practice in some states. Early reports are that a custom service for nitrogen solutions (about 37 per cent N) will be available at 13 or more locations, each serving a 20-mile radius, in North Carolina alone in 1953. During 1952 N was applied in this form at a cost to the farmer of about 11 cents per pound.

The use of anhydrous ammonia for potato production, small grains for winter grazing and certain sod crops are new uses for this product on which the Station has been asked for information but is doing no research.

2. Urea solids

Industry has announced plans to produce 85 per cent more fertilizer nitrogen as solids by 1955-56 than was produced in 1951-52. One important change in the nitrogen solids picture is the prospect for 268,000 tons of nitrogen as urea by 1955-56. During the past year, only 10,000 tons of urea nitrogen were sold in this country.

3. Nitric Phosphates

The acidulation of rock phosphate with nitric acid and mixtures of nitric and sulfuric or phosphoric acid to yield fertilizers which have been designated "nitric phosphates" is an important development in the fertilizer industry in this country. One plant of 60,000 ton capacity for 14-14-14 is under construction in the tri-cities area to produce these fertilizers. Several other plants have been announced including locations in Ohio and Mississippi. These fertilizers will be acid-forming high-analysis materials containing NPK. They may or may not contain sulfur. The water solubility of the phosphate will probably be much lower than in our presently available mixed goods. As soon as they appear on the market, all of us will be concerned with getting the right information to the farmer regarding their usage.

4. Acid-forming high-analysis mixtures

Plans have been announced to register and sell in Alabama this coming year such high-analysis acid-forming mixtures as 12-24-12 and 13-13-13, if approved by State Board of Agriculture. It now appears obvious that acid-forming fertilizers will become increasingly important in Alabama. As farmers shift from a row crop cotton-corn-peanut agriculture towards cash crop-livestock systems and the use of acid-forming fertilizers increases, the need for a more adequate liming program will be intensified. By the use of soil tests to determine the need for lime, we can do a much better job of liming according to soil and crop needs. This is going to be quite important as we increase pasture and forage legume acreages and bring in acid-forming fertilizers. These developments are in the right direction, I believe, but as a research agency, it will be our responsibility to guide this development by putting out the correct information on lime needs under the new system. A tremendous educational job is also indicated if these adjustments are made without serious consequences.

5. Concentrated super and other nonsulfur sources

Last year we pointed out the fact that nonsulfur-bearing phosphates were scheduled for a big increase in production. If Alabama uses any appreciable tonnage of the large increased supply of concentrated superphosphate mentioned above, we must know not only where sulfur is needed but how much is needed. Considerable publicity has been given to the sulfur response data which this Station has obtained on cotton. Unless we are in a position to advise the fertilizer manufacturers what quantities of sulfur are needed for our various soils and crops, there will be a tendency on their part to keep low analysis grades in the state and ship the concentrated super to other areas. This will mean that Alabama farmers will lose any benefits from cheaper plant nutrients in high-analysis fertilizers.

6. Minor elements in mixtures

One other development which needs serious attention by all members of the Station staff who advise farmers and agricultural workers on fertilizers is the increasing demand for information on minor elements. A representative of one of the largest fertilizer manufacturers in this country stated at a meeting in Auburn this fall that he believed the fertilizer industry would be forced to "move off and leave the experiment stations" by the growing pressure for incorporating minor elements in fertilizers. Unless we can be more specific as to what elements to incorporate and the quantities to use, this problem will not be satisfactorily solved. We were called on during the year to advise the Alabama State Department of Agriculture and Industries regarding regulations and control of sale of minor elements in fertilizers in the State.

Nitrogen for Legumes Controversy

County Agents in our peanut belt estimated that 65 to 75 per cent of the farmers are using 4-10-7 on peanuts. It appears that Alabama farmers are spending between one-quarter and one-half million dollars for fertilizer nitrogen on peanuts annually. The station does not recommend nitrogen for runner peanuts. The limited data obtained by various workers over a long period of years do not justify a recommendation of nitrogen on peanuts, but it is difficult to believe that so many farmers are wrong in their convictions that nitrogen pays on this crop. A few tests were put out this past season to study this problem, but progress is slow on a question the solution of which might save Alabama farmers in a few counties one-third as much as the taxpayers put into all agricultural research in this state. Whether nitrogen is needed in establishing crimson clover and the place for nitrogen on various types of grass-legume pasture mixtures will become more important as large supplies of chemical nitrogen become available.

Table I shows the estimated quantities of nitrogen needed in Alabama for adequate fertilization of our 1951 acreages of feed and forage crops. It is shown that the use of recommended amounts of nitrogen on the annual grass and grain crops alone, including corn, would require 21,000 more tons of nitrogen than was used in 1951 on all crops. Until these needs are satisfied, there appears little reason to blanket perennial legume-grass pastures with chemical nitrogen.

Table I. Estimated Nitrogen Needs for Feed and Forage Production in Alabama

Feed and Forage Crop	Acreage (000)[1/]	Nitrogen Recommended Lbs./A	Nitrogen Recommended Total Tons
Corn	2,000[2/]	75[3/]	75,000
Crimson clover-grass	225	50	5,625
Small grain	239	100	11,950
Small grain-legume	137	50	3,425
Annual summer grass	17	50	425
Total			96,425

Total Nitrogen Used on all Crops in Alabama in 1951-75,051

1/ Estimate except for corn acreage compiled from County Agent's 1951 annual reports.

2/ This estimate does not include corn following winter legumes.

3/ Based on the assumption that good varieties will be used and the best cropping practices followed.

SOME FACTORS INFLUENCING the PRODUCTION and NUTRITIVE VALUE of FORAGE

The success or failure of a livestock enterprise depends to a great extent on the quantity and quality of forage produced. These factors are highly important because most of our farm animals obtain all of their food supply directly from plants. Pasture and other forage account for about 50 per cent of this food supply in the United States. For ruminants this figure would be considerably higher, especially in the south and in the western range region.

