FORTY-FIFTH ANNUAL REPORT

Fiscal Year Ending June 30, 1934

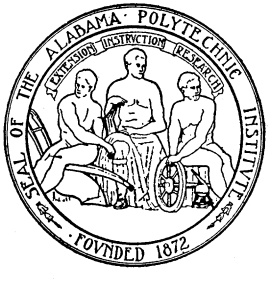
OF THE

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN



M. J. FUNCHESS, *Director*

AUBURN, ALABAMA

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ALABAMA POLYTECHNIC INSTITUTE

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

TRUSTEES

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C. W. Ashcraft (Eighth District)	Florence
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AGRICULTURAL EXPERIMENT STATION STAFF

ADMINISTRATIVE COMMITTEE

John Jenkins Wilmore, B.M.E., M.E., LL.D.
Bolling Hall Crenshaw, M.E., LL.D.
Luther Noble Duncan, M.S., LL.D.

M. J. Funchess, M.S., Director of Experiment Station
W. H. Weidenbach, B.S., Executive Secretary
P. O. Davis, B.S., Agricultural Editor
Mary E. Martin, Librarian
Sara Willeford, B.S., Agricultural Librarian

Agronomy and Soils:

M. J. Funchess, M.S.	Agronomist
J. W. Tidmore, Ph.D.	Soil Chemist
Anna L. Sommer, Ph.D.	Associate Soil Chemist
G. D. Scarseth, B.S.	Assistant Soil Chemist
J. A. Naftel, Ph.D.	Assistant Soil Chemist
R. E. Yoder, Ph.D.	Assistant Soil Chemist
H. B. Tisdale, M.S.	Associate Plant Breeder
J. T. Williamson, B.S.	Associate Agronomist
**R. Y. Bailey, B.S.	Assistant Agronomist
D. G. Sturkie, Ph.D.	Assistant Agronomist
*F. L. Davis, M.A.	Soil Chemist
**G. H. Jester, B.S.	Assistant in Agronomy
F. E. Bertram, B.S.	Assistant in Agronomy
E. L. Mayton, B.S.	Assistant in Agronomy
J. W. Richardson, B.S.	Assistant in Agronomy
**J. R. Taylor, B.S.	Assistant in Agronomy
E. C. Richardson, B.S.	Graduate Assistant

Animal Husbandry, Dairying, and Poultry:

J. C. Grimes, M.S.	Animal Husbandman
W. D. Salmon, M.A.	Animal Nutritionist
G. A. Schrader, Ph.D.	Associate Animal Nutritionist
C. O. Prickett, B.A.	Associate Animal Nutritionist
**G. A. Trollope, B.S.	Poultry Husbandman
D. F. King, M.S.	Assistant Poultry Husbandman
W. E. Sewell, M.S.	Assistant Animal Husbandman
G. J. Cottier, M.A.	Assistant in Animal Husbandry
J. G. Goodman, B.S.	Graduate Assistant in Animal Nutrition

*Assigned by the State Department of Agriculture and Industries.

**On leave.

Botany and Plant Pathology:

J. L. Seal, Ph.D. — Plant Pathologist
G. L. Fick, M.S. — Associate Botanist
E. V. Smith, M.S. — Assistant Botanist

Agricultural Economics:

**J. D. Pope, M.S. — Agricultural Economist
B. F. Alvord, M.S. — Associate Agricultural Economist
**C. M. Clark, M.S. — Assistant Agricultural Economist
Edith May Slights — Statistical Assistant

Agricultural Engineering:

M. L. Nichols, M.S. — Agricultural Engineer
J. W. Randolph, M.S. — Agricultural Engineer (Coop. U.S.D.A.)
A. Carnes, M.S. — Assistant Agricultural Engineer
**N. W. Wilson, B.S. — Assistant Agricultural Engineer
E. G. Diseker, B.S. — Assistant in Agricultural Engineering
I. F. Reed, M.S. — Assistant in Agricultural Engineering (Coop. U.S.D.A.)

Entomology:

J. M. Robinson, M.A. — Entomologist
H. S. Swingle, M.S. — Associate Entomologist
L. L. English, Ph.D. — Associate Entomologist
F. S. Arant, M.S. — Assistant Entomologist

Special Investigations:

J. F. Duggar, M.S. — Research Professor of Special Investigations

Horticulture and Forestry:

L. M. Ware, M.S. — Horticulturist
C. L. Isbell, Ph.D. — Horticulturist
**O. C. Medlock, M.S. — Assistant Horticulturist
R. W. Taylor, M.S. — Assistant Horticulturist
T. P. Whitten, B.S. — Graduate Assistant

Substations:

Fred Stewart, B.S. — Superintendent Tennessee Valley Substation, Belle Mina, Ala.
R. C. Christopher, B.S. — Superintendent Sand Mountain Substation, Crossville, Ala.
J. P. Wilson, B.S. — Superintendent Wiregrass Substation, Headland, Ala.
K. G. Baker, B.S. — Superintendent Black Belt Substation, Marion Junction, Ala.
C. L. McIntyre, B.S. — Assistant to Superintendent Black Belt Substation
**Otto Brown, M. S. — Superintendent Gulf Coast Substation, Fairhope, Ala.
Harold Yates, B.S. — Acting Superintendent Gulf Coast Substation, Fairhope, Ala.

CHANGES IN STATION STAFF DURING 1933-34

Appointments:

T. P. Whitten, B.S. — Graduate Assistant in Horticulture

Resignations:

J. G. Goodman, M.S. — Graduate Assistant in Animal Husbandry
E. E. McElwee, M.S. — Graduate Assistant in Horticulture

**On leave.

NEW PUBLICATIONS

Pope, James D.—**Principal Sources and Uses of State and County Revenues in Alabama.** *Alabama Agricultural Experiment Station Circular 63.* In the fiscal year 1932-33 property tax, business tax, and the combined gas and automobile tag tax each accounted for slightly less than one quarter of the State revenues; federal aid accounted for nearly 19 per cent. The remaining 10 per cent came from earnings of the Convict Department and minor sources. About 40 per cent of the expenditures were for highways and 22 per cent for education. About 12 per cent of the expenditures were for debt service other than that associated with highways.

Property taxes accounted for about 80 per cent of the county revenues. Of the combined state and county expenditures 38.7 per cent was spent for highways and 28.9 per cent for educational purposes.

King, D. F., and Trollope, G. A.—**Force-Molting of Hens and All-Night Lighting as Factors in Egg Production.** *Alabama Agricultural Experiment Station Circular 64.* The results of combining force-molting and artificial lighting to increase the profits from hens by this system of management, together with general suggestions on force-molting of hens and the use of all-night lighting for increased egg production are given in this circular.

Arant, F. S.—**Time of Turning Legumes and Planting Corn to Avoid Injury from the Southern Corn Root Worm.** *Alabama Agricultural Experiment Station Circular 65.* This circular gives the result of six years of experimental work with corn planted at weekly intervals following the turning of winter legumes March 15, April 1, and April 15. The most serious injury occurred in corn planted following the turning of legumes March 15 and the least injury following the turning April 15. No serious injury occurred to any corn planted at Auburn April 30 or thereafter following the turning and disking of winter legumes on or before April 15.

King, D. F., and Trollope, G. A.—**Simplified Rations for Farm Chickens.** *Alabama Agricultural Experiment Station Circular 66.* This circular compares the result of feeding simplified and complex rations to chicks and hens. According to the results obtained farmers may secure good results by feeding their chickens simple home-mixed rations.

Tidmore, J. W., and Simmons, C. F.—**The Use of Limestone in Mixed Fertilizers.** *Alabama Agricultural Experiment Station Circular 67.* This circular presents the results of a study which

show the advantages of using limestone as a filler and the amount of limestone required to neutralize the acidity developed by the mixed fertilizers used in Alabama.

Grimes, J. C., Sewell, W. E., and Cottier, G. J.—**Some Factors Affecting the Cost of Raising Pigs to Weaning Age.** *Alabama Agricultural Experiment Station Circular 68.* This circular reports the results of raising 147 litters of pigs to weaning age on the Experiment Station farm. The number of pigs raised in a litter affected materially the feed cost per pig and the weight per pig at weaning age.

