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AUBURN

M. J. FUNCHESS, *Director*

AUBURN, ALA.

Contents

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COLLEGE OF AGRICULTURE

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G. A. Schrader, Ph.D.	Associate Animal Nutritionist
W. C. Sherman, Ph.D.	Associate Animal Nutritionist
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C. D. Gordon, M.S.	Associate Poultry Husbandman
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Botany and Plant Pathology:

J. L. Seal, Ph.D.	Head, Botany and Plant Pathology
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J. R. Jackson, Ph.D.	Assistant in Botany and Plant Pathology
H. M. Darling, M.S.	(Fairhope) Assistant Plant Pathologist (Coop. State Dept. Agr., and Ala. Extension Service)
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*On leave.
**Deceased.

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*C. M. Clark, M.S.	Associate Agricultural Economist
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R. L. Melcher, M.S.	Assistant Agricultural Economist
Edith M. Slights	Statistical Assistant

Agricultural Engineering:

A. Carnes, M.S.	Acting Head, Agricultural Engineering
J. W. Randolph, M.S.	Agricultural Engineer (Coop. U.S.D.A.)
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R. E. Yoder, Ph.D.	Assistant Agricultural Engineer
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Special Investigations:

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

Horticulture and Forestry:

L. M. Ware, M.S.	Head, Horticulture and Forestry
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E. W. McElwee, M.S.	Assistant Horticulturist
Keith Barrons, M.S.	Assistant Horticulturist
R. W. Taylor, M.S.	Assistant Horticulturist
Donald J. Weddell, M.S.	Assistant Forester
Hubert Harris, B.S.	Assistant in Horticulture

Zoology-Entomology:

J. M. Robinson, M.A.	Head, Zoology-Entomology
H. S. Swingle, M.S.	Associate Entomologist
L. L. English, Ph.D.	Associate Entomologist
F. S. Arant, M. S.	Assistant Entomologist
H. S. Peters, M.S.	Associate Biologist (Coop. U.S.D.A. and State Department of Conservation)

Substations:

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

CHANGES IN STATION STAFF DURING 1936

Appointments:

N. J. Volk, Ph.D.	Associate Soil Chemist
H. R. Albrecht, M.S.	Assistant Agronomist
J. B. Dick, B.S.	Associate Agronomist (Coop. U.S.D.A.)
C. J. Koehn, Jr., Ph.D.	Associate Animal Nutritionist
W. C. Sherman, Ph.D.	Associate Animal Nutritionist
C. D. Gordon, M.S.	Associate Poultry Husbandman
J. R. Jackson, Ph.D.	Assistant in Botany and Plant Pathology
H. M. Darling, M.S.	(Fairhope), Assistant Plant Pathologist (Coop. State Dept. Agr. and Ala. Extension Service)
B. T. Inman, M.S.	Assistant Agricultural Economist
R. L. Melcher, M.S.	Assistant Agricultural Economist
Keith Barrons, M.S.	Assistant Horticulturist
Hubert Harris, B.S.	Assistant in Horticulture

Resignations:

C. J. Rehling, M.S.	Assistant in Soils
R. Y. Bailey, B.S.	Assistant Agronomist
G. A. Trollope, B.S.	Poultry Husbandman
M. L. Nichols, M.S.	Head, Agricultural Engineering
O. C. Medlock, M.S.	Assistant Horticulturist

*On leave.

NEW PUBLICATIONS

Tidmore, J. W., and Sturkie, D. G.—**Hairy Vetch and Austrian Winter Peas for Soil Improvement.** *Alabama Agricultural Experiment Station Circular 74.* The results of field tests are reported which show that a growth of 15 to 20 pounds green weight of vetch or Austrian winter peas turned under per 100 square feet is sufficient to greatly increase the yields of succeeding crops. The essentials for success with vetch and Austrian winter peas for soil improvement are pointed out.

Naftel, James A.—**The Value of Lime in a Two-Year Rotation on Sand Mountain.** *Alabama Agricultural Experiment Station Circular 75.* This is a progress report of experiments on the value of lime where legumes were grown in a rotation of cotton and corn on Sand Mountain. Results from the use of lime are discussed for both small amounts in the drill and large amounts applied broadcast; either method of application was found to be satisfactory and to be profitable.

Department of Animal Husbandry.—**Wintering and Fattening Beef Cattle in Alabama.** *Alabama Agricultural Experiment Station Leaflet No. 15.* This leaflet is a practical discussion of rations and methods of feeding beef cattle in Alabama.

Sommer, Anna L.—**The Relationship of the Phosphate Concentration of Solution Cultures to the Type and Size of Root Systems and the Time of Maturity of Certain Plants.** *Jour. Agr. Research 52: 133-148. 1936.* Experiments with different plants grown in solution cultures of various phosphate concentrations indicated that the minimum phosphate concentration at which plants can make good growth was dependent upon the size and type of the root systems; that is, the greater the surface exposed by the root systems to the nutrient solution, the lower was the minimum concentration necessary for good growth. The root top ratio was found to be inversely proportional to the phosphate concentration of the nutrient solution. Plants grown in culture solutions of low phosphate concentrations matured earlier than those grown in solutions of higher phosphate concentrations.

Baisden, Arther M., and Sommer, Anna L.—**A Comparison of Chilean and Purified Nitrates for Plant Growth in Sand and Solution Cultures.** *Western Irrigation, April 1936.* Plants supplied with Chilean nitrate as the source of nitrogen and with the other salts purified made much better (apparently normal) growth than those supplied with only purified salts.

Sommer, Anna L.—**Reduction of Nitrates to Nitrites by the Expressed Juice of Higher Green Plants.** *Plant Physiology 11:429-436. 1936.* A large number of nitrite determinations on

mixtures of nitrate, glucose, and expressed plant juices, to which toluene had been added and maintained at sufficient concentration to prevent the action of microorganisms, failed to indicate the presence of substances in the green plant which cause the catalytic reduction of nitrate to nitrite.

Sommer, Anna L.—**Nitrite and Formaldehyde Formation in Certain Green Algae.** *Plant Physiology 11:853-861. 1936.* Light was found to play an important part in the reduction of nitrate to nitrite within the algal cell. The addition of phosphate to the nutrient medium greatly accelerated the reduction of nitrate to nitrite and the formation of formaldehyde. Nitrites appeared to combine with formaldehyde or some early condensation product of formaldehyde in the first step in protein synthesis. Protein synthesis and the condensation of formaldehyde to form sugars were found to proceed simultaneously.

Naftel, James A.—**Soil Liming Investigations: I. The Calcium Carbonate Equilibration Method of Liming Soils for Fertility Investigations.** *Jour. Amer. Soc. Agron. 28:609-622. 1936.* A method for liming soils is reported by which soils of any degree of Ca saturation may be limed to comparable degrees for further fertility studies. By use of the method reported, soils are limed over the entire range in soil reaction; and the influence of reaction on soil processes may be investigated. The value of the proposed liming method on the sorption of ions and on the biological activity in soils was indicated by studies on potash and nitrification.

Naftel, James A.—**Soil Liming Investigations: II. The Influence of Lime on the Sorption and Distribution of Phosphorus in Aqueous and Soil Colloidal Systems.** *Jour. Amer. Soc. Agron. 28:740-752. 1936.* Results are reported on a study of the effect of calcium and magnesium on the distribution of phosphate in pure solutions and in soil-colloidal systems. The pH range for each of the three calcium salts of phosphoric acid was established. The greater solubility of phosphate, where calcium and magnesium were present in the system, was pointed out as significant in liming acid soils. Of the factors investigated, the concentration of carbon dioxide was the most important in determining the solubility of phosphorus.

Ware, L. M.—**Nitrate Requirements of Truck Crops on Newly Cleared Land.** *Amer. Soc. Hort. Sci. 33: 355-59.* Results of field experiments are presented showing in South Alabama for normal production of truck crops that newly cleared land required the first year after clearing an amount of nitrogen much in excess of that required in later years. Laboratory and greenhouse studies showed that this was due to a locking-up of nitrates by bacteria, the growth of which was encouraged by abundant organic material.