It has been shown that some of the forages produced in Alabama and other regions are deficient in certain nutrients which are necessary for normal animal growth. This and other Agricultural Experiment Stations' results have indicated that the yields and nutritive value of forage may be improved by applying the fertilizer nutrients which are deficient or unavailable in the soil and by the introduction of higher yielding and more nutritious forage plants.

The purpose of Part I of this paper is to evaluate and briefly summarize the more important effects of fertility, plant species and management on the yield, botanical composition and chemical composition of forage. Part II will discuss the importance of these factors in the nutrition of livestock and on the grazing value of forages of various quality.

PART I. The Effects of Fertilizers, Plant Species, and Management on the Yield, Botanical Composition, and Chemical Composition of Forage................ R. M. Patterson and John I. Wear

The terms herbage, or forage, as used in this paper, refer to the vegetative portion of plants and do not include seed unless specified. The factors discussed are those considered to be of primary importance in the nutrition of ruminants.

The nutritional constituents of forage may be classified into five basic parts: carbohydrates, proteins, fats, vitamins and minerals. This report will emphasize discussion of factors affecting protein, calcium and phosphorus content of forage and pasture plants. Other forage constituents and factors affecting them are discussed briefly.

Plants are high in carbohydrates of several types. The type and quality of carbohydrate compounds are more affected by plant type, species or strain and maturity than by fertility. The main role of fertilizers is to increase yield and not per cent carbohydrate in forage.

Forages are generally low in fats, although small amounts of fat compounds are stored in the cells of the vegetative portion of plants. Plant type and maturity are more important than fertility in regard to fat percentage of forage.

The only vitamins worthy of consideration in the nutrition of ruminants are vitamins A and D. Vitamin A value is correlated with leafiness, greenness and protein content. Any practice which will increase the protein content will increase the vitamin A value. Vitamin D is absent in fresh forage; however, animals obtain it from ingested sterols which are converted to vitamin D by the ultraviolet rays of the sun.

Mineral elements generally considered essential for plant growth are phosphorus, potassium, calcium, magnesium, sulphur, iron, boron, copper, manganese, and zinc. With the exception of boron, these elements along with the mineral elements, chlorine, cobalt, and sodium, are required for normal animal growth. Forage produced on the majority of fertile or fertilized (LPK) soils supply animals with a sufficient quantity of these minerals, with the exception of sodium and chlorine. Common sodium chloride salt is supplied to animals as a supplement.

The Effects of Fertilizers

Liming and fertilizing is overwhelmingly important on most pasture soils in order to increase yield and bring about conditions favorable for the introduction of better plants, particularly legumes. Legumes are valuable in that they add to the protein content of the herbage, are high in calcium, carotene, and phosphorus, and add nitrogen to the soil to increase the yield and quality of grasses. The amount of available phosphates in the soil is probably the main factor in determining the amount of phosphorus in herbage. Addition of calcium to the soil in the form of lime increases the calcium content of herbage. This increase in calcium and phosphorus content in forage is brought about in two ways: by increasing legume population and by increasing percentage content. Potassium content of herbage is seldom critical as far as livestock nutrition is concerned, but potassium often limits plant growth. Calcium, nitrogen, phosphorus and potassium are commonly deficient in Alabama soils.

Mayton has shown the effects of lime, fertilizer and soil type - location on plant composition and yield (Tables 1, 2 and 3). These yields were obtained at monthly intervals during the grazing season. It is interesting to note that even though an increase in yield and percentage nitrogen, phosphorus and calcium of the forage were obtained at each location, the quality of forage differed quite considerably between locations. This was probably the result of different species predominating at the different locations and to some extent, difference in nutrient availability.

Table 1. Yield and composition of pasture herbage resulting from various fertilizer treatments on Norfolk sandy loam at the Gulf Coast Substation, 1938-40.1/

Fertilizer treatment lbs. per acre		Lime	Yield, dry weight,	Percentage of dry matter		
Superphosphate	Muriate	lbs. per acre	lbs. per acre	N	P	Ca
0	0	0	1,261	1.05	0.10	0.24
200	50	----	1,609	1.14	0.16	0.30
400	50	----	1,879	1.28	0.17	0.40
800	50	----	2,088	1.35	0.19	0.48
200	50	2,000*	1,988	1.32	0.15	0.41

1/ Carpetgrass, Dallisgrass, and common lespedeza.

Table 2. Yield and composition of pasture herbage resulting from various fertilizer treatments on Bell and Houston clay at the Black Belt Substation, 1938-40. 1/

Fertilizer treatment: lbs. per acre	Yield, dry weight	Percentage of dry matter		
Superphosphate	lbs. per acre	N	P	Ca
0	2,541	1.56	0.16	0.94
200	4,256	1.84	0.23	0.98
400	6,959	2.35	0.29	1.19
800	5,289	2.20	0.31	1.07

1/ White clover, Black medic, Kentucky bluegrass and Dallisgrass.

Table 3. Yield and composition of pasture herbage resulting from various fertilizer treatments on Decatur clay at the Tennessee Valley Substation, 1938-40. 1/

Fertilizer treatment, lbs. per acre		Lime	Yield, dry weight	Percentage of dry matter		
Superphosphate	Muriate	lbs. per acre	lbs. per acre	N	P	Ca
0	0	0	1,085	2.68	0.29	0.75
	--	2,000	1,072	2.71	0.27	0.78
600	--	2,000	1,419	2.81	0.31	0.86
600	75	2,000	1,536	2.80	0.32	0.88
1,200	75	2,000	1,853	2.84	0.36	1.12

1/ White clover, hop clover, Kentucky bluegrass, Dallisgrass and common lespedeza.

The nitrogen content of pasturage during the grazing season from fertilized and unfertilized plots of an experiment located on a river terrace soil (Cahaba f.s.l.) for the year 1943 is shown in Figure 1. The L.P.K. treatment produced 70% more dry forage than the unfertilized plot. The percentage of calcium and phosphorus throughout the season followed the same general pattern; being highest early in the season and gradually decreasing as the season advances.

A report from Mississippi illustrates the importance of potassium on a soil deficient in this nutrient (Table 4). The large differences in chemical composition were primarily the result of an improvement in the botannical composition.