Grimes, J. C., Sewell, W. E., and Cottier, G. J.—**Feeding, Docking, and Castrating Spring Lambs.** *Alabama Agricultural Experiment Station Circular 69.* A report is given on five trials in feeding grain to spring lambs and four trials in docking and castrating spring lambs. Lambs which were fed grain in addition to their mother's milk returned a small profit above the feed and marketing cost. Docking and castrating lambs did not prove profitable in this experiment.

Pope, James D. and Wingate, Henry T.—**Factors Affecting Costs of Producing Pork in Southeast Alabama.** *Alabama Agricultural Experiment Station Bulletin No. 240.* Data were collected from 99 farms in 1927 and from 80 in 1928. All of these farms produced hogs fattened largely on peanuts.

Two factors, namely, yield per acre of crops "hogged-off" and adjustment of the number of hogs to the feed supply, exerted an outstanding influence on costs of production. As a two-year average the farms having above the average yield of these crops and above the average number of hogs per ton of feed, produced pork at about $5.50 per hundredweight of marketable gain; those farms which were below average in these two respects produced pork at approximately $8 per hundredweight.

Easter, E. C., and Nichols, M. L.—**Dairy Refrigeration on Rural Electric Lines.** *Alabama Agricultural Experiment Station Bulletin No. 241.* This bulletin reports the results of studies made as a part of the experimental work on rural electrification conducted in cooperation with the Alabama Power Company and with dairymen in different sections of the State. The work was based upon studies of the requirements for proper refrigeration of dairy products, as determined by bacteriologists and public health officials. Its objects were to study: (1) small dairy refrigeration units and results obtained from their use; (2) the adaptability of electrically operated equipment to the refrigeration needs of the dairies.

Medlock, O. C.—**Effect of Different Temperatures, Humidities and Free Ammonia on Pecans in Storage.** *Proc. 32nd Conv. of Nat. Pecan Assn., p. 21. 1933.* This paper presents the results of a four-year study of factors which affect the storage of the pecan. Pecans of the Stuart and Frotscher varieties were stored at low, high, and uncontrolled humidity and at room temperature, 50°F., 40°F., and 32°F. at all humidities. At room temperature and at 50°F. both varieties kept well in storage from harvest until March, after which time nuts stored at high humidity deteriorated rapidly. Nuts kept in a good marketable condition at 32°F. for one year and longer under conditions of low humidity and uncontrolled humidity. Nuts stored at 40°F. kept better than those stored at 50°F. but the results indicated that a temperature lower than 40°F. was necessary to keep pecans in marketable condition for one year. Uncured nuts kept as well in storage at low temperatures and at low humidity as cured nuts. Molding of kernels seems to be the most serious problem in pecan storage. Loss of high quality may occur before rancidity develops. Small amounts of free ammonia in the storage room caused darkening of the kernels.

Prickett, C. O.—**The Effect of a Deficiency of Vitamin B Upon the Central and Peripheral Nervous Systems of the Rat.** *American J. Physiol. 107:459-70. 1934.* A study has been made of the effect of a deficiency of vitamin B upon the nervous tissues of the rat.

Osmic acid and Sudan III preparations of peripheral nerves failed to show any evidence of myelin degeneration.

In the central nervous system, 75 per cent of the deficient animals showed disseminated foci of hemorrhage and cell damage of one or both sides in the pons and medulla. The structures most consistently affected were the nucleus of Deiters, the chief vestibular nucleus, the nucleus of Bechterew, and the solitary nucleus. The extent of the damage appeared to vary with the length of time the animal was left on experiment after the development of severe symptoms.

These findings, together with the recent work on the physiological action of vitamin B, indicate the brain as the site of the lesion responsible for the symptoms observed in vitamin B deficiency in rats.

Salmon, W. D., and Goodman, J. G.—**Studies of the Raw Egg-White Syndrome in Rats.** *Jour. Nutrition, 8, 1-24.* Raw egg-white, either fresh or dried, as the sole dietary source of protein for rats produced fur-like or woolly hair, alopecia, exfoliating dermatitis, hyperemia, skin-hemorrhages, blepharitis, stomatitis, salivation, variable edema and erythema of the feet, symptoms of nervous disturbance, and finally hypochlorhydria and some anemia.

The disease was readily produced by diets containing only 18 per cent of raw egg-white (dry basis).

If the diet did not contain more than 18 per cent of raw egg-white, the symptoms were prevented or cured by brewer's yeast, dried liver, milk or the extracted residue of brewer's yeast or liver, but were neither prevented nor cured by extracted casein, baker's yeast, extract or hydrolyzed residue of brewer's yeast, white corn, gelatine or dilute hydrochloric acid.

Coagulation of fresh egg-white by heat and extraction of the coagulum with 51 per cent alcohol rendered it innocuous. The concentrated extract had a harmful effect but failed to produce the severe symptoms caused by raw egg-white.

The data indicate a positive harmful factor in raw egg-white which is antagonized by the protective substances rather than the existence of a deficiency. Many of the symptoms are similar to those of vitamin G-deficiency and of pellagra but apparently are not due to an anti-vitamin G action of the harmful factor.

Scarseth, G. D., and Tidmore, J. W. **The Fixation of Phosphate by Soil Colloids.** *Jour. Amer. Soc. Agron. 26:138-151. 1934.* Electrodialized colloids, from soils varying widely in silica-sesquioxide ratios, were prepared so that they contained different amounts of Ca and were treated with 6 kinds of phosphates. The amount of phosphate fixation was determined by extracting with N/10 and N/500 H_2SO_4 solutions. The phosphate-fixing capacity varied with the silica-sesquioxide ratios. Fixation of the phosphate from $H_3(PO_4)_3$, $CaH\ PO_4$, and Na_3PO_4 was about equal in the colloids low in sesquioxides when the Ca saturation was below 100 per cent. $CaHPO_4$ and Na_3PO_4 were fixed to a slightly less extent than H_3PO_4 in the colloids high in sesquioxides. $Ca(H_2PO_4)_2$ was fixed slightly more than was H_3PO_4 in all the colloids. $Ca_3(PO_4)_2$ was about 10 per cent less available than $Ca(H_2PO_4)_2$ in the low sesquioxide and about equal to it in high sesquioxide colloids. Rock phosphate was 20 per cent less available than $Ca(H_2PO_4)_2$ in the low sesquioxide and slightly more available than $Ca(H_2PO_4)_2$ in the high sesquioxide colloids. The higher the sesquioxide content the smaller was the influence of the degree of Ca saturation below 100 per cent on the amount of phosphate fixed by the colloids. On the other hand, the tendency was for more phosphate to be soluble when the colloids contained a large excess of Ca.

Scarseth, G. D., and Tidmore, J. W. **The Fixation of Phosphates by Clay Soils.** *Jour. Amer. Soc. Agron. 26:152-162. 1934.* Acid heavy clay soils and calcareous heavy clay soils were treated in greenhouse pots with six different forms of phosphates at three different rates. The phosphates were added to the soil at the time of planting, 365, 180 and 30 days before the planting of

sorghum. The rate, degree of fixation, and the efficiency of the various phosphates were measured by the plant yields and soluble phosphates in the soil. The most soluble phosphates were fixed more rapidly. Relatively insoluble phosphates were fixed slowly but were inefficient in supplying available phosphorus to the plants. The rate of fixation was greatest at first and decreased rapidly with an increase in the time of contact with the soil. $CaCO_3$ applied to the acid soil greatly decreased the availability of readily soluble phosphates and the plant yields when applied immediately before planting; whereas after equilibrium was established, $CaCO_3$ was no longer present in the soil, the availability of the phosphates increased. $CaCO_3$ also depressed the yields when the soluble phosphate was low and increased the yields when the soluble phosphate was high in the case of different acid soils. The relative efficiencies of the different phosphates as determined by plant yields were 100, 117, 110, 103, 57, 25 for $Ca(H_2PO_4)_2$, superphosphate, $NH_4H_2PO_4$, $CaHPO_4$, $Ca_3(PO_4)_2$, and $FePO_4$, respectively.