AGRICULTURAL ECONOMICS

The Demand of Alabama Markets as a Basis for Adjustments in Agricultural Production within the State. (Buis T. Inman).—Preliminary data show that commercial feeds valued at $7,581,148 were sold in Alabama during 1935. These feed sales made almost entirely to farmers represented an expenditure of $27.72 per census farm, 69 per cent of which was for feed from outside the State (Table 1). With the exception of cottonseed meal, most of the ingredients which enter into these feeds are corn and by-products of milling flour and consequently are generally out-

TABLE 1.—Quantity and Retail Value of Commercial Feeds Sold in Alabama, 1935.

Feed	State-grown products		Out-of-State products		Total	
	Tons	Value	Tons	Value	Tons	Value
Mixed:						
Dairy	569	$ 21,622	32,269	$1,226,222	32,838	$1,247,844
Poultry: Mash	10	520	16,147	839,644	16,157	840,164
Scratch	25	1,125	12,596	566,820	12,621	567,945
Horse and mule	983	34,405	18,112	633,920	19,095	668,325
Hog supplement	-	-	1,432	71,600	1,432	71,600
Pigeon	-	-	153	10,251	153	10,251
Dog: Canned	-	-	300	42,000	300	42,000
Dry	40	4,000	166	16,600	206	20,600
Rabbit	-	-	47	2,961	47	2,961
By-products milling wheat	-	-	37,070	1,223,310	37,070	1,223,310
Velvet bean feed	333	4,995	12	180	345	5,175
Brewers' grain	-	-	1,375	49,500	1,375	49,500
Distillers' grain	-	-	364	15,288	364	15,288
Cottonseed meal	73,511	2,058,308	7,005	196,140	80,516	2,254,448
Peanut meal	3,240	97,200	-	-	3,240	97,200
Linseed meal	-	-	60	2,820	60	2,820
Soybean meal	-	-	70	2,800	70	2,800
Corn gluten feed	-	-	88	3,784	88	3,784
Ground, cracked and chopped corn	2,668	93,380	2,224	93,408	4,892	186,788
Corn bran	14	364	-	-	14	364
Corn feed meal	165	4,620	1,220	34,160	1,385	38,780
Whole ear corn ground	1,526	36,624	199	4,776	1,725	41,400
Ground oats	10	440	676	29,744	686	30,184
Peanut vine ground	-	-	8	80	8	80
Alfalfa meal	-	-	376	15,040	376	15,040
Chopped lespedeza	13	325	-	-	13	325
Apple pulp	-	-	50	1,500	50	1,500
Meat and bone meal	50	2,500	340	17,000	390	19,500
Skim milk powder	60	7,200	-	-	60	7,200
Rice bran	-	-	157	5,024	157	5,024
Beet pulp	-	-	2,594	108,948	2,594	108,948
Total	83,217	$2,367,628	135,110	$5,213,520	218,327	$7,581,148

of-State products. Very little Alabama-grown corn is used by feed manufacturers because it is white corn and lacks uniformity. The expenditure for commercial feeds alone was equal to 37 per cent of the cash income from livestock and livestock products in 1935.

Alabama's hay crop including sorghum as given by the U. S. Census of Agriculture amounted to 1,075 pounds per hay-eating animal unit in 1934 but to only 690 pounds in 1929. The acreage in hay increased 95 per cent during the five-year period while hay-eating animal units increased 7.7 per cent. Hay production per hay-eating animal unit ranged from 190 pounds in Clarke County to 2,493 pounds in Madison County. Northern Alabama generally showed the highest production of hay per hay-eating animal unit while the lowest production was in the east central and southwest counties.

Alabama's corn production was 30.2 bushels per animal unit in 1934. This was an increase of 1.2 bushels per animal unit over 1929. Corn production ranged from a low of 11.5 bushels per animal unit in Wilcox County to a high of 51.3 bushels in Marshall County. Northern Alabama counties had the highest production of corn in relation to livestock while southwestern Alabama had the lowest production.

Corn yields in Alabama trended upward at the rate of .14 of a bushel per acre annually from 1889 to 1910. The following six-year period was marked by a high average yield of approximately 17.5 bushels per acre. However, corn yields trended downward from 1914 to 1936 at the rate of .14 of a bushel annually amounting to a decrease of 3.8 bushels per acre in 22 years.

Factors Related to Labor Income on Farms of the Dadeville Erosion Control Area, 1935. (Ben F. Alvord).—Records were obtained from 180 farms for the year 1935 in the Dadeville Erosion Control Area and analyzed to determine what factors were associated with farmers' success in that year. Seventy-five of these farms were operated by colored and 105 by white farmers.

The records indicated that colored farmers on the average did not earn a normal rate of interest on their investment. Thus colored farmers having large farm businesses tended to have low labor incomes. They likewise did not earn a normal value for their unpaid family labor after other costs were considered. As a result, the more family labor the colored farm operators used on their farms, the lower their labor incomes tended to be. No other consistent relationships were found between labor income and other factors on these farms.

Labor incomes of white farmers, on the other hand, were related with a considerable degree of consistency to a number of factors in 1935. A general indication of these relations may be seen in Table 2. It lists the average labor income of the group

of white farmers having highest and of the group having lowest amounts of the respective factors.

These indicated relationships of factors to labor income are not necessarily causal, but they were found in most instances to exist in some degree in both 1933 and 1934, as well as in 1935. The positive relationship, however, between number of productive animal units per 20 crop acres and labor income and also that between the portion of cash receipts obtained from livestock and labor income did not appear to exist in 1934.

TABLE 2.—Relation of Specified Factors to Labor Income on Farms of 105 White Operators of the Dadeville Erosion Control Area, 1935.

Factor	Average annual labor income* (dollars)
Portion of crop acreage in cotton:	
Less than 26 per cent	2
More than 45 per cent	181
Productive animal units per 20 crop acres:	
Less than 1.5 animal units	1
More than 3.4 animal units	200
Portion of cash receipts from livestock:	
Less than 15 per cent	48
More than 25 per cent	246
Crop acres operated:	
Less than 40 acres	−20
More than 59 acres	278
Acres of cotton produced:	
Less than 15 acres	−26
More than 24 acres	319
Operator's investment:	
Less than $1,100	56
More than $2,500	125
Yield of cotton lint per acre:	
Less than 200 pounds	2
More than 249 pounds	168
Fertilizer per acre of cotton:	
Less than 250 pounds	85
More than 300 pounds	112
Acres of cotton per plow:	
Less than 6.6 acres	−25
More than 8.5 acres	200
Farm produce used in the home:	
Produce valued at less than $300	−1
Produce valued at more than $399	322

*Minus denotes negative income.

AGRICULTURAL ENGINEERING

A Study of the Relationship of the Dynamic Properties of Soil to the Elements of Tillage Implement Design. (F. A. Kummer).—A method was derived by which the curvature of a moldboard

could be predetermined and reproduced in the form of a pattern to be used in the design of plow shapes. A number of cams are used to produce a motion similar to that of a soil particle as it moves over the moldboard surface. The apparatus is completed, and tests on experimental plow shapes are being conducted.

AGRONOMY AND SOILS

The Solubilities of Phosphates in Soils as Related to the Yields of Cotton. (G. D. Scarseth).—The amount of water-soluble phosphate found in 100 different soils, from areas being tested in the field for the fertilizer requirements of cotton, was found to be below 0.4 pounds of P_2O_5 per acre for 50 per cent of the soils. The soils with pH values above 6.3 had a much higher content of water-soluble phosphate than the soils with pH values below 6.3. The greater the acidity, below pH 6.3, the smaller were the amounts of water-soluble phosphates present. The amounts found coincided only slightly with the cotton yields.