Table 4. Chemical Composition of Pasturage Fertilized with Basic Slag and with Basic Slag and Muriate of Potash. 1/

Fertilizer Treatment	Percentage of dry matter: Ca	P	K	Crude protein
Slag	0.42	0.22	1.19	8.1
Slag + potash	0.82	0.39	2.59	18.5

1/ Data from Mississippi State College.

Results from Connecticut pasture studies, which illustrate the effects of fertility on protein and botannical composition are shown in Table 5. In this experiment, the addition of phosphorus and lime increased both the clover content and crude protein content of the forage.

Table 5. Botannical composition and crude protein content of white clover - Kentucky bluegrass pasture as affected by fertilization. 1/

Fertilizer Treatment	Percentage of dry matter: Clover	Percentage of dry matter: Crude protein
No fertilizer	Little	11.7
Phosphorus	14.0	14.5
Phosphorus and lime	44.0	21.1

1/ Data from Connecticut State College

The Effects of Plant Species

The type of plant is an important factor in determining yield and nutrient content of forage. On the average, legume forage contains from 12 to 25% crude protein and grasses contain from 5 to 9%. Under some conditions these values may be exceeded. In general, tropical and subtropical grasses such as Bahia contain less protein than temperate grasses such as Dallisgrass. Legumes have a higher content of calcium than grasses, but many of the better grasses have approximately the same phosphorus content as legumes.

It has been shown that tall growing species under proper management will outyield short growing species. An intermediate white clover-bluegrass sod may produce from 3000-5000 pounds of dry forage per acre while the range of a Ladino clover-orchardgrass sod would be from 4,000-10,000 pounds per acre. Short growing grasses form dense sods and competition for nutrients in the association eventually results in low production.

A graph based on production potentials of short and tall growing species illustrates the importance of selecting taller species for higher forage yields (figure 2).

West Virginia pasture research results show the difference between species at different levels of fertility (Table 6). These results indicate that the range of phosphorus content is much higher in the better species. This has been found at other experiment stations.

Table 6. The ranges in phosphorus and calcium content of Kentucky bluegrass, of white clover and of broom sedge. 1/

CROP	Range in percentage: Phosphorus	Range in percentage: Calcium
Kentucky bluegrass	0.16-0.44	0.33-0.59
White clover	0.24-0.55	1.30-1.96
Broom sedge	0.13-0.22	0.26-0.32

1/ Data from University of West Virginia

The Effect of Management

Grazing or cutting management is one of the most important factors influencing productivity and maintenance of stands of grasses and legumes grown for pasture, hay or lilage. The ultimate goal of management is to assure continued survival of the seeded species in desirable proportions and to assure the most efficient production possible not only for the season as a whole but during unfavorable periods of the season. In practice, grazing or cutting tends to be a destructive process at best, since it periodically removes much of the photosynthetic area of the plants and an abrupt decrease in the photosynthetic activity ordinarily reduces both top and root growth.

Most of the forages utilized for pasturage deteriorate in feeding value and palatability as they approach maturity. Another goal of management is to assure utilization of forages of high feeding value without great reduction in production.

The following graph illustrates some of the changes which normally occur in forage plants as they approach maturity (Figure 3). It is easily recognizable that both maximum yield and maximum quality cannot be assured by the same practice. Hence the adopted practice must of necessity be one of compromise.

The effect of date of first cutting on percentage of leaves and on the chemical composition of sericea was reported in U.S.D.A. Circular 863. A portion of the data are shown in Table 7. This data shows that percentage of leaves and crude protein decreases while fiber content increases if sericea is allowed to mature before it is cut for hay.

Table 7. Effect of first date of cutting on the percentage leaves and chemical composition of sericea. 1/

Date of first cutting	Percentage of dry matter				
	Leaves	Crude protein	Fiber	Fat	Carbohydrates
May 29	62.0	18.5	32.7	2.1	40.2
June 26	50.0	13.1	38.9	2.0	41.8
July 31	43.0	10.3	39.7	3.1	43.2

1/ Data from U.S.D.A.

The effect of stage of maturity of Bermudagrass on the chemical composition is shown in Table 8. A number of other grasses were studied with parallel results. Protein decreases, calcium content changes little, and phosphorus content decreases with maturity.

Table 8. The chemical composition of Bermudagrass as affected by cutting at different stages of maturity. 1/

Stage of maturity	Percentage of dry matter		
	Protein	Calcium	Phosphorus
Young	10.8	0.46	0.19
Medium	5.4	0.51	0.14
Bloom	3.7	0.36	0.06
Mature	3.2	0.36	0.05

1/ Data from Texas Agricultural & Mechanical College

The effects of various cutting treatments on the forage yield and chemical composition of an alfalfa-bromegrass mixture at New Brunswick, New Jersey, are shown in Tables 9 and 10. All of the data are not presented on these slides but the range in cutting treatments are covered. The data shown here indicate that both maximum dry matter and nutrient constituents are obtained by cutting this particular mixture at the one-half bloom stage.

Table 9. Second season yields of an alfalfa-bromegrass mixture as affected by various cutting treatments. 1/

Cutting treatment	Dry forage in pounds per acre		
	Alfalfa	Bromegrass	Total
5 inch ht.	290	1750	2910
10 inch ht.	950	1910	3260
1/10 bloom	2240	2060	4640
1/2 bloom	3560	2070	6010
Seed pod	3280	2330	5770
L.S.D. at 5%	530	N.S.	840

1/ Data from Rutgers University

Table 10. The chemical composition of an alfalfa-bromegrass mixture in the second season as affected by various cutting treatments. 1/

Cutting treatment	Percentage of dry matter		
	Crude Protein	Calcium	Phosphorus
5 inch ht.	23.6	0.70	0.37
10 inch ht.	23.9	0.77	0.35
1/10 bloom	21.0	0.98	0.26
1/2 bloom	20.3	0.96	0.30
Seed pod	19.3	1.03	0.20
L.S.D. at 5%	0.5	0.07	0.03

1/ Data from Rutgers University.