Sturkie, D. G.—**A Study of Lint and Seed Development in Cotton as Influenced by Environmental Factors.** *Jour. Amer. Soc. Agron. 26, 1-24. 1934.*

This paper reports the results of five years' study of the influence of soil type, climatic conditions, and soil moisture on the length of lint, weight per boll, weight per seed, weight of lint per seed, lint index, number of seed per boll, and percentage of lint.

Tidmore, J. W.—**Ammonium Hydroxide versus Calcium Nitrate for Cotton Seedlings.** *Jour. Amer. Soc. Agron. 25, 619-622. 1933.* It was shown that ammonium hydroxide added to concentrated solution cultures was as efficient for cotton seedlings as calcium nitrate, whereas ammonium hydroxide added to dilute solution cultures was entirely unsatisfactory for cotton seedlings.

Tidmore, J. W., and Williamson, J. T.—**Experiment with Nitrogenous Fertilizers and Limestone.** *American Fertilizer, Nov. 18, 1933.* The results of a large number of field tests showing efficiency of various sources of nitrogen with and without limestone are reported. The acidic nitrogenous fertilizers without limestone were less efficient for cotton on Norfolk sandy loam than sodium nitrate, whereas they were as efficient when the land was limed.

Ware, L. M.—**Polishing, Bleaching, and Dyeing the Pecan.** *Proc. 32nd. Conv. of Nat. Pecan Assn., p. 42. 1933.* The pecan was found to have on the surface of the shell three layers exposed, each of which bleached quite differently. To produce a uniform product it was found necessary to remove all layers

down to the schlerenchymous cells. In the laboratory, these layers were satisfactorily removed by wire brushes or by rotation in drums containing sharp sand. Pecans when polished were satisfactorily bleached by dipping them first for four minutes in a solution of sodium hypochlorite containing 2 per cent active chlorine, and then for one minute in a ¼ per cent sulphuric acid bath. It was found that a bleached pecan to be acceptable to the pecan trade had to be dyed. Basic brown, 1/100 per cent; chrysoidine, 1/250 per cent; and phosphine 1/16 per cent produced a light natural tint which seemed to satisfy the trade.

Ware, L. M.—**Influence of Fertilizer Treatment on Certain Characteristics of the Irish Potato.** *Proc. Amer. Soc. Hort. Sci. 30:485-490. 1933.* Results of laboratory, field, and storage studies are reported. In the laboratory studies it was found that as the rate of application of a complete fertilizer was increased the percentage of reducing sugars, total sugars, total solids and starch in the tubers decreased and the electrical resistance of the juices was reduced. Correspondingly, field and storage studies showed a definite increase in yield and plant vigor and a progressive decrease in the shrinkage of tubers in storage with each added amount of fertilizer. Differences in tubers which could be attributed to a given element or to a given source of material were small and inconsistent.

AGRICULTURAL ECONOMICS

Problems of Economic Readjustment in the Black Belt of Alabama. (C. M. Clark and J. D. Pope).—A study of the extent and nature, the relative profitableness, and the possibilities and limitations of various economic adjustments underway in the Black Belt area showed: that cotton production continues to overshadow other enterprises in importance, especially in those areas where acre-yields were relatively high; that dairy farming was more prominent in those sections nearest large whole milk markets; that cotton farming was conducted by colored renters while dairy, beef cattle, and hay farms were largely operated by white owners.

The results of the study showed that returns from cotton farming were very low, averaging a loss of $11 for the operator's labor; while dairy farming was decidedly more profitable than any other type of farming, averaging $644 for the operator's labor. On the average, beef cattle farming was the least profitable of all types of farming; but in those cases where cattle farmers had a low investment per acre, a small proportion of total investment in buildings, produced a large proportion of feed required, and produced a high value of beef per acre, the returns compared favorably with other types of farming. In

cotton farming the returns for the operator's labor tended to increase as the number of acres in cotton and yield per acre became greater. In dairy farming larger labor incomes were obtained by the farmers having the larger dairy herds and getting the greater number of gallons of milk per cow.

The results of the study showed that adjustments to utilize more profitably the agricultural resources of the area depended to a considerable extent on the possible productive efficiency in the different types of farming. Increased efficiency in cotton production is limited by the low productivity of Black Belt soils, by their lack of response to normal applications of commercial fertilizer, by the presence of the boll weevil, and by the small acreage handled per operator. Possibilities of shifting rapidly from cotton production to dairy and beef cattle production are limited by lack of skilled management, by large capital outlay required, by unsatisfactory markets, by unsatisfactory tenure agreements, and by low productive efficiency.

AGRICULTURAL ENGINEERING

Studies of Plow Action. (M. L. Nichols and I. F. Reed).—Field and laboratory studies of the reactions of various soils to moldboard plows were made to develop practical tillage methods and equipment for the Black Belt or prairie region of Alabama. The studies showed that the pulverization of soil was accomplished by two sets of shear planes at right angles to each other. The first set of planes is formed by the advancing wedge of the plow. The planes extend forward from the moldboard at an angle of approximately 45° to the line of travel and upward at an angle of 45° to the horizontal. The second set of planes is at right angles to those above mentioned and is produced by the concave surface of the moldboard as the soil is pushed up during inversion. These findings together with the evaluation of the shear values of various soils and the method of measuring moldboard shapes furnish a basis for selection and design of American or "digger" type moldboards.

Relationship of Shape of Moldboard to Shedding. (R. D. Doner and M. L. Nichols).—It was shown in a previous report that the common American moldboard exerted a uniform pressure on the soil in a direction parallel to the shear planes. Mathematical studies of the forces acting along the path of travel of a soil particle passing over the surface of the plow showed that the normal pressure reached a maximum at the point of greatest curvature. Field observations showed that sticking occurred at this point. The studies also showed that the pressure could be reduced on the same type of surface by moving the area of greatest pressure nearer the tip of the wing of the moldboard and that satisfactory turning could still be

maintained by increasing the vertical angle of the share. This shape of moldboard was tried and found to be much superior for scouring in the sticky soils of the State; consequently, the period during which these soils can be plowed was extended, the draft reduced, and the general effectiveness of plowing increased.

Erosion Control Studies. (E. G. Diseker).—Rye and vetch were compared as winter cover crops for erosion control. Both crops were planted late in the fall. A perfect stand of vetch and approximately an 85 per cent stand of rye were obtained. The vetch was found to be much more effective as a soil-saving crop than the rye, even after allowance was made for variations in stand.

Strip-cropping experiments in the controlled plots and in the field again showed the value of this practice from a soil-saving viewpoint. In a field of cotton half of which was in 20-foot strips of soybeans, it was found that there was no appreciable increase in time required to tend the cotton or in time required to make the hay.

Effects of Soil Crusts on Cotton Stands. (A. Carnes).—Soil crusts, which frequently form on many of the soils of the State and seriously affect the stands of cotton, were studied under controlled or measured conditions in the laboratory and field. These studies showed that soil crusts were produced by the infiltration of soil particles under the action of water and subsequent cementation on drying. It was found that the cotton plants could exert sufficient force, when planted under proper conditions, to break all crusts studied. Under conditions where crusts were commonly formed, the soil beneath the seed was not sufficiently compacted to provide a footing for the young plants to break the crust. Laboratory and field experiments in which the soil was compacted under the seed indicated that soil crusts were not a serious handicap in getting a stand of cotton.

AGRONOMY AND SOILS

The Old Rotation Experiment. (R. Y. Bailey).—This experiment, which was started in 1896, included plots that have been cropped continuously to cotton with and without legumes, a two-year rotation of cotton and corn with legumes, and a three-year rotation of cotton, corn, and oats with legumes. Until 1932 Plots 1 and 2 were cropped continuously to corn with legumes being grown and turned under on Plot 1. The crop on these two plots was changed to cotton in 1932 and the legumes discontinued on Plot 1 in order to study the residual value of the legumes turned under over the 35-year period. All plots in the experiment have been fertilized uniformly with phosphate and potash.

Average yields for the fourteen-year period, 1920-1933, inclusive, show that the plot planted continuously to cotton with legumes produced more than twice as much as the plot planted continuously to cotton without legumes. Where legumes were used in the cropping system the average yields of cotton for the two-year rotation of cotton and corn and the three-year rotation of cotton, corn, and oats, respectively, were 1,060 and 943 pounds of seed cotton per acre. The corn yields for the respective rotations were 21.6 and 22.2 bushels of corn per acre.