When the phosphates were extracted from the soils with an extracting solvent at pH 3.0, the correlation of the amounts obtained with the cotton yields was significant. The highest correlation was obtained when the extracting solution had a pH of 2.0.

The texture of the soil affected the correlation. In the light-textured soils (clay content less than 25 per cent), the correlation between the phosphate soluble at pH 2.0 and the yields of cotton (N and K supplied) was low regardless of the pH value of the soil. This correlation was higher as the soils became heavier, so that in the group of soils containing over 31 per cent clay the correlation was high, especially in the group of soils that had pH values below 6.3. The correlation between the amounts of available phosphate and the yields of crops was found to be much higher when the crops were grown in greenhouse tests than when the comparison was made under field conditions. The reason for this is that in the field such factors as moisture supply, insect injury, diseases, faulty stands, and weeds may affect the yields more than the supply of available phosphates, even when the nitrogen and potassium supply is adequate.

The Action of Calcium Silicate in Soils as Related to the Availability of Phosphates. (G. D. Scarseth).—The silicate anion of calcium silicate (blast furnace slag) was found to have a slight effect in releasing the phosphate sorbed on the surfaces of the colloid in an acid clay soil with a high content of alumino-silicates and a low content of free iron (Eutaw clay). The silicate anion of Ca silicate was not as effective in this respect as the anions of Mg or Na silicates. The calcium silicate retarded the rate of fixation of added soluble phosphates. In an acid clay soil with a lower content of alumino-silicates and a high content of free iron (Cecil clay), the phosphate replacement was not ap-

parent. In this soil the benefit from the slag was obtained only in changing the reaction from pH 4.7 to 7.1 and thus decreasing the insolubility of the iron phosphates. Calcium silicate was much more effective in decreasing the rate of fixation of phosphate from Ammo-Phos than was $CaCO_3$ when compared on either Eutaw or Cecil clays. When a small amount of rock phosphate was used in combination with calcium silicate, the available phosphate level was increased by the action of the silicate; when a large amount of rock phosphate was used, this difference was not apparent.

Sources and Rates of Nitrogen for Oats. (E. L. Mayton).—Five rates and 5 sources of nitrogen were compared for oats on a Norfolk sandy loam soil over the 10-year period, 1927-1936. The different sources (nitrate of soda, ammonium sulfate, calcium nitrate, urea, and Leunasalpeter) were used at a rate equivalent to 200 pounds of nitrate of soda per acre. During this period, each source of nitrogen produced approximately the same yield; the average for the different sources was 32.6 bushels of oats per acre; this was 23.2 bushels more than the plots which received no nitrogen.

Nitrate of soda was used at rates of 100, 200, 300, 400, and 500 pounds per acre. The average results showed that each 100 pounds of nitrate of soda through the 300-pound rate increased the yield of oats approximately 10 bushels per acre. Applications heavier than 300 pounds were not usually profitable.

Rotation Experiments. (E. L. Mayton).—This study includes two experiments which have been conducted over a long period to determine the effects of legume crops turned into the soil in different cropping systems.

The first experiment which was started in 1896, includes plots cropped continuously to cotton with and without winter legumes and also various two- and three-year rotations in which winter legumes were turned for succeeding crops. All plots have been uniformly fertilized with phosphate and potash fertilizers. No nitrogenous fertilizers have been applied to crops of cotton or corn since the beginning of the experiment.

The average yields for the 17-year period 1920-1936 show that legumes increased the yields of seed cotton 560 pounds per acre in the continuous cropping system, 700 pounds in the 2-year rotations, and 560 pounds in the 3-year rotation. Legumes were discontinued on one plot in 1932 so that the residual effect of legumes turned under since 1896 might be studied. During the last 5-year period, this plot has produced an average of 800 pounds of seed cotton per acre more than the plot which has never grown legumes.

In a similar experiment, the effect of mineral fertilizers and of legumes when used separately and in combination in a 3-year

rotation has been studied. The plan of the rotation was changed slightly in 1932 and now five years' results are available.

These results show that mineral fertilizers (superphosphate and potash) used alone increased the yields of seed cotton by 104 pounds per acre and of oats by 1.5 bushels per acre; they did not increase the yield of corn. When used without minerals, legumes increased the yields of cotton, corn, and oats an average of 149 pounds, 12.5 bushels, and 9.7 bushels per acre, respectively. Where legumes and mineral fertilizers were used together in the rotation, the increases were 907 pounds of seed cotton, 23 bushels of corn, and 9 bushels of oats per acre. The yield of oats on other plots in this experiment was further increased by top dressing with nitrogen fertilizers. On Norfolk sandy loam soils, it is not possible to produce satisfactory yields of oats by the use of legumes as the only source of nitrogen.

Meta- and Pyrophosphate Within the Algal Cell. (Anna L. Sommer).—By means of the Allison magneto-optic apparatus, salts of meta- and pyrophosphoric acid were found to be present in the living algal cells. However, after these plants were grown in a phosphate-free medium for a considerable time, only the metaphosphate was detected.

Calcium Cyanamide as a Herbicide on Bermuda Grass Lawns. (D. G. Sturkie).—A study of various rates and times of application of calcium cyanamide on Bermuda grass lawns during the 5-year period, 1931-1936, has shown that this material may be effectively used in controlling winter weeds. In addition to controlling weeds, the cyanamide supplies nitrogen which greatly stimulates the Bermuda grass the following summer.

One of the best ways to apply the cyanamide is to broadcast it on the lawn, applying 2 pounds per 100 square feet in December, and another 2 pounds on the same area about the middle of January. If the 4 pounds are applied at one time, it should be applied in December or January and not later than February 1. The heavy application made later than February 1 will delay the Bermuda in the spring. The treatment should not be applied to lawns where Italian rye or bluegrass is growing.

The Effect of Lime on the Efficiency of Various Fertilizers on Cecil Clay as Determined by Yields and Composition of Plants. (James A. Naftel).—Six successive crops were grown with various combinations of nitrogen, phosphorus, and potassium, and with organic matter applied over the calcium saturation range from 26.5 to 200 per cent. The soil reaction was studied over the range in pH from 5.0 to 7.8.

Considerable response to lime was obtained on this soil where the phosphorus was added in limited quantities; in the series without phosphorus and in that with half normal amounts of phosphorus, the yields reached a maximum at the high lime

saturations. There was little response to potassium with this soil. The largest total yields were obtained where organic matter was used in addition to the complete fertilizer. Perhaps the most significant observation during this study was that overliming injury was not evident; on the contrary, high rates of lime increased yields of crops where the fertilizers were limited.

The Relation of Boron Deficiency to Overliming on a Light-Textured Soil. (James A. Naftel).—Liming a Norfolk loamy sand to the point where an excess was present resulted in overliming injury to vetch and soybeans grown on the soil; in some cases a crop failure resulted. The addition of large amounts of phosphorus to the soil, soil and plant amendments of manganese, or soil amendments of calcium silicate did not overcome the injurious effect of excessive liming. On the other hand, additions of basic slag in amounts which rendered the soil quite alkaline did not cause overliming injury. The addition of boron to a soil otherwise overlimed completely prevented the injurious effect of overliming; the effect of boron in preventing overliming on turnips is shown in Figure 1. It was concluded that overliming on this light-textured soil was due to boron deficiency.

FIGURE 1.—No boron added to Nos. 1, 2, and 3 which were limed to 0, 50, and 150 per cent saturation, respectively; 1 p.p.m. boron added to Nos. 4, 5, and 6 limed similarly to Nos. 1, 2, and 3, respectively.

The Effect of Lime on the Competition of Microorganisms and Higher Plants. (James A. Naftel).—It has been well established that microorganisms compete with higher plants for nitrogen; this suggests the possibility that there may be competition for phosphorus, potassium, or some of the minor elements essential for growth and which may be present in certain soils in limited amounts. Liming soils is known to increase the microorganism population which utilizes the available nutrients; as a result of this, higher plants may suffer temporarily or until the microorganisms themselves decompose. As a corollary, liming soils often causes a temporary decrease in plant growth.