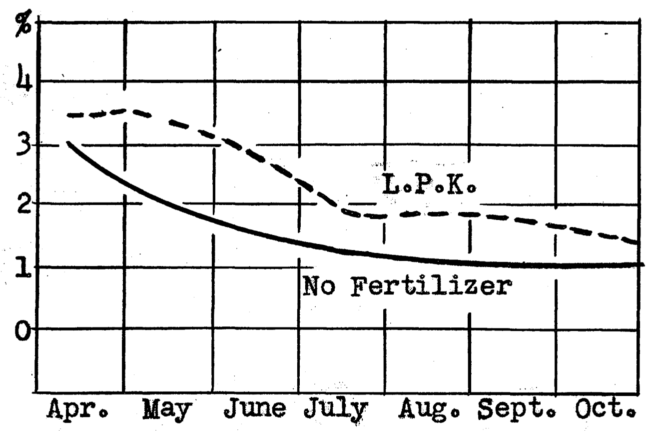


Fig. 1. Nitrogen content of pasturate during grazing season from fertilized and unfertilized plots, Cahaba f.s.l. 1943.

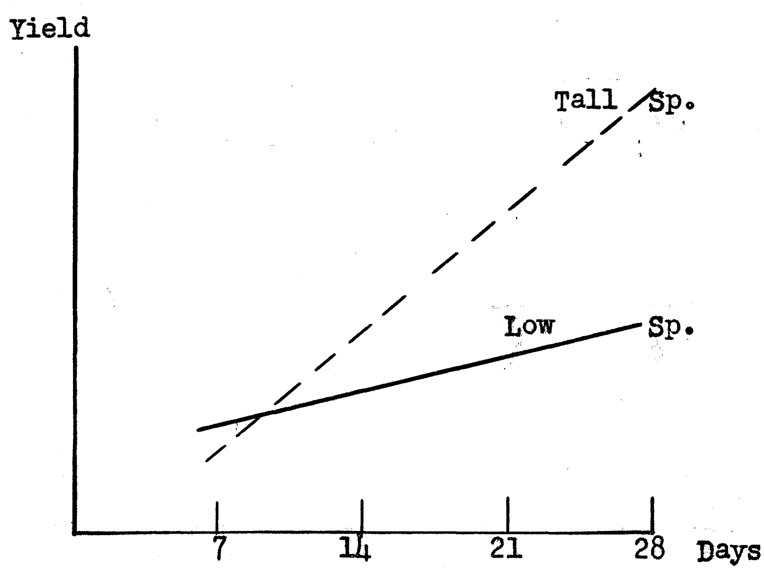
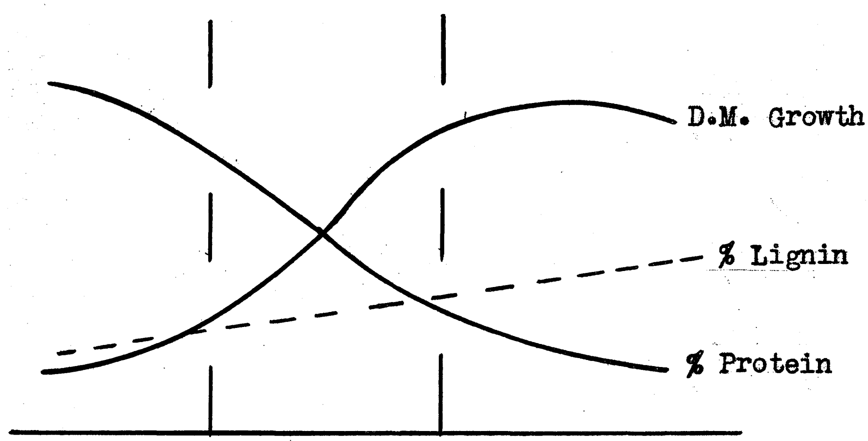


Fig. 2. Typical yield potentials of tall growing versus low growing pasture species.



- -	Stems	+ +
+ +	Leaves	- -
+ +	Palatability	- -
75%	Digestibility	50% or less

Fig. 3. Typical changes in forage plants as they mature.

PART II. The Effects of Fertilizers Upon the Nutritive Value of Pasture Herbage .... C. M. Martin

Studies designed to investigate the nutritive value of pasture herbage have been confined for the most part to considerations of energy value (total) digestible nutrients), protein content, or mineral composition; however, the available experimental data should be examined to determine just how effective changes in these chemical entities appear to account for observed differences in feeding-values of swards composed of various plant species and produced under various conditions of fertilization. By way of definition, the term nutritive value in the strictest sense must imply the feeding value of a specified quantity of material. Pasture studies in which no records of the actual feeding-value of specific quantities of the herbage are available, do not really measure nutritive worth. The extensive data that show increased herbage yields, and increased stock-carrying capacity, with or without chemical analysis, are not in themselves a measure of increased nutritive value. For example, by adding the proper proportions and amounts of certain soil amendments and fertilizer nutrients to a given pasture area, the yield of herbage may often be tremendously increased and furnish feed for an increased number of stock. The nutritive value of given quantity of that herbage may, however, be quite unchanged by the treatment.

Chemical analyses probably have acquired a significance out of proportion to their real worth in the evaluation of the nutritive value of livestock feeds. The fact that the herbage of our pasture contains, or by treatment can be made to contain a larger proportion of protein, minerals and vitamins is of little significance unless it can at the same time be shown that these additional nutrients affect its feeding value. That such differences, as determined by chemical analyses, are significant nutritionally in any given case must be shown by feeding-tests.

Energy value. - In general, energy value will be closely correlated with the dry-matter and the fiber contents of the herbage, and will, of course, be directly related to the feeding-value. All three of the primary nutrients contribute to the energy value of a forage: the carbohydrates, proteins and fats, with fat contributing 2.25 times as much energy per unit of nutrient than the other two. By weight these three nutrients include all but the minerals and account for between 85 and 95 per cent of the dry matter of the feed.