A comparison of the yields from Plots 1 and 2 over the two-year period, 1932-1933, show that Plot 1 has produced an average of 1,007 pounds of seed cotton per acre more than Plot 2 which has never been planted to legumes. This difference in yield is due to the residual effect of winter legumes.

Sources and Rates of Nitrogen for Oats. (R. Y. Bailey).—Five different sources and five different rates of application of nitrogen were compared for oats on Norfolk sandy loam soil over the period 1927-1934. The different sources (nitrate of soda, ammonium sulfate, calcium nitrate, urea, and Leunasalpeter) were compared at a rate equivalent to 200 pounds of nitrate of soda per acre. Each source of nitrogen produced approximately the same yield, the average for the different sources being 32.6 bushels of oats per acre, an increase of 22.9 bushels over the plots which received no nitrogen.

Nitrate of soda was used at different rates that varied by increments of 100 pounds per acre through 500 pounds. Each increment of 100 pounds through the 300-pound rate increased the yield of oats by approximately 10 bushels per acre. The 400- and 500-pound rate produced only slightly more than the 300-pound rate.

Rate of Fertilizing Cotton With and Without Poisoning. (R. Y. Bailey and J. M. Robinson). —Four different rates of a 4.8-9.6-4.8 fertilizer made from nitrate of soda, superphosphate, and muriate of potash were compared for cotton on Norfolk sandy loam at Auburn over the ten-year period, 1924-1933. Treatments were duplicated on two sections. Cotton on one section was dusted for the control of boll weevil when the average infestation had reached 10 per cent; the cotton on the corresponding section was not dusted.

The rates of fertilizer application were varied by increments of 500 pounds per acre through 2,000 pounds. Every third plot was left unfertilized as a check plot. Boll weevil infestation was heavy enough during six years of the ten to necessitate dusting. This dusting for boll weevil has accounted for an average increase of 40 pounds of seed cotton per acre on the check plots and 203 pounds on the fertilized plots. The increases in yield for the different fertilizer applications on the dusted

section were 587, 454, 186, and 83 pounds of seed cotton per acre for the first, second, third, and fourth increment of 500 pounds, respectively.

The Effect of CO_2 Content of the Soil Suspension on the pH Value. (J. A. Naftel).—It was found that the pH value of soils which have been limed is greatly influenced by the CO_2 content of the soil. In order to avoid large errors in determining the reaction of such soils, it became necessary to equilibrate the suspensions with the CO_2 of the atmosphere constant before determining the pH value. As would be expected the differences in the values before and after equilibration are much greater for soils above pH 7.0 than for those below. It is suggested that a consideration of this might help to explain the "liming factor" encountered in certain lime requirement methods.

Studies on the Mechanism of Phosphate Retention by Soils. (G. D. Scarseth).—A natural alumino-silicate colloidal clay (Bentonite) was freed from all mobile ions by electrodialysis and made into sixteen series of 3 per cent suspensions with 8 individual treatments in each series. The concentrations of phosphate, sodium, calcium, and hydroxyl ions were varied systematically. At equilibrium, tests were made for the amount of phosphate ions retained by the colloids, the pH values, and conductivity of the different systems both before carbonation and after carbonation when at equilibrium with the CO_2 of the air.

The alumino-silicate colloid was found to sorb the phosphate ions. Maximum retention occurred at about pH 5.2 to 6.1 when Ca ions were the exchangeable cations present and at about pH 6.1 when Na ions were present. The anion sorption capacity in the presence of the Na ions was found to be approximately $\frac{1}{3}$ of the cation sorption capacity. The Ca ions greatly increased the phosphate sorption capacity of the colloidal complex in the acid range. At the point where the cation valences were saturated with Ca ions (pH 8.2) the concentration of phosphate ions in solution decreased as the concentration of the unsorbed Ca ions increased, showing the formation of insoluble calcium phosphates. All the phosphate was insoluble when the system contained free $CaCO_3$. No insoluble phosphates were formed at the high pH values when Na ions were the cations used.

The phosphate retained at the pH values of 5.5 to 6.1 is believed to be retained on the colloidal surfaces of the alumino-silicate by the aluminum valence. The phosphate ion was found to be exchangeable and was replaced by OH and SiO_4 anions.

The retention of the phosphate ion by the colloid was greatly increased when the alumino-silicate was enriched with iron. With Ca on the clay complex and after the systems had been carbonated, the minimum retention occurred between pH 4.0 and

5.5. The formation of $Fe_2(CO_3)_3$ from the carbonation treatment lowered the concentration of iron ions, thus permitting a great amount of phosphate ions to remain in solution. The maximum retention occurred at pH 3.0 where insoluble iron phosphates were formed and at pH values above 8.0 where insoluble calcium phosphates were formed in the presence of $CaCO_3$. This would indicate that injury from "over liming" may be caused by a deficiency in available phosphates to the plant.

The data show that plant injury from light applications of lime is also a question of the availability of the phosphate and is likely to occur only in soils relatively low in sesquioxides. Changing the pH from 4.0 to between 5.5 and 6.2 caused all the phosphate to be retained by the sesquioxide content colloid when the amount of phosphate added to the system was relatively small, but when the amount of phosphate added was large the retention was not nearly complete.

The Replacement of Unavailable Native Phosphates in Soils by Silicate Ions. (G. D. Scarseth).—The phenomenon of the replacement of the phosphate ion in alumino-silicate colloid systems by the silicate ion as found in the laboratory studies was

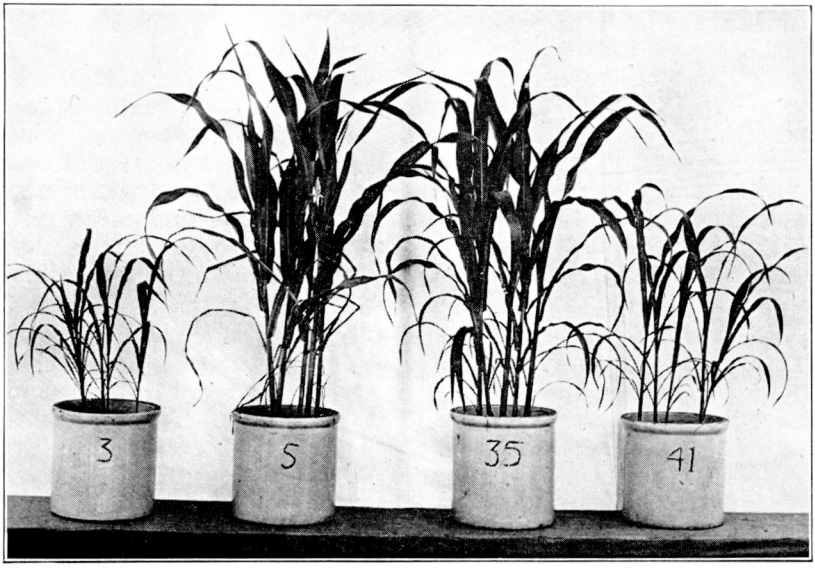

FIGURE 1.—Sorghum on a Eutaw clay showing that sodium silicate made the phosphorus in the soil more available to the plant. Each pot received liberal applications of nitrogen and potassium fertilizers. The treatment used, the yields obtained, and the available phosphorus in the soil at the time of photographing are shown in Table 1.

verified by pot tests in the greenhouse using four soils planted to sorghum. The most outstanding phosphate replacement resulted on a very acid, heavy clay soil with a SiO_2/R_2O_3 ratio of 2.7 where sodium silicate produced a growth without a phosphate fertilizer almost equal to that on the phosphate-fertilized soil as shown in Figure 1 and Table 1.

TABLE 1.—Yield of Sorghum and Available Phosphorus as Influenced by Phosphate and Sodium Silicate.