A study was begun to determine the influence of lime on the competition between soil microorganisms and higher plants. The soil was limed in increments up to 200 per cent saturation with the following fertilizer or energy sources: a. nothing; b. 5 tons per acre of dextrose; c. 5 tons per acre of ground soybeans; and d. 1,200 pounds per acre of a 6-10-4 fertilizer. Soil analyses for water-soluble constituents were made at 5, 10, and 20 days after liming.

Of the constituents studied, NO_3-N and P were most affected. Lime increased the accumulation of NO_3-N in the soils without other amendments, but none was found at 5 days where dextrose or soybeans were added. After 10 days, NO_3-N began to accumulate where soybeans were added, but none was found in the dextrose soils. The same situation existed after 20 days. Inorganic P was decreased in all of the soils when lime was added in large amounts except where soybeans were present. Organic P was increased by liming and exerted its greatest effect where the microorganisms were most abundant (dextrose and soybean cultures). These results may be interpreted to indicate that liming soils stimulates the microorganism population which temporarily competes with higher plants for available nutrients which are present in limited amounts.

ANIMAL HUSBANDRY, DAIRYING, AND POULTRY

Beef Production in East Alabama. (J. C. Grimes).—Seventy acres of land consisting mostly of abandoned cotton land and woodland was used as a pasture for 18 breeding cows during the summer of 1936. The grass and clover in this pasture were volunteer and consisted mostly of hop clover, lespedeza, carpet grass, and Dallis grass.

The returns, in the form of beef produced, from this herd were 5,549 pounds worth $294.20. The cost of winter feed was $113.23 and the returns above winter feed cost per acre of land used were $2.58.

During the 140-day wintering period each cow consumed 169 pounds velvet beans, 80 pounds cottonseed meal, and 1.77 tons sorghum silage. The cost of these feeds was $6.29 per cow.

Kudzu as a Grazing Crop. (J. C. Grimes).—The results from grazing four acres of kudzu with beef cattle during three summers indicate:

1. That kudzu can be grazed without damage to the stand if proper precautions are taken; that is, if the pasture is not overstocked and the cattle are removed in time for the plants to recuperate before frost.

2. That the most desirable rate of grazing kudzu is approximately one cow per acre.

3. That during the average summer one acre of kudzu will furnish grazing for one cow for a period ranging from 60 to 75 days, depending on the rainfall.

4. That in a grazing program kudzu is most valuable when used as a temporary grazing crop. It will furnish good grazing in July and August when the carrying capacity of most permanent pastures is low.

5. That beef cows grazing kudzu gain from one to one and one-fourth pounds per day.

The Use of Ice in Curing Meat on the Farm. (W. E. Sewell).—During the past year pork put in cure during nine different months of the year was successfully preserved, though further work must be done to make such meat more attractive in appearance and less salty. In this method the warm meat was divided into the various cuts and the hams and shoulders boned or cut across in three places. All of the meat was then chilled with ice and dry packed in curing mixture. The cure was broken and repacked twice at 4-day intervals. The total curing period was 28 days. Whole meat treated in the same manner was preserved in 5 different cures made between October 17 and March 31, but it spoiled during warmer periods.

Results of one test on the length of time low temperatures are necessary for brine curing indicated that meat from 200-pound hogs may cure successfully when subjected to a temperature of 36° F. for one week, but four weeks or more at this temperature was necessary for consistent results.

Three tests on the length of time in brine necessary for curing meat from 200-pound hogs gave variable results up to four weeks. All of the meat allowed to remain in brine four weeks or more cured successfully.

Management of the Farm Flock. (D. F. King).—In this study it was found that a flock of 50 hens managed as a typical farm flock produced 4,993 eggs, 100 pounds of hens for meat and 39.6 pounds of friers during the year. The value of the hens at 15 cents per pound and the friers at 25 cents per pound was sufficient to pay for the replacing of the flock with young birds. Seventy per cent of the feed consumed by the flock was homegrown, and the hens returned 120 eggs for each bushel of corn consumed.

Sack-Cement Poultry House Construction. (D. F. King).—Laboratory and field tests conducted to determine the value of sacks painted with a cement mixture for use as a building material for construction of poultry houses indicate that this type of structure will withstand two years of weathering in this climate and is suitable for temporary poultry houses.

Detecting Infertile Eggs Previous to Incubation. (D. F. King).—In an effort to develop a suitable method of detecting

infertile eggs before incubation it was found that by using a 500-watt light and filtering out all rays other than those from 400 to 700 m u in length, both white and brown eggs may be candled after having been at a temperature of 100° F. for 15 hours with an accuracy of 95 per cent. Infertile eggs removed from the incubator at this time are satisfactory for food purposes. It was found also that certain slow-developing eggs, which do not hatch well, also could be removed after 15 hours at 100° F.

The Inheritance of Resistance to Fowl Paralyis (Neurolymphomatosis). (C. D. Gordon).—Excessive mortality, particularly among adult chickens, is without question the most serious problem confronting the commercial poultry industry at the present time. Both breeding and management affect mortality.

In this experiment, begun during the early part of 1936, an attempt is being made to classify every chicken as to cause of death and to produce by selective methods strains whose genetic constitution will enable them to resist disease.

Data collected to January 1, 1937 on 743 pullets in their first laying year, from eight different matings, may be summarized as follows:

1. Three hundred-twenty had succumbed from various causes; namely, neurolymphomatosis 198, nephritis 26, enteritis 47, peritonitis 18, and all other causes 31.

2. None of the males used were homozygous enough for disease-resistant factors to cause the mortality of their daughters to vary significantly from those of any other pen. However, within pens, various males in combination with certain hens did produce families with satisfactory livability. Similar results were obtained for other factors such as egg production and egg size.

The program for the future includes the perpetuation of resistant individuals already discovered as well as a continued search for additional suitable breeding material.

The Supplemental Value of Peanuts to Chick and Laying Rations (G. J. Cottier and D. F. King).—This report covers the second and third trials of a study to determine the value of ground peanuts with shells, ground peanuts without shells, and peanut meal when fed alone and in combination with meatscraps and dried buttermilk as protein supplements in simplified rations for chicks. The rate of growth was very unsatisfactory when the peanut products were fed as the sole protein supplement. Peanut meal when fed as the sole protein supplement or in combination with an animal protein gave better results than any of the other peanut products studied. The rate of growth was improved considerably in every pen where peanut products were supplemented with animal proteins except in the second trial where peanuts without shells were supplemented with meatscraps. Peanut rations supplemented with dried buttermilk were superior to pea-

nut rations supplemented with meatscraps. Rations high in fiber or fat produced slow growing chicks.

In the study of 275 eggs to determine the effect of feeding peanuts and peanut oil on the firmness of the fat in the yolks of the eggs produced, it was found that the nature of the fat in eggs can be changed rather rapidly by changing the ration of a hen. The amount of fat in the ration did not affect the rate of change. A hen on an all-mash ration is not consistent in the nature of fat she puts in her eggs. Hens on the same ration vary in the nature of fat they put in their eggs. Eggs from the hens fed peanut products had higher refractive index readings than eggs from the control hens. Hens fed high fat rations produced eggs with spotted yolks. No correlation was found to exist between the amount of fat in the ration and other measurements of interior quality of eggs.

Value of Kudzu and Other Forms of Summer Green Feed for Poultry. (G. J. Cottier and D. F. King).—The object of this experiment was to compare kudzu with cowpeas and soybeans as a summer green feed for poultry. In this experiment each green feed was compared when hand fed to confined birds and also when being grazed. The ration other than green feed was the same in all lots. This report covers four and one-half months in the summer of 1936. Kudzu was ready to be used as a summer green feed earlier in the spring than cowpeas or soybeans and made a large yield even though it was a dry season. Although kudzu was not as palatable as soybeans, it was found to be a satisfactory, inexpensive summer green feed for poultry.

