FORTY-EIGHTH ANNUAL REPORT

January 1, to December 31, 1937

OF THE

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

M. J. FUNCHESS, *Director*

AUBURN, ALA.

Contents

ALABAMA POLYTECHNIC INSTITUTE

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

TRUSTEES

His Excellency, Bibb Graves, President	Ex-Officio
A. H. Collins, State Superintendent of Education	Ex-Officio
Francis W. Hare (First District)	Monroeville, Ala.
George Blue (Second District)	Montgomery, Ala.
T. D. Samford (Third District)	Opelika, Ala.
H. H. Conner (Third District)	Eufaula, Ala.
H. D. Merrill (Fourth District)	Anniston, Ala.
C. S. Culver (Fifth District)	Gadsden, Ala.
Robert K. Green (Sixth District)	Greensboro, Ala.
Paul S. Haley (Seventh District)	Jasper, Ala.
Edward A. O'Neal (Eighth District)	Florence, Ala.
Victor H. Hanson (Ninth District)	Birmingham, Ala.

P. O. Davis, Secretary of Board
Auburn, Ala.

AGRICULTURAL EXPERIMENT STATION STAFF

Luther Noble Duncan, B.S., M.S., LL.D., President
M. J. Funchess, M.S., D.Sc., Director of Experiment Station
W. H. Weidenbach, B.S., Executive Secretary
Kirtley Brown, A.B., Agricultural Editor
Mary E. Martin, Librarian
Sara Willeford, B.S., Agricultural Librarian

Agricultural Economics:

B. F. Alvord, M.S.	Head, Agricultural Economics
B. T. Inman, M. S.	Assistant Agricultural Economist
E. G. Schiffman, M.A.	Assistant Agricultural Economist

Agricultural Engineering:

R. E. Yoder, Ph.D.	Acting Head, Agricultural Engineering
J. W. Randolph, M.S.	Agricultural Engineer (Coop. U.S.D.A.)
E. G. Diseker, B.S.	Assistant Agricultural Engineer
E. D. Gordon, M.S.	Associate Agricultural Engineer (Coop. U.S.D.A.)
I. F. Reed, M.S.	Assistant Agricultural Engineer (Coop. U.S.D.A.)
Fred Kummer, B.S.	Assistant Agricultural Engineer
C. H. Bailey, B.S.	Assistant in Agricultural Engineering
B. C. Small, B.S.	Graduate Assistant
C. M. Stokes, B.S.	Graduate Assistant

Agronomy and Soils:

J. W. Tidmore, Ph.D.	Head, Agronomy and Soils
Anna L. Sommer, Ph.D.	Associate Soil Chemist
G. D. Scarseth, Ph.D.	Associate Soil Chemist
N. J. Volk, Ph.D.	Associate Soil Chemist
J. R. Taylor, Ph.D.	Associate Soil Chemist
J. A. Naftel, Ph.D.	Assistant Soil Chemist
H. B. Tisdale, M.S.	Associate Plant Breeder
J. T. Williamson, B.S.	Associate Agronomist
H. R. Albrecht, M.S.	Assistant Agronomist
J. B. Dick, B.S.	Associate Agronomist (Coop. U.S.D.A.)
D. G. Sturkie, Ph.D.	Associate Agronomist
E. L. Mayton, M.S.	Assistant Agronomist
J. W. Richardson, B.S.	(Brewton) Assistant in Agronomy
F. E. Bertram, B.S.	(Prattville) Assistant in Agronomy
W. V. Chandler, B.S.	Graduate Assistant
H. R. Benford, B.S.	Graduate Assistant

Animal Husbandry, Dairying, and Poultry:

J. C. Grimes, M.S.	Head, Animal Husbandry, Dairying and Poultry
W. D. Salmon, M.A.	Animal Nutritionist
C. J. Koehn, Ph.D.	Associate Animal Nutritionist
*C. O. Prickett, B.A.	Associate Animal Nutritionist
G. A. Schrader, Ph.D.	Associate Animal Nutritionist

*On leave.