Pot	Treatment	Yield dry weight (gms.)	Available phosphorus (Truog) (lbs.)
3	No phosphorus	11.6	Trace
5	Phosphorus (NaH_2PO_4) Eq. 1 ton superphosphate per A.	63.9	24.3
35	No phosphorus 2 tons sodium silicate	42.7	5.7
41	No phosphorus. $NaHCO_3$ Na eq. to Na in Pot No. 35	16.2	Trace

Reduction of Nitrate to Nitrite by the Green Plants. (A. L. Sommer). This work was started in an effort to determine the role of phosphorus in the catalytic reduction of nitrate to nitrite by the expressed juice from green plants as described in the literature. The expressed juice of the tops and roots of tomato plants were used in most cases. Wheat, cotton, and buckwheat were also used. Where sufficient precautions were taken to prevent the growth of microorganisms, very little and often no reduction was obtained. Where there was reduction, evidence indicated stoichimetrical rather than enzymic or other catalytic action.

No evidence of reduction of nitrate to nitrite for solutions with or without the presence of algae in the dark could be obtained by the Allison apparatus. On exposure to light the presence of nitrite was detected. The amount of nitrite increased rapidly with an increase in the time of exposure and the intensity of the light. At very low light intensities greater amounts of nitrite were found in solutions plus algae than in solutions from which the algae had been filtered before exposure to light. Where phosphate was not added to the solution and the light intensity was not sufficiently low, more nitrite was sometimes found in the filtered than in the unfiltered solutions. The addition of phosphate to the solution greatly increased the rate of formation of the nitrite in the presence of the algae but produced no change when the algae were absent.

An Experiment on Some of the Factors Affecting Lint Development in Cotton. (D. G. Sturkie).—In 1933, a study was begun to determine the effect that fertilizers and organic matter might have on the development of seed and lint in cotton. The fertilizer and moisture treatments used are shown in Table 2.

The results obtained in 1933 may be briefly summarized as follows:

(1) When the soil was kept moist, the fertilizer used had no effect on the length of the lint but a nitrogenous fertilizer appreciably increased the weight per boll and decreased the ginning percentage.

(2) When the soil was permitted to become dry the cotton that was highly fertilized with a nitrogenous fertilizer produced cotton with a smaller boll, shorter lint, and a higher ginning percentage than cotton that was not fertilized or that received only phosphate and potash.

The results may be explained by the fact that cotton receiving nitrogen made a much larger vegetative growth than the cotton that had not received nitrogen. The large plants used the available soil moisture much faster than the small ones and thus caused a stress for water to be set up earlier in the large plants than in the small ones. Thus, a heavy application of a fertilizer containing nitrogen may result in producing cotton in a dry year that has a shorter lint and smaller boll than unfertilized cotton. In a wet year there would be a marked increase in the size of the boll from the fertilizer application but little or no effect on the length of the lint.

These results, which are for one year only, show that soil moisture is of more importance than the fertilizer used in affecting the length of lint or the percentage of lint.

TABLE 2.—The Moisture and Fertilizer Treatments.

Plot	Fertilizer treatment Pounds per acre	Moisture conditions of soil after July 13
1	Manure, 25,000; superphosphate, 500	Dry*
2	Superphosphate, 1,000; nitrate of soda, 750; muriate, 250	Dry*
3	Superphosphate, 1,000; muriate, 250	Dry*
4	Same as Plot 1	Moist
5	Same as Plot 2	Moist
6	Same as Plot 3	Moist
7	Nitrate of soda, 750; muriate, 250	Dry*
8	Superphosphate, 1,000; nitrate of soda, 750	Dry*
9	None	Dry*
10	Same as Plot 7	Moist**
11	Same as Plot 8	Moist**
12	Same as Plot 9	Moist**

*Rain was kept off of these plots after July 13 by means of canvas covers.
**These plots were watered in addition to the rain as often as necessary to keep the soil moist throughout the growing season.

A Study of the Time of Planting of Carpet, Dallis, and Bermuda Grasses. (D. G. Sturkie).—This study was begun in October 1931. One planting of each of the grasses was made about the 15th of each month. The best results have been obtained by planting in January or February. The results indicate that if moisture is sufficient any of these grasses may be planted in any month of the year except August and September. Plantings in the spring and summer months are sometimes failures because of dry weather killing the young plants. Early fall plantings in some years result in the plants being killed by early hard freezes.

The seed of Bermuda grass from which hulls (glumes) have been removed germinate much quicker than those with the hulls on and appear to be preferable for planting.

A Study of the Uniformity of Soil Types. (Franklin L. Davis).—In a laboratory and greenhouse study of the uniformity of soil types and of the fundamental differences between the different soil series of Alabama, experimental work during the last year has been done on the following soils: 9 Cecil sandy loams, 2 Cecil loamy sands, 3 Cecil sandy clay loams, 3 Cecil clay loams, 4 Cecil clays, and 1 Davidson clay. Laboratory studies have included the following determinations and analyses: Complete mechanical analysis of the surface soil and subsoil, colloidal clay content of the surface soil and subsoil, separation and chemical analysis of the colloidal fraction of the surface soil and subsoil, total base exchange capacity and exchangeable calcium and magnesium of the surface soil and subsoil, organic matter content of the surface soil, total P_2O_5 of the surface soil and subsoil, the hydrogen-ion concentration, the lime required to bring the reaction to pH 6.50 and the readily available PO_4 by Truog's method and by a modification of this method of all surface soils and those subsoils on which greenhouse studies were made. Greenhouse studies have included seven fertilizer treatments in duplicate pot cultures of all surface soils and of three of the subsoils. Three successive crops, one of Austrian winter peas and two of sorghum, have been grown in the pot cultures of all soils in the greenhouse. The greenhouse work was so designed that, by comparison of the yield in response to each of the different fertilizer treatments to the yield in response to the complete fertilizer (N P K) treatment on each of the soils, the crop response to the following fertilizer treatments could be determined: (1) potash, (2) phosphate, (3) lime, (4) residual phosphate without lime, (5) residual phosphate with lime and (6) phosphate and potash.

The variation of the yields in response to the complete fertilizer (N P K) treatment shows the soils of the different soil types to be quite variable within the type in regard to soil productiveness. The comparative yields of each of the soils for

the various fertilizer treatments showed that the variation of the soils within the soil type in response to the different fertilizing elements was greater than the variation between the soil types. Continued cropping showed that there was a general difference between the different soil types in their reserve supply of phosphorus and potassium, and that there was a general difference between the different soil types in crop response to the residual effect of applications of phosphate. The need for liming varied from soil to soil regardless of soil type. This lack of uniformity of the soil type in response to the various fertilizing elements and liming is attributable to the difference in the cultural, fertilizer, and cropping practices which the soils had previously received.

As determined in the laboratory, the physical and chemical properties of the soils of a given type were generally quite variable. In fact, the variation in properties of the different soil types of the Cecil series is so great that only those properties that are definitely associated with or determined by soil texture varied significantly from one soil type to another.

ANIMAL HUSBANDRY

The Effect of Vitamin B[1] Insufficiency Upon the Nervous Tissues of Young Dogs. (C. O. Prickett).—A litter of six young dogs were rid of parasites, fed an adequate diet, and observed until they were three months old. At that time, four animals were placed on a diet[2] containing an insufficient supply of vitamin B but adequate in all other respects. The remaining two dogs were continued on an adequate diet.

Marked variation was observed in the food intake and the time necessary for animals on the deficient diet to develop spastic symptoms. One animal showed a mild degree of spasticity early in the experiment, cured up spontaneously, and was finally discarded after 154 days on experiment, at which time there had been no recurrence of the spastic symptoms. The three remaining dogs developed a severe spasticity and were allowed to continue on experiment until moribund. In the later stages the animals appeared blind, but differentiation between blindness and vertigo was difficult. The history of the two control animals was normal at all times.

At necropsy the three deficient animals showed a variable degree of enteritis, which affected particularly the ileum, and a generalized congestion of the meninges, brain, and spinal cord. In two animals subcapsular hemorrhages were seen in the liver, and particularly marked congestion was observed in the midbrain, pons, and medulla. In one animal the occipital poles of

[1]Vitamin B refers to the heat labile fraction as designated by the Committee on Nomenclature of the American Society of Biological Chemists (1929).

[2]This diet contained 23 per cent fat and 8 per cent autoclaved yeast.

the cerebral hemorrhages were darkened, granular, and appeared caseous.

In one control animal old adhesions were seen about the appendix, but otherwise no deviation from the normal was seen.