Lameness in Hogs Produced by Austrian Pea (Pisum arvense) Forage. (W. D. Salmon and W. E. Sewell).—Last year a peculiar lameness in hogs was reported to this laboratory. The condition developed in hogs that were grazing on Austrian peas. A questionnaire to the county agents in this State brought reports of a few other observations of a similar condition in hogs that were being pastured on Austrian peas; some of the agents stated, however, that the peas were good forage for hogs.

To determine definitely whether Austrian peas would produce any abnormality, a lot of 10 hogs was placed on an acre of Austrian peas March 14, 1936. A control lot of 10 hogs was placed on an acre of oats at the same time. Both lots received a limited ration of white corn (a daily feed equivalent to 2 per cent of the live weight of hogs). A mineral mixture was kept in each lot throughout the experiment.

The Austrian peas were refused for a few days but were then eaten readily. The oats were eaten readily from the beginning of the experiment.

Mild symptoms of incoordination or muscular weakness in the hind legs began to appear among some of the hogs on the Aus-

trian pea pasture in the fifth week of the test. By the end of the sixth week all the hogs in this lot were affected, some much more severely than others.

The condition was characterized by weakness in the rear pasterns which caused the hogs to "knuckle over." In some cases this weakness extended to the rump and loin, causing the animals to walk with a "reeling gait." The affected animals would fall frequently when attempting to walk or run; sometimes they could not rise from a reclining position without being lifted, and two animals eventually were unable to stand. None of the hogs on the adjacent oat forage developed any abnormality.

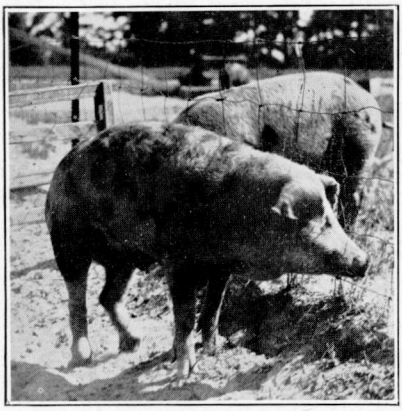

FIGURE 2.—Photograph showing "knuckling over" of pastern joints caused by grazing Austrian peas.

The average daily gain was 0.6 pound per hog on Austrian peas and 0.8 pound on oats. The corn consumed per 100 pounds of gain was 369 pounds on peas and 280 pounds on oats.

Although the symptoms remotely resemble those of vitamin A deficiency in hogs, the Austrian pea plant is rich in vitamin A as shown in tests on rats. It is possible that the condition is similar to lathyrism, which is caused by eating certain species of Lathyrus peas. No previous accounts of such injury from the eating of any members of the Pisum genus have been found.

The Physiology of Vitamin B Deficiency in the Rat. (W. D. Salmon).—Growth is stimulated and the onset of beriberi (terminal symptoms of vitamin B deficiency) is delayed by replacing carbohydrate with protein in vitamin B-deficient diets. No such effects are obtained by replacing fat with protein. In other words, fat has a more marked effect than protein when either is substituted for carbohydrate in a vitamin B-deficient diet.

The effect of replacing carbohydrate with protein apparently is not due to the specific dynamic action of the protein, since glycine does not have a similar effect. Rats can not tolerate a high carbohydrate diet containing 28 per cent of glycine either in the presence or absence of adequate vitamin B. The tolerance to glycine, however, is markedly increased if the carbohydrate in the diet is replaced by coconut fat.

Rats receiving a high carbohydrate diet which is deficient in vitamin B are extremely sensitive to large doses of desiccated thyroid. Either vitamin B or fat affords some protection against the injurious effect of the thyroid.

The time of onset of beriberi is affected also by the kind of carbohydrate in the deficient diet. The onset is most rapid when corn starch is the non-nitrogenous source of energy, less rapid when sucrose is used instead of corn starch and is definitely delayed by dextrin or glucose (refined corn sugar).

Synthetic vitamin B (Winthrop) and 0.50 gm. of autoclaved yeast daily as the sole sources of water-soluble vitamins do not permit optimum growth in rats but do prevent the development of any abnormal symptoms other than the slow growth.

A Comparison of a Limited vs. Ad Libitum Feeding of Different Synthetic Vitamin B Deficient Diets on Their Effectiveness in Producing Spastic Beriberi in the Rat. (G. A. Schrader and C. O. Prickett).—In attempting to procure a diet and a method of feeding which was most effective in producing the spasticity and incoordination characteristic of rat beriberi, different carbohydrates, by themselves and with fat (coconut fat), were compared. Two methods of feeding were used. In one, the rats were allowed to eat the basal diet at will (*ad libitum* feeding); in the other, the food intake was adjusted to a maintenance-plus level (limited feeding). In the limited feeding method, the energy intake was kept constant for all diets and was 12.0 plus Calories per rat per day. A starch diet, 3 B, a sucrose diet, 3 G, a starch-fat diet, 23 B, and a sucrose-fat diet 23 C, were used. Approximately one-half of the non-protein energy was furnished by the fat in diets 23 B and 23 C.

The percentage of rats developing spastic beriberi was poorest on diet 3 B, next on diet 3 G, and equally good on diets 23 B and 23 C. The two methods of feeding were about equally effective. The percentages were 44.4, 63.6, 93.1, and 93.1 on the limited feeding and 50.0, 70.6, 83.3, and 90.5 on the *ad libitum* feeding, respectively, for diets 3 B, 3 G, 23 B, and 23 C.

The time for spastic beriberi to develop was essentially the same for all diets on the *ad libitum* method of feeding; 43.7, 40.6, 49.1, and 42.1 days were required for diets 3 B, 3 G, 23 B, and 23 C, respectively. The longer time for diet 23 B was due to one rat requiring 96 days; the average time for the other rats on this diet was 43.9 days. A longer time was needed when the limited method of feeding was used, and the fat-containing diets showed a further prolongation in time. The average time to beriberi was 50.4, 51.8, 59.3, and 67.1 days, respectively, on diets 3 B, 3 G, 23 B, and 23 C.

An Apparent Anomaly of Dextrinized Corn Starch in Producing Spastic Beriberi in the Rat. (G. A. Schrader and C. O. Prickett).—It was shown in the above report that rats on the corn starch diet, 3 B, and the corn starch-fat diet, 23 B, developed spastic beriberi in 50.4 and 59.3 days, respectively, when subjected to the "limited" method of feeding. Some of the same corn starch was dextrinized by autoclaving for 5 hours at 15

pounds pressure in one kg. quantities per pan, after thorough moistening with water.

Twenty-eight rats were fed a diet, 3 D, in which the dextrin replaced the starch in diet 3 B, and 28 were fed a diet, 23 D, in which the dextrin replaced the starch in the starch-fat diet, 23 B. The "limited" method of feeding was employed. Seven rats on diet 3 D and 17 rats on diet 23 D developed spastic beriberi. The average time to spastic beriberi was 118.7 and 127.1 days, respectively, for the two diets.

Why autoclaving the corn starch should have such a prolonging effect on the time to beriberi is unknown. Autoclaving, if anything, should have tended to destroy any vitamin B remaining in the corn starch.

A Comparison of the Growth of Young Rats Fed Either Various Purified Synthetic Diets Supplemented with Brewer's Yeast, the Same Diets Supplemented with Autoclaved Yeast Plus Vitamin B Solid, or a Stock Diet. (G. A. Schrader and C. O. Prickett). —Diets 3 G, 3 B, 23 C, 23 B, and 60 C were compared with the stock diet used in this laboratory, for their ability to support the growth of rats during a 16-week experimental period. The above synthetic diets were supplemented either with 0.5 gm. brewer's yeast per rat daily or with 0.5 gm. of autoclaved baker's yeast per rat daily plus 20 mgs. of a vitamin B solid per rat on alternate days. The rats were housed in individual cages and received the basal diets *ad libitum*. The results are given in Table 3.