Sheehy (1932) has shown that on the average, grasses have a greater content of dry matter than do legumes at comparable stages of growth. However, one connot say that grasses because of their greater dry matter will yield more net energy to the animal than the legumes, for the latter value will be influenced by the fiber of the feeds. Stapledon (1933) reported that grasses were significantly higher in fiber than legumes. Thus the lower fiber in legumes and higher fiber in grasses may tend to balance the lower dry matter content of legumes and the higher fiber content of grasses. In this connection Stapledon (1933) concluded that at the same stage of maturity (during the period of rapid growth) all grasses have about the same feeding-value as measured by grazing sheep, but legumes have a higher nutritive value than grasses. Kirsch (1933) however, reports appreciable differences in the nutritive value of certain grasses, as measured in digestion trials with cows. Crampton (1934) employing rabbits substantiates the findings of Kirsch (1933).

From the limited data available, it appears that there are likely to be differences in feeding-value between the different species which compose a mixed pasture herbage. Fertilization or other treatment may cause sufficient change of either flora, or possibly within a single species, to alter appreciably the nutritive value of the herbage. The data, however, are not sufficiently convincing that these differences can be fully accounted for on the basis of energy value.

Minerals. - The mineral problem in pasture herbage centers almost entirely around the two elements, calcium and phosphorus. In certain areas iodine, manganese, zinc, cobalt and copper may be deficient in pasture herbage, but it has not generally been with the idea of enriching the forage in these elements that most pasture fertility programs have been designed. However, there are a few areas where one or more of these elements are added for the purpose of (1) to increase yield, and/or (2) increase the forage content, or (3) to counteract the effects of toxic amounts of certain elements.

Huffman et. al., (1933) reported a daily requirement of 10-12 gms. of phosphorus per day for dairy heifers to first lactation. This is about 0.1 per cent of the dry matter of the average ration. Archibald and Bennett (1933) state that 0.15 per cent phosphorus in the pasture herbage is the lower limit of safety. Young grasses or legumes on land well supplied with phosphorus have a good content of phosphorus, usually containing 0.25 per cent or more of it, on the dry basis. The percentage of phosphorus decrease somewhat as the plants become older, but until they are nearly mature there will generally be plenty for livestock. If the forage becomes mature and weathered, the phosphorus content falls greatly. Even where there is no phosphorus deficiency in the soil, such forage may not supply enough to meet the requirements of animals pastured on it. If the soil is slightly deficient in phosphorus, pasture plants may furnish enough phosphorus during active growth, but there may be a serious deficiency when the plants become mature and weathered. Watkins and Knox (1945) have reported that on New Mexico range pasture where there was a moderate deficiency of phosphorus, grasses had over 0.10 per cent of phosphorus on the dry matter basis during active growth. When the forage became mature and weathered during the winter, it had only about one-half as much phosphorus, which was much less than stock need.

Lindsay (1931) reports a daily calcium-intake for dairy heifers of between 2.5 and 4.5 grams of calcium per 100 pounds of live weight as being satisfactory during a trial lasting for three years. In terms of the ration this represented an intake of 0.44-0.85 per cent calcium. Henderson and Weakly (1934) state that rations having less than 0.35 per cent calcium and 0.2 per cent phosphorus give rise to a bone condition low in ash and consequently low in calcium and phosphorus.

The percentage of calcium, on the dry basis, in pasture forage, appears to decrease somewhat as growth advances, however, the change is much less than in the content of phosphorus. Even mature and weathered forage will generally supply enough calcium for grazing animals, unless the soil is extremely deficient in the mineral.

As to the ratio of calcium to phosphorus, investigators are agreed that for the complete diet a ratio of from 2:1 to 1:2 of Ca to P is optimum, and as the ratio deviates from these proportions, the necessity for vitamin D or its substitute increase, as indicated the incidence of rickets in growing animals. Cattle that are outside in the sunlight most of the day have no need for vitamin D in the diet.

The Ca:P ration reported for pasture herbage show wide deviations from the ideal 2:1 to 1:2 ratio. Crampton et. al., (1934) reported that the Ca:P ratio in unfertilized pasture herbage ran from 2:1 to 10:1, according to the species of plant. Fertilization with phosphates in this study increased the Ca and P, but did not appreciably alter the ratio.

Unless there is an actual shortage of Ca or P in the herbage, which may often be the case with P, the data do not support the implication that the higher the Ca and P the greater the feeding-value. Larger intakes above the requirements for normal growth, reproduction and lactation would appear to dilute rather than increase the nutritive value of the herbage when it represents the entire diet.

Protein. - Whether protein is burned as a source of energy or used for tissue-growth and repair depends upon (a) the amount present in the diet, and (b) its nature or quality as measured by its amino-acid make-up. In general, diets in which the quality of protein is satisfactory should carry between 9 and 16 per cent of protein, depending upon the age of the animal and the production expected. Proteins incomplete with respect to essential amino acids will have a low biological value. This may be partly compensated for by large intakes, and may explain the tendency to consider desirable those pasture treatments which increase the protein content of the herbage.

The proportion of digestible crude protein proposed by Morrison (1948) for different classes of grazing stock (exclusive of calves under 500 lbs.) range from 4 to 11 per cent of the dry matter of the ration, depending upon the class and age of animal in question. If the average digestibility of protein is 75 per cent, these requirements in terms of total crude protein become 5 to 15 per cent.

Comparison of the protein content of most young pasture herbage (13.1-20.5) with feeding-standard requirements suggests that protein is probably not a limiting factor in the nutritive value of such forages.

A feeding trial reported by Graves (1933) does not indicate that the high protein of pasture herbage (13.1 - 20.5% of dry matter) when fed to dairy cows increased its nutritive value over a ration of grass hay in which the protein level was much lower (9.9 -14.9 per cent).

Watson et. al., (1932) reported that nitrogen fertilization increased the protein content of pasture herbage, however, grazing sheep failed to make increased live-weight gains due to the increase percentage of protein.