Sudan III preparations of peripheral nerves of both control and deficient animals showed no evidence of degenerative changes; Marchi preparations of the nerves from both groups evidenced a heterogeneous precipitation of blackened material which made it impossible to satisfactorily demonstrate whether degenerative changes were present or not.

Nissl preparations of the brains and spinal cords of animals in the deficient group have not as yet been studied in detail, but numerous areas were seen in the cerebrum in which marked destruction of the cortico cyto-architecture was caused apparently by an ischemic type of change. These changes were usually bilaterally symmetrical, were more numerous in the temporal and occipital regions, and appeared in all three dogs. In one animal a massive area of hemorrhage and decortication was found in the occipital poles of both hemispheres, but was more marked on the right side.

In the mid-brain, pons, and medulla the type of lesion differed from that observed in the cerebrum. Areas of glial and vascular poliferation were seen which involved the corpora quadrigemina in all three deficient animals. In two animals the same type of change was seen to involve the area of the vestibular and cochlear nuclei, the vermis of the cerebellum, and the substantia gelatinosa. In the vermis of the cerebellum there was also a partial destruction of the granular layers and Purkinje cells which gave a moth-eaten appearance to the structure.

No deviation from the normal was seen in the brains and spinal cords of control animals.

More detailed microscopic study, and substantiation with other animals will doubtless lead to a better interpretation of the changes thus far observed.

Studies of the Vitamin B Complex. I. The Effect of Fats and of Individual Esters Upon the Vitamin B Requirement of Rats. (W. D. Salmon and J. G. Goodman).—In order to determine why different fats vary in their efficacy in decreasing the requirements for vitamin B a series of single fatty acid esters was prepared and fed to rats this year. When the diet contained glyceryl or ethyl esters equivalent to 23 per cent of fatty acid, the acids ranked in the order of decreasing effectiveness as follows: caprylic, caproic, heptylic, lauric, myristic, nonylic, undecylic, and oleic. Valeric, propionic and acetic had very low efficiencies; palmitic and stearic had no demonstrable sparing effect, probably due in part to their high melting points

and poor absorption. Butyric glyceride was toxic to rats even when the diet contained adequate vitamin B.

It was found possible to cure spastic cases of vitamin B-deficiency by the administration of esters of caprylic, caproic, heptylic or lauric acids without the administration of vitamin B.

In these studies it was found that baker's yeast autoclaved 8 hours at 17 to 20 pounds pressure still contained traces of vitamin B. Hence, when this material is used as a source of vitamin G in vitamin B determinations it is necessary to control the amount fed to each rat. The inclusion of the autoclaved yeast as a certain percentage of basal diets which are fed *ad libitum* is poor technique.

The onset of vitamin B-deficiency disease is not hastened by the substitution of 23 per cent of lactic acid as the glyceride for sucrose in the diet.

Preliminary studies with the Allison apparatus have shown reduced amounts of the short-chain fatty acids in the brains and livers of vitamin B-deficient rats. However, these tissues contain the short-chain fatty acids in sufficient amounts to indicate that the symptoms of vitamin B-deficiency can not be explained by a lack of these substances as structural constituents of the nervous tissues.

II The Quantity of Glycogen in the Vitamin B-Deficient Rat and Its Ability to Deplete this Glycogen During Starvation. (G. A. Schrader). It has been reported that the vitamin B-deficient animal may have extraordinarily large deposits of glycogen in its body when symptoms of beriberi appear and that this glycogen may be depleted with difficulty during subsequent starvation, voluntary or forced. This is the reason for reporting the composite data (Table 3) obtained during the course of the past four years' work. In all cases of starvation the animals were without access to food for approximately 24 hours, although it has been estimated that only during about the last 15 hours was the alimentary tract, stomach, and small intestines free from food.

The data in Table 3 show no large accumulation of glycogen in the vitamin B-deficient rats (Diets 3 G and 552) as compared with the rats receiving adequate vitamin B (Diet 552 plus vitamin B and stock diet). In fact the rats from the stock colony show the largest glycogen storage with those on vitamin B-deficient diet plus vitamin B next, and those on the vitamin B-deficient diet the least.

Likewise all the rats, independent of diet or supplement, are able to deplete their glycogen stores to about the same degree per unit weight, except those on Diet 3 G which are considerably lower. No reason is known for the low values found for starved rats on this diet. It should be pointed out, however, that even though the starved controls on Diet 552 gave an aver-

age glycogen value close to that obtained for the normal rats and those on Diet 552 plus vitamin B, yet there was a considerable variation in individual cases. This variability in case of depletion of stored glycogen during starvation may be accentuated in other species of animals and thus explain the difference in results obtained elsewhere.

III The Ability of the Vitamin B-Deficient Rat to Utilize d-Lactic Acid. (G. A. Schrader).—It was shown previously that the vitamin B-deficient rat can both burn glucose and convert it into body and liver glycogen. However, the work last year indicated a poorer utilization of d-lactic acid for both of these purposes and further work was undertaken on this substance.

As with glucose, the rats actually showing the muscular incoordination characteristic of extreme vitamin B-deficiency (beriberi), Group I, have been compared with rats on the same diet, but not showing symptoms, Group II, and also with rats on the same diet with adequate vitamin B, Group III. The food intake of the three groups was kept uniform. Inasmuch as very little difference was found between Groups I and II they have been averaged together. Starvation controls within each group were necessarily made so as to afford a definite basis of comparison.

Although the individual data, glycogen formation and heat production from d-lactic acid, were somewhat variable and a much poorer utilization of lactic acid occurred than for d-glucose there did not seem to be any significant indication of a breakdown in the lactic acid metabolism of the vitamin B-deficient rat. One reason for this conclusion is a rather poor utilization of d-lactic acid by the animals receiving vitamin B. Another reason is based on the results obtained by feeding r-lactic acid to rats on the same vitamin B-deficient diet as used above. These rats ate from 0.3 to 0.5 g. of lactic acid daily but did not develop beriberi any sooner than rats on this diet alone; in fact a slightly longer time was required for beriberi to develop in the rats receiving lactic acid. If lactic acid metabolism fails in vitamin B-deficiency, allowing this acid or its intermediary products to accumulate in the animal, beriberi should develop within a shorter experimental period. Inasmuch as this did not occur it is difficult to see how failure in lactic acid metabolism can be present in rats on a vitamin B-deficient diet and can be the specific cause of the symptoms of acute vitamin B-deficiency.

IV The Apparent Ability of the Vitamin B-Deficient Rat to Transform Carbohydrate into Fat. (G. A. Schrader).—Respiration experiments have been carried out on carefully controlled groups of rats with the purpose of determining the ability of the rat on a vitamin B-deficient diet to convert carbohydrate into fat.

Two diets uere used; in one the sole source of energy, other

than from protein, was from cocoanut fat; in the other the sole source of energy, other than protein and the fat contained in the added oils (0.20 Ml. linseed and 0.10 Ml. cod liver oil per rat daily), was from sucrose. The rats were arranged in 5 groups as follows: Group I-High carbohydrate, Group II-High carbohydrate plus vitamin B, Group III-High fat, Group IV-High fat plus vitamin B, and Group V-High carbohydrate plus vitamin B (diet available *ad libitum*). The energy intake of Groups II, III, and IV was governed by and was kept equal to that of Group I. Respiratory quotients were determined on these 5 groups of rats at weekly intervals for 5 weeks. Food was always given to the rats about 2½ hours before making the determinations.

In every case respiratory quotients of over 1.00 (average 1.26) were found for all rats on the high carbohydrate diet, irrespective of whether they received no vitamin B or vitamin B with either a limited or an unlimited energy intake. On the other hand at no time was a respiratory quotient of 1.00 secured from the rats on the high fat diet; in fact after the first week the R. Q.s from these rats approximated 0.80, indicating that the energy was mainly secured from fat.

It is logical to conclude from these data that the rats on the high carbohydrate diet can convert carbohydrate into fat. However, there is a bare possibility that incomplete oxidation of carbohydrate can account for the R. Q.s over 1.00. This possibility appears remote because of the similar R. Q.s obtained from the rats on the high carbohydrate diet but which received adequate vitamin B (Groups II and V).

TABLE 3.—The Quantity of Glycogen in the Vitamin B-Deficient Rat and Its Ability to Deplete this Glycogen During Starvation.