TABLE 3.—Comparative Weights of Rats on Different Synthetic Diets and Supplements with Those on a Stock Diet, after 16 Weeks on Experiment.

Diet	Males		Females	
	Number	Average final weight (gms.)	Number	Average final weight (gms.)
500 mgs. autoclaved yeast plus 10 mgs. vitamin B solid per rat daily[1]				
3 G	3	200	3	159
3 B	5	197	1	215
23 C	3	201	3	165
23 B	3	219	3	175
60 C[2]	5	194	4	197
500 mgs. brewer's yeast per rat daily				
3 G	4	280	2	222
3 B	5	297	1	222
23 C	2	348	4	224
23 B	4	283	2	216
60 C[2]	5	302	4	229
No supplements				
Stock diet No. 30	2	395	4	224

[1]Actually 20 mgs. of vitamin B solid was fed on alternate days.
[2]Diet 60 C contains 59.2 per cent coconut fat, and no carbohydrate.

In general, the rats on the supplemented synthetic diets did not grow as rapidly or attain as heavy a weight as did the rats on the stock diet. However, the female rats receiving the brewer's yeast supplement attained a normal weight, but the rate of growth was less rapid than for the females on the stock diet.

Brewer's yeast was a more effective supplement than was the autoclaved yeast and vitamin B solid. Supposedly these supplements, in the quantities fed, should have been equally effective.

Symptomatology and Pathology of Potassium and Magnesium Deficiencies in the Rat and the Chick. (G. A. Schrader, C. O. Prickett and W. D. Salmon).—The effect of a deficiency of potassium and of magnesium was studied separately and as the double deficiency. The basal diet consisted of water-acetic acid extracted yellow corn meal, wheat middlings and casein, and cod liver oil. This was supplemented with complete or incomplete essential salts.

Rats receiving the potassium deficient diet showed slow loss in weight, short fur-like hair, cyanosis, abdominal distention, and lethargy leading to coma and death (23 days average). Pathological changes occurred in the intestine, pancreas, kidneys, and heart. Marked ascites was usually present.

Rats receiving the magnesium deficient diet developed generalized hyperemia of the skin, followed by circumscribed areas of erythema, hemorrhages, eschar formation, and exfoliation. Edema of the extremities and nasal region was occasionally seen. An early hyperirritability, apparently progressive, led to tonic-clonic convulsions, and often to death (35 days average). Death was characterized by its suddenness and unpredictability. Considering the spectacular nature of the symptoms, surprisingly little histopathology was encountered. Aside from the usual occurrence of changes in the skin, one-third of the rats evidenced degenerative changes in the liver.

The symptomatology and pathology resulting from a deficiency of both potassium and magnesium in the rat were similar to those of potassium deficiency, except that the animals evidenced the early hyperirritability of magnesium deficiency.

No abnormalities, except subnormal growth, were encountered in the rat when potassium and magnesium, either as the simple salts or as a part of a complex salt mixture, were added to the basal diet.

Chicks receiving the potassium deficient diet lost weight slowly, became weak and inactive, and died in an average of 12 days. Chicks on the magnesium deficient diet gained weight slowly, showed hyperirritability, leg weakness, and tonic-clonic convulsions followed by death (10-12 days average); some animals exhibited several convulsions before death resulted.

Although many of the pre-mortal symptoms occurring in potassium or magnesium deficiency in the rat were not duplicated in the chick, the extremely early death of chicks from each defici-

ency indicates the great requirement of this species for these minerals.

No deaths occurred in a positive control groups of chicks, and it was discontinued at the end of the third week. These animals grew at a subnormal rate, having only doubled their starting weight in this time.

A Comparison of the Polarized Light, Marchi, and Sudan III Methods for the Diagnosis of Myelin Degeneration in Peripheral Nerves. (C. O. Prickett).—Examinations of peripheral nerves in polarized light has shown that this method is decidedly superior to the older Marchi and Sudan III methods for demonstrating myelin degeneration. The method is accurate, involves few technical manipulations, and artefact such as those so commonly seen in Marchi preparations are absent.

As early as 24 hours after transection of the sciatic nerve, marked and consistent changes can readily be seen in both the myelin sheath and axis cylinder by the polarized light method. The earliest any definite degenerative changes were observed by the Marchi method was 48 hours after transection and 96 hours was necessary for changes to become apparent with the Sudan III method. The changes observed in the latter methods, however, are confined to the myelin sheaths.

The Occurrence of Hemorrhagic Foci in the Brains of Rats Showing Symptoms of Spastic Beriberi. (C. O. Prickett and G. A. Schrader).—Examinations of 216 brains have shown that hemorrhagic foci involving primarily the vestibular, cochlear, and cerebellar nuclei were found in 21 per cent of the rats killed immediately after the onset of symptoms. In contrast to this, 94 per cent of the rats killed 3 days after symptoms developed showed hemorrhages. Nine per cent of the animals killed immediately after the onset of spastic symptoms showed bilateral hemorrhages, while of those allowed to remain on experiment 3 days after developing symptoms, 75 per cent showed bilateral involvement.

The Use of Petrunkevitch's Cupric-Phenol and Cupric-Paranitrophenol Fixatives on the Tissues of the Rat. (C. O. Prickett and Cornelia Stevens).—Petrunkevitch's cupric-phenol and cupric-paranitrophenol fixatives have given excellent results for both body and nervous tissues of the rat. Fixation is accomplished at the rate of one-half millimeter an hour and can be prolonged indefinitely without harm if the cupric-paranitrophenol mixture is used. The tissues, after fixation, have a desirable rubbery consistency and do not shrink much during the dehydration or embedding process. Both alcohol and dioxane dehydration have been used with very good results. The tissues were embedded in either paraffin or pyroxylin and in either case very good sections were obtained.

The use of these fixatives coupled with staining with Galigher's Standard Hematoxylin and counterstained with Triosin at pH 5.4-5.6 have given superior preparations.

Vitamin A Studies of Cowpeas and Soybeans. (W. C. Sherman).—The determination of carotene in cowpeas and soybeans affords a rapid and reliable means of estimating their vitamin A potency provided the biological value of the carotene from these sources is established. The method of Kuhn and Brockman (Z. f. physiol. chem., 206, 41 (1932)) was modified for the determination of carotene in cowpeas and soybeans. In the extractions Skellysolve B (b.p. 60-70°) was substituted for benzine.

Spectrophotometric measurements and biological assays gave evidence of wide variations in the carotene content of different varieties of mature cowpeas and soybeans. Much of the carotene present in the green immature soybeans disappeared in their ripening process. The degree of yellow pigmentation of the mature soybeans is not a reliable indication of their carotene content and vitamin A potency because a major portion of the color appears to be due to the alcohol-soluble xanthophyll which has no vitamin A activity. These investigations are being continued.

The Effect of Pigmentation in Cowpeas and Soybeans Upon Their Canning Quality. (W. C. Sherman).—Fresh succulent cowpeas (12 varieties) and soybeans (24 varieties) were tested for canning quality. They were heated for 60 minutes at 110° C. in glass jars of one pint capacity. This heat process produced a marked turbidity in the liquor on all varieties of cowpeas, which upon standing formed a flocculent precipitate. A greater amount of flocculation was apparent in the colored and spotted varieties than in the colorless, green, and yellow varieties. This precipitate was brown and white in the respective groups. The supernatant liquor on the former was also brown in color.

The liquor on all of the soybeans showed only slight pigmentation and was nearly free from turbidity and flocculation. The green color of the soybean was well preserved in those varieties which would be yellow and green when mature. Those soybeans which would be brown or black in maturity turned brown in the heat treatment; spotted varieties became brown and green.

Studies on Commercial Canned Dog Food. (C. J. Koehn).—Sixteen brands of commercial canned dog foods sold in Alabama were tested for their ability to produce growth in young rats. The dog foods were fed *ad libitum* as a sole source of food to rats beginning at the age of weaning. The weight gained during the first eight weeks of the experiment (the period of most rapid growth and, therefore, of maximum nutritional requirements) was used as a measure of nutritive value.