Beeson and others (1941) reported information on sudan grass grown on a light-textured, phosphate deficient soil. Potash and nitrogen were applied to the entire field and super-phosphate in addition to one-half the area. These investigators state that the superphosphate fertilized plots yielded a significantly larges quantity of hay than did the no phosphate plot. A test of the feeding value of the two hays was made using lambs as the test animals. A paired feeding trial was conducted and was followed by digestion trials. No difference was observed in the growth of the lambs, and there was no significant difference in the digestibility of the hay. An additional experiment with field peas yielded similar results.

Eheart and Pratt (1942) have reported the results of extensive experiments in which fertilized and unfertilized bluegrass pasture was fed to milking cows. In these studies digestion and balance studies were conducted to determine if fertilization of bluegrass pasture affected the digestibility and utilization of its nutrient constituents as well as the quality and quantity of milk produced. From these results the general conclusions may be drawn that, for practical purposes, the herbage from unfertilized bluegrass pasture will meet the needs for milk production as well as fertilized pasture, provided enough herbage is available to supply the additional energy required to gather herbage from the poorer sod. In spite of this fact, it is recognized that the increased yield, due to fertilization, justifies the practice of fertilizing pastures.

Webb et. al., (1948) summarized the results of four years of field experimentation on some lands of the university of Illinois, Dixon Springs Experiment Station in southern Illinois. Six ten-acre fields that were low in fertility and severely eroded and which had been farmed for many years were used in this experiment. The purpose of this sutdy was to learn whether soil deficiencies of such nature as to interfere with the general health and reproduction of sheep existed and to study the effect of applications of calcium and phosphorus upon the vegetation and the animals. These investigators found that the use of fertilizer affected the chemical and botanical composition of the herbage, however, such effects as were obtained did not show in the bone ash or serum phosphate or reproductive performance of the sheep.

Matrone et. al., (1949) reported that phosphate fertilization of soybean hays grown on a soil deficient in phosphorus produced no significant change in composition as measured by standard feedingstuffs analysis, which included calcium and phosphorus. Fattening trials and digestibility studies with lambs using soybean hay for roughage and raw soybeans for concentrate gave no significant differences either in weight gains or apparent digestibilities between feeds from phosphate-fertilized and those from non-phosphate-fertilized plots. However, when cerlose replaced soybeans as the concentrate, lambs which received soybean hay fertilized with phosphate gained an average of 0.282 lb. daily per lamb as compared to 0.192 lb. for the non-phosphate group. This difference was significant at the 5% level. Digestion studies using soybean hay alone as well as with cerelose as the concentrate on a second hay crop gave a significantly higher apparent digestibility for the protein of hay from the phosphate-fertilized plots. This difference was shown to be related to the quantity rather than the quality of protein. Serum phosphate values and digestibility of ash by lambs fed hay from phosphate-fertilized plots plus cerelose were higher than those lambs receiving hay from non-phosphated plots plus sugar. These investigators state that generalizations on the influence of fertilization on the nutritive value of plants for animal feed are not warranted at this stage of the investigation due to entirely too few reliable data.

Trace Minerals. There are many who advocate the promiscuous use of a great number of trace minerals, either in the forms of fertilizer or as mineral supplements to cattle. The addition of anything to a livestock feed that is not needed is wasteful regardless of the cost. Large-scale "shotgun" supplementation of trace minerals for farm animals under the phrase "added for insurance purposes" does not add anything to a ration unless there is some indicated need for it. In general, this would seem to be the soundest policy in the interest of both efficient and economical livestock feeding. Furthermore, widespread addition of minerals to livestock rations may have adverse effects either in exceeding the tolerance of the animal for a particular element or in interfering with the utilization of some needed nutrient.

A summary of the present knowledge of the needs of trace mineral elements is given in Table 11.

TABLE II**

The trace mineral element

needs of farm animals

Mineral Element	Deficiency Shown for	Recommendation or Requirement	Remarks
Cobalt	Cattle Sheep	Of the Ration 0.04 ppm[1] 0.07 ppm[1]	Supplementation advised in deficient areas. 2-6 gms. cobalt salts per ton of conc. or 0.5 oz. cobalt salts/100 lbs. of salt or simple mineral mixture
Manganese	Chickens		
	Chicks	25 mg./lb./feed[2]	Sometimes deficient in feeds
	Breeders	15 mg./lb./feed[2]	4 oz. $MnSO_4$/ton feed
	Turkeys		
	Poults	25 mg./ton/feed[2]	
	Breeders	15 mg./ton/feed[2]	
	Swine		Supplementary need not demonstrated
Copper	Sheep	5 ppm[4]	Adequate in ordinary feeds except in Florida
	Cattle	5-7 ppm[4]	
	Swine	- - - -	Adequate except for suckling pigs indoors
	Poultry	?	Adequate in ordinary rations
Iodine	All farm animals		
	Chickens	0.3-0.5 mg./lg./feed[2]	Supplementation with iodized salt advised especially for pregnant animals in iodine deficient areas in northern U.S.
	Others	0.1 ppm[78]*	
Iron	All farm animals	?	Adequate in livestock rations except suckling pigs indoors
Zinc	No farm animal	?	Supplementation not recommended
Boron	No farm or any other animal	?	Supplementation not recommended
Nickel	No animal	?	Supplementation not recommended
Molybdenum	No animal		Excess amounts increase copper needs
Fluorine	No farm animal		Toxic effects of most interest in feeding farm animals

*Estimated
**Smith, S.E., Proceedings of the 1951 Cornell Nutrition Conference for Feed Manufacturers Nov. 1 and 2, 1951 Pages 94-5

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SUMMARY

The important factors which affect yield and nutritive value of forage have been evaluated. It was shown that fertilizer increased forage yields, increased the mineral content of forage, and improved the botannical composition of forage on land where the particular fertilizer nutrients were deficient or unavailable. The type of plant and management practices followed were discussed as important factors that influenced yield and quality of forage.