Diet	Number rats	Treatment	Glycogen per 50 g. rat (mgs.)	Difference (mgs.)
3 G*	13	Starved	78.6	——
	17	Not starved	223.9	145.3
552**	47	Starved	112.4	——
	21	Not starved	195.1	82.7
552 plus vitamin B	9	Starved	110.4	——
	13	Not starved	225.1	114.7
Stock	26	Starved	113.5	——
	3	Not starved	324.8	211.3

*Diet 3 G contained 77 per cent of sucrose.
**Diet 552 contained 43.4 per cent of sucrose and 23 per cent of fat.

The Supplemental Value of Peanuts to the Laying Ration. (D. F. King and G. J. Cottier).—The object of this project was to study the supplementary value of whole peanuts, ground peanuts (with and without shells), and peanut meal in farm flock rations for laying hens. Four hundred S. C. White Leghorn pullets, divided into 10 lots, were used.

Small egg size, poor body weight, and low egg production were obtained when peanuts were fed as the sole protein supplement. Peanut meal gave higher egg production than any other peanut products when fed as the only protein supplement. The efficiency of the peanut products was materially improved where skim milk was substituted in proportion to supply 50 per cent of the protein supplement. The highest rate of egg production, best body weight, and greatest egg size were obtained where skim milk was used as the sole protein supplement. Rations that were high in fat gave low egg production. A positive correlation existed between rate of egg production, egg size, and body weight of birds. Hens fed peanuts deposited a very soft fat in their bodies in comparison with hens fed skim milk. Eggs produced by peanut-fed hens also contained a very soft fat when compared to eggs produced on a normal ration.

BOTANY AND PLANT PHYSIOLOGY

Diseases of Winter Peas and Vetches. (J. L. Seal).—During the past season the most prevalent disease on winter peas and vetches was that caused by Mycosphaerella sp.; however, some damage was caused by Ascochyta sp. In the summer and fall of 1933, the pycnidio-spores formed on old pea plants of the spring crop were frequently checked as to their germination. These spores retained a high percentage of viability until late November when this work was discontinued. At this time, infection of young pea plants was readily obtained from the spores living upon the old plants by placing the old plants over the young plants growing in the fields. Little spread and very little damage could be attributed to these organisms until the freezes of February and March, after which the organisms could be found abundant on practically every plant in the planting.

From tests made on the seed of various seed lots from different sources, no seed lot was found that was entirely free of these organisms. The western seed generally show less infection than local seed; however, local seed which have been held in storage for 15 months carry no more organisms than the western seed. In general, the vetches seem to be more resistant to these organisms than the peas. Hungarian and some strains of Oregon vetch seem to be highly resistant and very promising as cover crops.

Studies of Wild Onion Control with Creosote-Kerosene Spray. (E. V. Smith).—In the fall of 1932 and again in the fall of 1933, wild onions were dug at weekly intervals throughout their growing season to determine the rate of germination and the time and rate of secondary bulb and aerial bulblet formation. Germination began in the early fall and progressed so rapidly that less than one per cent of the bulbs from an average digging

was dormant in January. The formation of new bulbs within the old bulbs was first noted in late December, 1932, and aerial bulblets were matured in May and June.

Plots on an onion-infested Bermuda grass lawn were sprayed with a 10-90 mixture of creosote-kerosene at rates varying from 218 to 653 gallons per acre. Applications were made in late December 1932 and January 1933, a period when fewest bulbs were dormant. Fall examinations showed that the onions were markedly reduced on these plots as compared with the untreated plots.

Studies of Nut Grass. (G. L. Fick, E. V. Smith, and R. Y. Bailey).—Results are available on two series of plots, 5 x 5 ft. square, on land heavily infested with nut grass. Some plots have been clipped with a hoe at intervals of 1, 2, 4, and 7 days, and others have remained unclipped. The plots of one series were clipped through two growing seasons (1932 and 1933), those of the other through one growing season (1933). As clipping progressed the number and vigor of sprouts appearing between clipping gradually decreased on all treated plots. On May 25, 1934, the sprouts on all clipped plots of both series were counted. Clipping had markedly reduced the stand of sprouts, all treatments reducing the average number of sprouts to less than 10 per plot, as compared with an average of 3,026 and 3,920 sprouts, respectively, for the control plots of the 2-year and 1-year series. Other sprout counts will be made during the 1934 season. Present indications are that clipping regularly at short intervals for one or two years greatly reduces the stand and vigor of nut grass but does not eradicate it.

An experiment to determine the longevity of nut grass tubers was begun on May 18, 1933. At monthly intervals since that date two marked tubers, each growing in Norfolk sandy loam in a 2-gallon pot in the greenhouse, have been removed and used in sprouting tests. After twelve months some of the tubers were still alive and were capable of giving rise to a new system.

During the growing season of 1933 an area heavily infested with nut grass was plowed as often as sprouts appeared. Twelve plowings were made; the interval between plowings varied from 7 to 22 days. Sprout counts were made early in the 1934 growing season on 10 areas, of 1/1012 acre each, in the plowed section and on 10 areas in the adjacent unplowed section. The average number of sprouts per 1/1012 acre in the plowed section was 2 as compared to 71 in the unplowed section. The results of this preliminary experiment suggested the value of a more elaborate and accurately controlled experiment, including plowing and discing treatments at various regular intervals; such an experiment was begun on June 9, 1934.

Sixty-eight concrete bins, each inclosing an area of 1/640 acre, were built during the summer of 1933. The bins were

filled with carefully selected subsoil and an 8-inch surface layer of Norfolk sandy loam. At several intervals after filling, the apparent specific gravity of the subsoil in the bins was determined and used as a measure of compaction. Since it had been observed that nut grass tubers usually do not occur in the undisturbed subsoil underlying Norfolk sandy loam in the field, the subsoil in the bins was allowed to reach a compactness closely approaching that found in the field. The plots were then plowed, fertilized, and planted to nut grass. By July 1, 1934, there was a vigorous young growth of nut grass on all plots. As soon as the nut grass becomes firmly established chemical control tests will be initiated.

ENTOMOLOGY

The Control of Citrus Insects with Oil Emulsions. (L. L. English.)—Oil emulsions have shown a marked residual effect in controlling the red spider on satsumas in experiments extending over a period of 3 years. Oil sprays applied in July and September were highly effective in preventing an infestation of spider during the winter months. In laboratory experiments the tank-mix oil spray was more effective than several proprietary emulsions against purple scale and white fly. Five polyhydroxol alcohols, when applied as sprays, were ineffective against white fly larvae.

Orchard Heaters. (L. L. English).—Following a successful demonstration of orchard heating in one of the commercial satsuma orange groves in Mobile County, an investigation was made of orchard heaters and heater fuels for this section. A distinction between the Alabama and California freeze problems was recognized and the work here was developed on the basis of radiated heat, rather than convected air currents which are effective in California.

A simple quantitative method for measuring the relative radiation from heaters was developed and a number of heaters and fuels were tested by this method. Of the fuels examined petroleum coke is the most promising. At present fuel prices, the cost of operation of an oil heater is about three times that of a petroleum coke heater which gives off the same amount of radiant heat. By-product or coal coke was a cheap and practical fuel but the radiation developed with this fuel was much lower than that from petroleum coke. Certain improvements were made in heaters for burning petroleum coke.

Physiology of Insects with Reference to Their Control. (H. S. Swingle).—The speed of decomposition of the arsenical insecticides was found to be dependent upon both the hydrogen ion

concentration of the solution and upon the anions present. It was found that phosphates were present in the digestive juices of leaf-feeding insects, being especially abundant in those having an alkaline reaction. The speed of decomposition of the more important arsenical insecticides was therefore determined in phosphate buffer solutions. The phosphate ion has little effect upon the speed of decomposition at acidities from pH 2.0 to pH 5.0; while at pH 6.0 to pH 10.0 this ion increases both the speed and extent of decomposition of the common arsenical insecticides.

The Vegetable Weevil (Listroderes obliquus). (J. M. Robinson).—Four female weevils laid 3,182 eggs from January 10 to May 26, 1934. The maximum number laid by one adult was 1,989 eggs and the minimum number was 13 eggs; the average number laid was 795.5 eggs per female.