A great variation in the weight gained by the rats receiving the various dog foods was observed. The rats receiving the best

dog food gained more than four times as much as those receiving the poorest. The interesting observation was made that the dog food having the highest protein and fat and the lowest moisture content produced the least growth. Thus, the chemical analysis of the dog food is not necessarily a true index to its nutritive value.

BOTANY AND PLANT PATHOLOGY

Nut Grass Studies. (E. V. Smith and E. L. Mayton).—Nut grass infested plots were either plowed or disked at intervals of 1, 2, 4 weeks and whenever sprouts appeared; respectively, (arbitrary, intervals varied from 14 to 28 days) during two successive growing seasons, 1934-1935. Plowing or disking at intervals of one or two weeks or plowing whenever sprouts appeared eradicated nut grass in two years.

In a new combination tillage and cropping experiment begun in the spring of 1936, plowing at intervals of three weeks reduced the infestation, as determined by tuber counts, as much as plowing at intervals of one or two weeks. In this series, turning the land with a twister in the spring and plowing with a sweep at intervals of two weeks seemed to be as effective as plowing with a 2-horse turn plow or a 2-horse disc.

A series of one-sixtieth-acre plots was fenced and grazed by laying hens. As few as four hens, equivalent to 240 hens per acre, eradicated nut grass in two successive growing seasons. It is significant, from the standpoint of economical eradication, that the gross returns from the hens exceeded the feed cost.

Wild Onion Studies. (E. V. Smith).—The germination of onion bulbs, *Allium vineale* L., which begins sometime during the summer, progresses so rapidly during the fall and early winter that usually 95 per cent or more of the bulbs are sprouted during the month of January. The formation of new dormant bulbs within the tissues of the old bulbs begins in January, but few break through the outer tissues of the old bulbs before February and March. Some of the old plants also produce aerial bulblets in May and June. The above data indicate that spraying should be most effective during January and early February when there are fewest dormant bulbs.

The Mycosphaerella Disease of Winter Peas and Diseases of Winter Peas and Vetches Caused by Ascochyta species. (J. L. Seal).—These diseases were generally found in plantings of peas and vetches during this past season; however, weather conditions were such that they did not develop in epidemic form and very few reports of losses were received from growers over the State. From studies of diseased plants and isolations made from them it was evident that *A. pinodella* was the predominant organism

present. *A. pisi* and *M. pinodes* were found in field plantings of winter peas; the latter has been found repeatedly in plantings of canning peas during the past fall, frequently in the perfect stage.

The organisms are carried on and in the seed and to date no method of seed treatment has been found that will destroy the internally borne organisms without materially injuring the germination of the seed. These organisms live from year to year in the soil. Considering the life histories of these organisms, the most feasible and desirable control measure would seem to be resistant strains of peas.

ENTOMOLOGY

The Vegetable Weevil (Listroderes obliquus). (J. M. Robinson).—Eighteen of 50 adult weevils kept in vails throughout the summer began depositing eggs in middle November and continued through December. The total number of eggs deposited by an adult weevil varied from 2 to 111, the average being 49.5. Toxicity tests with the larvae of the vegetable weevil resulted in sodium fluosilicate killing 50 per cent in 19 hours and 71 per cent in 23 hours. Cubé root killed 57 per cent in 23 hours and 71 per cent in 36 hours. Other materials tested killed a much smaller per cent of the larvae in the same period of time, except magnesium arsenate, which killed 71 per cent of the larvae in 36 hours.

Toxicity tests with adult weevils resulted in the cubé root and sulphur mixture (1-7), and sodium fluosilicate, killing 100 per cent within 48 hours. All of the other materials tested were less effective, cryolite and talc being least toxic.

Life History and Control of the Cowpea Curculio, Chalcodermus aeneus Boh. (F. S. Arant).—Field experiments were conducted for the control of the cowpea curculio. Magnesium arsenate, autoclaved ("safened") calcium arsenate, and sodium fluosilicate containing 50 per cent colloidal silica were applied as dusts on plots replicated four times. The average percentages of cowpea curculio infestation on the various plots were as follows: Calcium arsenate, 9.01 per cent; magnesium arsenate, 10.99 per cent; sodium fluosilicate, 10.74 per cent; check, 30.77 per cent. The autoclaved calcium arsenate produced very severe burning to foliage; the other dusts caused no injury.

Production of Food for Fresh-Water Fish. (H. S. Swingle, E. V. Smith, and G. D. Scarseth).—An unfertilized pond, stocked with bream, bull-head cats, crappie, and chub suckers, produced at the rate of 160 pounds of mixed fish per acre per year. The highest production of gold fish in a fertilized pond was at the rate of 723 pounds per acre. A pond stocked with bluegill bream

only and lightly fertilized produced at the rate of 200 pounds of fish per acre.

The unfertilized pools stocked with bluegill bream only produced at the rate of approximately 100 pounds of fish per acre. Highly fertilized pools stocked with the same amount of bream produced at the rate of over 500 pounds of fish per acre. The use of fertilizers increased the plankton production from two to eight times and the fish production from two to six times that in the unfertilized checks. Fish production varied directly with plankton production, and the average dry weight of plankton per liter of water was found to be the best indicator of the productivity of a pond for bluegill bream.

The addition of nitrogen, phosphorus, calcium and potash fertilizers was necessary for maximum production. At the concentration used, no difference could be detected between ammophos and superphosphate as the source of phosphorus for pond fertilization. Ammonia nitrogen appeared more effective than nitrate nitrogen.

The highest production of bream was in a pool fertilized with superphosphate plus ammonium sulfate plus basic slag. The next highest was in a pool fertilized with cottonseed meal plus superphosphate.

Plankton growth with a dry weight of 55 mg. per liter of water appeared to be close to the maximum amount desirable. Where plankton growth exceeded this the oxygen content of the water was often seriously depleted upon decomposition of the phytoplankton. Young bluegill bream fry successfully lived through such a period during which the oxygen content of the pond water dropped to 0.1 mg. O_2 per liter. Year-old bream died at this concentration of oxygen.

Bluegill bream, less than two inches in length, fed largely upon microcrustacea and insect larvae. The larger bream, in addition to the above diet, also fed to a considerable extent upon Naias, a higher plant. Young crappie, up to six inches in length, fed largely upon microcrustacea and insect larvae. A few, as small as four inches in length, were found to be feeding upon minnows. Bullhead cats appeared to be omnivorous, feeding upon both plants and animals, with the latter predominating in larger specimens.

Bluegill bream spawned in the brood pond on approximately May 25, June 1, and September 4. The brood bream in the pond averaged one-fourth pound each and produced an average of 2,471 fry per female.

Physiology of Insects with Reference to Their Control. (H. S. Swingle).—The phosphate ion was found in the digestive juices of all insects examined.

From chemical studies it was found that, in an alkaline solution of acid lead arsenate, while part of the arsenic gradually became soluble, the lead was rendered more insoluble. Lead phos-

phate and lead arsenate behaved in a similar manner in the presence of hydrogen ions, thus indicating that the phosphate ion might be expected to replace part of the arsenate ion in the insoluble lead compounds formed in alkaline solutions of acid lead arsenate, and thus increase the amount of soluble arsenic.

Rate of Fertilizing Cotton with and without Poisoning. (E. L. Mayton 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 thirteen-year period, 1924-1936. 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 7 years of the 13 to necessitate dusting. This dusting for the boll weevil has accounted for an average increase of 55 pounds of seed cotton per acre on the check plots and 352 pounds on the fertilized plots. The increase in yield for the different fertilizer applications on the dusted sections were 306, 244, 332, and 304 pounds of seed cotton per acre for the first, second, third, and fourth increments of 500 pounds, respectively.