The mineral content of pasture plants is not merely a reflection of the mineral content of the soil in which the plants are grown. Many investigations indicate the problem is much more complex. In addition to the presence of particular minerals in the soil other factors that influence the uptake of minerals and the nutritive value of pasture herbage are (1) the availability of the particular minerals, (2) the presence of certain quantities of other minerals, (3) the physical characteristics of the soil, (4) available soil moisture, (5) temperature, (6) amount of sunlight, (7) the state of maturity of the plant, and (8) the type of plant. If any of these latter factors limit production of high quality forage, the mineral content of the soil becomes a factor of lesser importance.

A plant is not a repository for the greatest amount of material available about its roots. In general, a particular plant variety tends to develop toward a characteristic form and chemical composition when grown under optimum conditions. Legumes are generally more constant in chemical composition than grasses.

On the basis of present evidence it appears that the greatest effect of fertilizing pastures is to increase the livestock carrying capacity of a given land area. It has not been conclusively shown by animal responses that increased mineral content of forage was particularly beneficial except in extreme mineral deficiency areas where the mineral content of herbage was below the critical level.

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MANUFACTURE-GRADE MILK PRODUCTION in ALABAMA .... K. M. Autrey

To obtain information on problems and opportunities relating to the production of Alabama milk for manufacturing purposes, questionnaires (A) were sent to agricultural leaders throughout the state. These included county agents, substation superintendents, personnel with the manufacture-milk companies, etc.

A second questionnaire (B) similar to the first was sent to a number of farmers that were named as being successful producers of manufacture-grade milk. This is a report on the response to these two questionnaires.

General Information

I. Farm ownership. More than half of the reporters indicated that a major percentage of the milk-producing farms in their areas were tenant-operated. This was considered a serious impediment to increasing volume and efficiency in milk production. Of the 18 "successful" producers answering, none were operating on leased land. Incidentally, a large majority of the reporters called the quality of dairy labor poor or only fair. Very few considered the quality good.

II. Size of herds. Average of all milk sheds was 5.3 cows per producer. In the Piedmont the figure was slightly less than the average for the state. It is significant that the producer (B) reporting gave an average of 12 milking cows per farm in November, 1952. In addition to this there were 7 dry cows and heavy-springing heifers on the average farm of these "successful" producers. The range in the latter group was 3 to 32 milking cows.

All except two producers reported plans to expand their milking herds within the next 2 years. Extent of the expansion was estimated at a 73% increase in size of the dairy herd. A majority of the producers felt that increasing size of the dairy herd would increase efficiency of production. Reporters of the "educational group" (A) felt that size of herds should be increased to 10 cows to improve efficiency of production. All but one reporter felt this increase could be accomplished without extra labor. None thought herd size should be decreased.

III. Number of Producers. There are apparently about 12,000 producers of manufacture-grade milk in Alabama. Carnation Company, Dadeville Area, reports 1282 in 1952.

Most reporters (A) felt it was more desirable to increase size of herd than number of producers; but almost half felt it would be more desirable to increase number of producers. It was estimated that a 46% increase in number of producers could logically be accomplished within two years (Piedmont 39%)

IV. Sources of cash income. Producers (B) estimated that 56% of their cash income comes from sale of milk. Other cash crops, in order of importance, were cotton, hogs and broilers.

V. Seasonal production. Only 49% of the farmers produce milk all year round. In the Piedmont the figure is 60%. The least milk is produced in winter. Fall is second lowest period. Producers (B) reported that about 60% of their production was made during the 6 months from March through August.

VI. The outlook. All producers (B) felt the outlook for manufacture-grade milk production was good.

Feeding

I. Adequacy of feed program. Forty percent (40%) of the reporters (A) considered the winter feed program poor. Only 7% considered it good. About 75% felt the summer program was fair but only 12% considered it good. Almost all reporters (A) felt the reserve feed program was inadequate.

About 70% of the producers (B) considered their pasture program adequate with winter pasture being poorer, relatively, than summer pasture.

II. Feed crops.

A. Warm weather pasture. In the Piedmont Sericea topped the list, ranking first in all but two reports from this area. "Permanent pasture" was second and kudzu was a close third. Others included Dallis grass, Sudan grass, Johnson grass, Bermuda, carpet, annual lespedeza, and white clover.

The producers (B) reported sericea as the main crop, but summer annuals, principally Sudan grass and millet, ranked second.

B. Cool weather crops. In the Piedmont as in most other areas of the state Crimson clover in various combinations with oats and rye grass ranked first. Next was fescue with white or ladino clover.

C. Hay crops. Sericea ranked first easily. Kudzu was second, alfalfa third. Apparently the "successful producers" (B) used more alfalfa and more oat-vetch hay than the average farmer.

III. Level of grain feeding. Reporters from the educational group (A) estimated that about 20% of the producers depend on roughage alone for milk production. Fifty-one (51) percent depend on a "limited" amount of concentrate. Of the producers (B) 5 reported feeding a high level of concentrate (1# conc. 2-3# milk) and 11 reported feeding at a lower level of concentrate.

IV. Reasons for inadequate feed. In the Piedmont the 2 main reasons were inadequate financing and inadequate equipment. The Producers (B) named these two in reverse order as the principal obstacles in feed production. The next most important reasons were infertile land and lack of "know-how".

V. Potential for growing feed. A majority of reporters felt that with no reduction in row crops adequate feed could be grown for twice the present number of cows on the farms. In the Piedmont all but one expressed this view.

It was felt that with adequate pasture and harvested roughage production per cow could be increased 25-50%.

Breeding

I. Quality and breeds of cows. Only 7 percent considered the general quality of cows "good" (A). Of the bulls used 65 percent were considered of poor breeding. On the other hand, producers (B) are mainly using purebred bulls and feel confident the bulls are well-bred. About 75% (B) have a planned breeding program.

In the Piedmont (A) there is a decided increase in interest in the larger breeds of dairy cattle.

However, more than half of the producers (B) feel there is no particular need for larger breeds such as the Holstein. They indicated that more than 80 percent of their cattle are Jerseys and about one third of these are purebreds. Most of these (B) are breeding to Jersey bulls.