An average of approximately 18 days was required for the hatching of the eggs, 18 days for growth of the larvae, and 11 days for the pupal period.

Pecan Weevil (Curculio caryae). (H. S. Swingle).—From insectary records it was found that approximately 50 per cent of the pecan weevil larvae die during their first year in the soil; 18 per cent emerge as adults after two years; 27 per cent die during the next year; and 5 per cent emerge as adults after three years. Part of the pecan weevils require two years and part three years to complete their life cycle.

Applications of disease organisms to the soil were not effective for the control of the pecan weevil larvae.

Jarring again proved to be an effective control for the pecan weevil adults, as was shown by records of the reduction in the number of weevils present on the trees, by records of the injury to immature nuts, and by records of the number of wormy nuts at harvest.

At harvest it was found that an average of 87 per cent of the nuts were free of worms on trees which had been jarred, while only 67 per cent of the nuts on unjarred trees were free of worms.

Life History and Control of the Cowpea Curculio (Chalcadermis aeneus). (F. S. Arant).—Cowpeas were dusted in the field to determine the effectiveness of certain insecticides in controlling the cowpea curculio. Eight applications of the following dusts were made: sodium fluosilicate containing 25 per cent colloidal silica, calcium arsenate, Pyrethrum dust, and Florate, which is a new commercial product containing 5 per cent rotenone, 1 per cent pyrethrins, 1 per cent nicotine, 2.5 per cent residual deposit of rotenone, and 90.3 per cent inert material.

Only 5.5 per cent of the peas were punctured on the plot dusted with calcium arsenate, whereas 31 per cent were punc-

tured on the corresponding undusted plot. Nine per cent of the peas were punctured on the plot dusted with sodium fluosilicate and 29 per cent on the corresponding undusted plot. The percentage of punctured peas on the plots dusted with Pyrenthrum and Florate was only slightly lower than on the corresponding undusted plots.

Calcium arsenate produced moderate burning of foilage; the other dusts produced no burning.

HORTICULTURE AND FORESTRY

Black Locust as a Plant for Soil Erosion Control and Fence Posts. (L. M. Ware).—Quite contrary to the general belief and to the information contained in literature, the growth of the black locust has been very disappointing when transplants have been placed on eroded lands, on poor land, or under situations where plants have received little care. Slash and loblolly pines under situations where the locust has failed have made very satisfactory growth and have almost completely checked erosion. The locust, however, planted for fence posts on prepared land, given two cultivations, and supplied about one-half pound of a complete fertilizer has made an average diameter growth of 1.04 inches and a height growth of 8.12 feet within 13 months from seed. Locust planted 3 years earlier on a similar site but given no care had made a total height growth in 3 years of 2.69 feet and a total diameter growth of .39 inches. In one experiment locust plants grown in beds and transplanted to the field had made 3.38 feet height growth within 13 months from seed where the soil was prepared; two cultivations in addition to preparation increased the height 47 per cent; the further addition of nitrogen, although the plants were well nodulated, gave a still further increase in height of 23 per cent; and the further addition of potash gave a still further increase in height of 17 per cent.

Range of the Slash Pine in Alabama. (L. M. Ware).—The slash pine is well adapted to the southern fourth of Alabama and is found growing naturally in this area. Because of its rapid and early growth, its early and heavy gum production, its excellent timber characteristics, and because of its adaptability to artificial planting, it was desirable to determine the extent to which its northern limits might be extended. Plantings have been made in Central Alabama, North Central, and North Alabama on Norfolk, Cecil, and Decatur soils respectively. At each place and on each soil the slash pine is growing very satisfactorily. The oldest planting, 60 miles north of its natural range, is 8 years old from transplants. The average annual height growth has been 2.28 feet for the slash pine as compared to 1.83 feet for the loblolly pine, 1.15 feet for the shortleaf pine, and .72 feet

for the longleaf pine. In North Alabama the planting is five years old from transplants. The average height growth per year of the slash has been 2.24 feet as compared to 2.71 feet for the loblolly.

Beet Variety Test. (C. L. Isbell).—For two years a study has been made to determine the yield, uniformity, and quality of different varieties of beets. Varieties represented by Fireball, Good for All, and Ohio Canner made low yields and produced a low percentage of beets off-color. The beets of these varieties are comparatively small and rather uniform in shape and size. In preparing the roots of these varieties for table use, the skin is difficult to remove unless the beets have been well cooked. Many of the varieties producing comparatively large yields, such as Extra Early Eclipse, Improved Early Blood and some others, are not very uniform in color, shape or size. It is not necessary to cook these varieties as much for the purpose of removing the skin preparatory for table use as it is the varieties that grow more slowly and produce lower yields.

Neither yield, intensity of color, nor uniformity of color appeared to have any direct correlation with the amount of soluble solids present.

The choice of the variety or varieties of beets to grow should be largely determined by whether the grower wants a deeply colored uniform product at the expense of low yields or large yields at the expense of a less uniform product. If high yields are desired and if a variety of medium uniformity and fair quality is acceptable, the Detroit Dark Red appears to be the most promising variety.

Nematode Injury to the Roots of Table Varieties of Cowpeas. (C. L. Isbell).—While observing the root system of various table varieties of cowpeas to determine the general extent of their development, an apparent difference was detected in the extent to which the roots were damaged by nematodes. To determine if the apparent difference actually existed several table varieties and a few field varieties were grown during 1932 and 1933 in garden soil heavily infested with nematodes. Representative plants were taken up at intervals, beginning with young plants and continuing until the plants were mature. The roots were carefully examined, without the use of magnification. It is shown in Table 4 that varieties differed greatly in degree of infestation. All the varieties of crowders were damaged. Many of the plants of some of the crowder varieties died before fruiting. The group of white peas with black eyes ranged in degree of injury from a medium amount on the Virginia Black Eye to what amounted to almost no injury on the California Black Eye. The Lady or Rice pea was found to be very susceptible to nematode injury. The Counch or Gentleman pea was extremely re-

sistant, even more so than the Victor which has been reported by the United States Department of Agriculture to be one of the most highly resistant varieties.

TABLE 4.—Relative Nematode Injury to Roots of Table Varieties of Cowpeas Grown in Infested Sandy Soil at Auburn, Alabama, 1932-1933.

Variety	Summary of Results for 1932 and 1933		
	No. plants examined	Per cent infested	Degree of infestation
Black Crowder	49	51.31	Medium
Brown Crowder	82	24.08	Medium
Calif. Black Eye	159	4.01	Free to very light
Counch	304	0.33	Considered free
Cream Crowder	119	84.50	Medium to very heavy, many plants killed
Cream Crowder (large seeded)	57	56.14	Medium to heavy
Dixie Queen	152	63.41	Light to medium
Extra Early Black Eye	110	22.43	Free to light
Lady	140	90.62	Very heavy, many plants killed
Lady Crowder	30	60.00	Medium to heavy
Leopard (bch.) field peas	110	100.00	Very heavy, many plants killed
Leopard (vining purple hull) field pea	50	96.00	Very heavy, many plants killed
Purple Hull (white)	92	29.71	Free to very light
Six Weeks (field pea)	247	9.19	Free except area
Speckle Crowder	182	74.79	Very light to medium
Taylor (field pea)	110	86.83	Medium to heavy
Va. Black Eye	182	58.24	Very light to medium
Brown Eye	30	50.00	Light to medium
Victor (field pea)	157	46.07	Free to heavy
White Crowder	135	83.33	Medium to heavy
Woods Sumptuous	167	72.87	Light to heavy

SPECIAL INVESTIGATIONS

Dissimilar Nodulation Following the Planting of Unhulled and Shelled Seed of Winter Legumes. (J. F. Duggar).—On inoculated plants grown on soils lacking the appropriate nitrogen-fixing micro-organisms, bur clover and hubam plants from unhulled seed developed larger numbers of nodules than where shelled seed were planted. In most experiments inoculated crimson clover, subterranean clover, and black medic also tended to earlier and more intensive nodulation where unhulled rather than shelled seed were planted. This initial advantage in nodule numbers from planting unhulled seed is attributed to the conveyance by them of larger amounts of inoculum. The differences in nodulation tended to disappear as the plants aged.