HORTICULTURE AND FORESTRY

Relative Importance of Soil Moisture and Nitrates on the Growth of Young Pecan Trees. (L. M. Ware).—Studies of the growth of young pecan trees grown in metal bins under different cultural systems show that soil moisture exerts a very great influence on the growth of the young trees and that a favorable soil moisture level is of much more importance than a high nitrate level in determining tree growth. A comparison of three treatments will serve to illustrate the difference. The average nitrate (NO_3) content of the soil during May, June, and July for three years in the Bermuda plots receiving a high application of nitrogen has been 73.3 p.p.m. and the average moisture content has been 5.32 per cent. In the clean-culture plots receiving nitrogen the average nitrate content for the same months has been 56.0 p.p.m. and the moisture content has been 6.83 per cent. In the mulched plots receiving no nitrogen the average nitrate content has been 9.57 p.p.m. and the average moisture content has been 10.48 per cent. After three years growth in the bins, the average diameter of the trees in the sod is 1.0 inch, in the clean-culture plots 1.71 inches, and in the mulched plots 2.38 inches. The average twig growth for 1936 of trees in the sod plots was

111 inches, of trees in the clean-culture plots 351 inches, and of trees in the mulched plots 587 inches.

Vegetable Variety Studies. (C. L. Isbell).—A four-year study of eggplant, okra, and pepper varieties has been completed.

EGGPLANT.—The oriental varieties, Early Purple and Long Purple, produced relatively small fruits which were large enough for use in about 60 days after the plants were transplanted. The yield of these varieties averaged 13,877 pounds per acre. The varieties, other than the oriental, came into production 70 days after transplanting and produced an average of 29,205 pounds per acre. The eating quality of the oriental varieties compared favorably with that of the other varieties.

OKRA.—The time from planting to first harvest of green okra averaged 86 days for the variety French Market. The other five varieties came into production 63 days after planting. The average yield in pounds per acre of green okra was 6,680 for French Market and 10,935 for the other varieties. Plants from which the okra was harvested green grew larger and produced more than twice as many pods as did the plants on which the pods matured.

PEPPERS.—It required from 56 to 64 days, with an average of 61 days, from transplanting to first harvest of green pepper with nine of the ten sweet varieties tested. Pimento was the latest, requiring from 58 to 80 days, with an average of 65 days. The yield ranged from 17,036 pounds per acre for Golden Queen to 23,434 pounds for World Beater, with an average for all sweet varieties of about 20,000 pounds.

The size of the pods by weight and the thickness of the walls of the pods of the varieties California Wonder and World Beater compared favorably with pimento. Green peppers were stored under conditions similar to those under which peppers are kept on display counters in retail grocery stores. At the end of the first, second, third, and fourth weeks color development was approximately 7, 28, 80, and 97 per cent in order named. The per cent spoilage for the same weeks was 7, 17, 31, and 61. Rough handling or exposure for very long to hot sun before storing very greatly increased spoilage. Ripe pods dried slowly in the sun. If exposed to rain while being dried, some of the color dissolved out of the yellow variety and much of the sugar dissolved out of the varieties with thick pod walls. The dried pepper was a fair substitute for canned pimento. When the dried product was stored in open paper bags, cigar beetles caused some injury.

The Effect of Fires of Different Frequencies on the Survival of Different Species of Pines. (D. J. Weddell and L. M. Ware).—Survival records of the four principal pines of the South following burning at different frequencies show on the "annual-

burn" plot a survival of 1.2 per cent for Loblolly, 3 per cent for Slash, 42.8 per cent for Longleaf, and 6 per cent for Shortleaf. On the "two-year-burn" the records show a survival of 18.4 per cent for Loblolly, of 31.5 per cent for Slash, of 57.7 per cent for Longleaf, and of 55.9 per cent for Shortleaf. The annual-burn plot was burned the first time when the seedlings were one year old from transplants; these plots have been burned three times since setting. The two-year-burn plot has been burned only once. On the annual-burn plot, 56 per cent of the original stand of Shortleaf trees developed sprouts from the crown after the tops had been killed.

The Influence of Additional Illumination and Shading on the Earliness of China-Asters. (E. W. McElwee).—Experimental results secured in 1936 show that Queen of the Market Asters, an early type, flowered 48 days earlier than the check (1) when the plants were given 5 hours additional illumination from electric lights for six weeks during the seedling stage, and (2) when the plants were given 5 hours additional illumination in the seedling stage and shaded with black cloth after being planted in the cloth house. Under the same conditions and treatments Royal Aster, a medium-early type, flowered (1) 27 days earlier than the check when given additional illumination, (2) 30 days earlier than the check when given additional illumination and shaded, and (3) 11 days earlier than the check when shaded with black cloth. These results show that the use of additional illumination on seedling asters is more effective than shading in inducing early flowering in early and medium-early type asters. There was no consistent difference in earliness between plots shaded with black sateen cloth and those shaded with rubberized cloth.

Hygro-thermograph readings taken in the shaded plots showed no increase in temperature when the shading cloth was applied at 5 p. m. Between 5 p. m. and 8 p. m. the humidity increased 10 per cent faster under the black sateen cloth and 16 per cent faster under the rubberized cloth than the humidity of the cloth house. After 8 p. m. all 3 humidities gradually approached a common level. This increase in humidity did not have any apparent influence on the quality of the flowers.

SPECIAL INVESTIGATIONS

Crotalaria Studies. (J. F. Duggar).—Seed of *Crotalaria spectabilis*, scarified on a commercial scarifier, germinated in 1936 in Norfolk sandy soil as follows: from a depth of ½ inch, 67 per cent; from 1 inch, 52 per cent; from 2 inches, 27 per cent; from both 4 inches and 6 inches, only 1 per cent. Only 2½ per cent of unscarified seeds emerged from a depth of 2 inches in 1936.

Crotalaria

Unscarified crotalaria seed that was planted in May, 1935, at depths of 2, 4, and 6 inches and that gave that season germination percentages of 60, 32, and 1 per cent respectively, gave residual germination in 1936 of less than 1 per cent for each of these depths where there was no cultivation in either year.

When crotalaria seeds were revolved for 30 minutes in a keg containing a mixture of sand and small gravel, their subsequent germination was 64 per cent. When corresponding mixtures of seed, sand, and fine gravel were shaken for the same length of time in a one-gallon glass jar, the germination was 66 per cent; from shaking merely seed in a jar, lined with emery cloth, the germination was 62 per cent. The check lot of crotalaria seed run through a commercial scarifying machine germinated 84 per cent.

Studies on Lespedeza sericea. (J. F. Duggar).—On sandy upland a two-year-old sod of sericea was mowed whenever it averaged 12, 18, and 21 to 28 inches in height. Only two mowings were possible in 1936, whatever the designed height. The season's yield of hay per acre aggregated 4,009 pounds for the 12-inch stage, 5,835 pounds for the 18-inch stage, and 6,112 pounds for the mowing made when plant height was 21 to 28 inches.

A crop of 353 pounds of unhulled seed per acre, harvested near time of frost, was obtained on a plot that earlier in the same season had yielded, at a height of 18 inches, 2,630 pounds of sericea hay per acre; the crop of unhulled seed from an entire season's growth was 519 pounds.

Acre yields of protein were rather close together, whatever the height at which the crop was mowed, but percentage of protein decreased as the plants were more advanced in maturity when harvested.

Scarified sericea seeds were planted on each of three soils (Davidson fine sandy loam, Cecil clay, and Eutaw clay) on the surface without covering, merely rolled in, and at depths of ¼ inch, ½ inch, 1½ inches, and 2 inches. The best germination (31, 46, and 51 per cent respectively for the three soils) was from a planting depth of ¼ inch. This shallow depth gave an average germination of 43 per cent, in comparison with averages of 13 per cent for no covering, 19 per cent for merely rolling the seed, 22 per cent for ½ inch, 6 per cent for 1½ inches, and only 1 per cent from planting at a depth of 2 inches.