II. Use of beef bulls. During 1951-52 about half of the milk cows have been bred to beef bulls. This practice is apparently decreasing. Only 2 of 15 producers (B) reported use of beef bulls on dairy cows.

III. Artificial breeding. Where the program is available the general attitude toward artificial breeding is "favorable", in contrast to "unfavorable" by a 2 to 1 ratio (A). This was true in the Piedmont as well as over the entire state. Of 8 producers (B) having used artificial breeding, 7 reported satisfactory results.

Criticisms of the program were, in order of importance:

1. Low conception rate.
2. Scattered cow population.
3. Need for better understanding of program.
4. Poor communication.

Low production was mentioned a total of only 3 times on all reports submitted.

Educational Programs that are or Would be Most Valuable for Increasing Milk Production.

I. Feed production and harvesting. Easily ranked first (A and B)

II. Improved breeding.

III. Raising herd replacements.

IV. Disease control.

Research Needs

I. Feed production and grazing management. Silage production was mentioned specifically in a number of cases.

II. Disease control.

III. Others. Feeding calves, irrigation, adaptability of new breeds of cows, etc.

K. M. Autrey - 12/15/52

ORGANIZATION of the RESEARCH PROGRAM of the AGRICULTURAL EXPERIMENT STATION SYSTEM of the ALABAMA POLYTECHNIC INSTITUTE .... Coyt Wilson

The research program of the Alabama Agricultural Experiment Station System is supported by funds from the following sources:

1. Federal grants authorized by the Hatch, Adams, Purnell, Bankhead-Jones, and Research and Marketing Acts.

2. State funds appropriated by the State Legislature.

3. Grants from commercial companies, non-profit organizations, etc.

4. Sales funds from the sale of products resulting from research programs, such as, cotton, beef, milk, and eggs.

5. Payment by various agencies for services rendered under contracts.

The Experiment Station System is organized into eleven subject-matter departments, ten Substations, six Experiment Fields, and a Field Station devoted to the study of problems on ornamental horticulture. Although the six Experiment Fields are operated by the Department of Agronomy and Soils, they receive an ear-marked appropriation in the same manner as the Substation. Other outlying units, without special appropriation, include the Experiment Forests, the Plant Breeding Unit, and Southeastern Alabama Horticulture Field. In the past most of the "basic" research has been done in the laboratories and greenhouses at Auburn while the outlying units have concentrated their efforts in the field of applied research. Although this division has many practical advantages, it appears likely that the line of demarcation will be less distinct in the future. Quite a bit of work is already underway that requires the services of personnel and the use of facilities at the Main Station and at one or more outlying units.

Generally speaking, funds are budgeted to departments or stations rather than to projects. Within certain limits, the department head or superintendent determines how much money is to be spent on each project. In the case of work supported by Federal grant funds, the amount of support is often determined at the time the formal project outline is approved. Grants usually are ear-marked for specific research problems. In contract research, the details of the research project and the support are usually determined before the contract is signed. State Research funds are used to support specific research projects or to supplement projects inadequately supported by Federal grant funds. Sales funds are used to defray normal operating expenses, i. e. farm expenses, feed, etc., and to help support research projects. There is very little research supported entirely by Sales funds.

Formal project outlines are required by law for that research that is supported by Federal grant funds. These outlines are reviewed by a Station Projects Committee, approved by the Director and by the Office of Experiment Stations. Copies of these project outlines are filed in the Office of Experiment Stations and in the Director's Office and a progress report is submitted to the Office of Experiment Stations each year. The Office of Experiment Stations desires to obtain titles of projects supported by other funds but they do not receive copies of the project outlines.

Some of the problems on which we work cannot be confined to any one of our eleven subject-matter departments. For example, a complete research program on supplemental irrigation should include work in the fields of soil physics and chemistry, agricultural engineering, agronomy, horticulture, animal husbandry, dairy husbandry, and agricultural exonomics. Since most present day research workers are highly specialized, it is not likely that any one man will be able to do the research in all these fields. It is necessary, therefore, that provisions be made for utilizing the services of specialists in two or more fields on these problems. At present, there is no completely satisfactory method of accomplishing this. There are at least three ways of approaching the problem.

1. Development of one project outline covering the entire problem with one project leader and a number of assistant project leaders. This arrangement does not provide for the freedom of action desired by most research workers.

2. Development of one master project outline and the development of two or more "subprojects" or "contributing projects" each having a project leader. Under this arrangement the leaders of the subprojects may constitute a steering committee for the master project.

3. A departmental approach by which each department develops a program covering those phases of the problem that logically fall within the scope of the department.

We have tried or are in the process of trying each of these methods. It appears likely that we will have to develop still other methods of approaching the problem. The ideal system would provide for, (1) bringing the special competences of the various specialists to bear on the problem, (2) for protecting each individual against the danger of his becoming a service man for another specialist, and (3) for expediting the work to the extent that the greatest amount of information is obtained in the shortest possible time at the lowest possible cost.

Obviously, we cannot wait until we have a perfect solution to all of our problems in organization before attacking problems requiring inter-departmental cooperation. It is necessary to continue to make efforts to improve the organization. The present plan is to proceed as rapidly as possible along the following lines.

1. All research work at the Main Station and the outlying units is to be done within the scope of approved project outlines.

2. Each project outline will have an identifying number and one project leader. There may be one or more assistants or associate project leaders.

3. Project outlines will be subject to review by special committees before being approved by the Director's Office. It is probable that in some border-line instances, the work will cover fields in two or more departments. This should not cause any friction if the outline is reviewed and approved by all interested parties before the work is started.

4. In some instances project outlines may be rather general in nature. When this is true, the specific fields of work should be covered by detailed work plans approved by the department head. It will not be necessary to file a copy of the work plan in the Director's Office.

5. In addition to the narrative annual report prepared for the Director, a summary report will be prepared on each project at regular intervals. For this purpose there is available a State Form similar to OES Form 8. A summary report should be prepared for each approved work plan. Each of these will carry the number of the general project under which the work is done.

6. A punch card system of indexing and abstracting projects and experimental results will be maintained in the Director's Office.