W. C. Sherman, Ph.D. — Associate Animal Nutritionist
J. L. West, D.V.M. — Assistant Animal Nutritionist
W. E. Sewell, M.A. — Assistant Animal Husbandman
D. F. King, M.S. — Associate Poultry Husbandman
C. D. Gordon, M.S. — Associate Poultry Husbandman
G. J. Cottier, M.A. — Assistant in Poultry Husbandry

Botany and Plant Pathology:

J. L. Seal, Ph.D. — Head, Botany and Plant Pathology
E. V. Smith, M.S. — Associate Botanist and Plant Pathologist
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)

Horticulture and Forestry:

L. M. Ware, M.S. — Head, Horticulture and Forestry
C. L. Isbell, Ph.D. — Horticulturist
E. W. McElwee, M.S. — Assistant Horticulturist
Keith C. 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
W. A. Johnson, B.S. — Laboratory Technician

Special Investigations:

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

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
A. M. Pearson, Ph.D. — Associate Biologist (Coop. U.S.D.A. and State Department of Conservation)

Substations:

Fred Stewart, B.S. — Superintendent Tennessee Valley Substation, Belle Mina, Ala.
J. K. Boseck, B.S. — Assistant 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.
C. A. Brogden, B.S. — Assistant Superintendent Wiregrass Substation, Headland, Ala.
K. G. Baker, B.S. — Superintendent Black Belt Substation, Marion Junction, Ala.
Otto Brown, M.S. — Superintendent Gulf Coast Substation, Fairhope, Ala.
Harold Yates, B.S. — Assistant Superintendent Gulf Coast Substation, Fairhope, Ala.

CHANGES IN STATION STAFF DURING 1937

Appointments:

W. V. Chandler, B.S. — Graduate Assistant
H. R. Benford, B.S. — Graduate Assistant
F. E. Bertram, B.S. — Assistant in Agronomy
E. G. Schiffman, M.A. — Assistant Agricultural Economist
C. H. Bailey, B.S. — Assistant in Agricultural Engineering
W. A. Johnson, B.S. — Laboratory Technician
A. M. Pearson, Ph.D. — Associate Biologist (Coop. U.S.D.A. and State Department of Conservation)
J. L. West, D.V.M. — Assistant Animal Nutritionist
C. M. Stokes, B.S. — Graduate Assistant
J. K. Boseck, B.S. — Asst. Supt. Tennessee Valley Substation
C. A. Brogden, B.S. — Asst. Supt. Wiregrass Substation

Resignations:

A. Carnes, M.S. — Acting Head, Agricultural Engineering
H. S. Peters, M.S. — Assoc. Biologist (Coop. U.S.D.A. and State Department of Conservation)
C. M. Clark, M.S. — Associate Agricultural Economist
R. L. Melcher, M.S. — Assistant Agricultural Economist
Edith M. Slights — Statistical Assistant

NEW PUBLICATIONS

Articles in Scientific Journals

McElwee, E. W.—**Test Production of Early Asters Outdoors Under Southern Conditions.** *The Florist Review,* January 14, 1937.

Naftel, James A.—**Soil Liming Investigations: III. The Influence of Calcium and a Mixture of Calcium and Magnesium Carbonate on Certain Chemical Changes of Soils.** *Jour. Amer. Soc. Agron.* 29:526-536 (1937).

Naftel, James A.—**Soil Liming Investigations: IV. The Influence of Lime on Yields and on the Chemical Composition of Plants.** *Jour. Amer. Soc. Agron.* 29:537-547 (1937).

Naftel, James A.—**Soil Liming Investigations: V. The Relation of Boron Deficiency to Over-Liming Injury.** *Jour. Amer. Soc. Agron.* 29:761-771 (1937).

Salmon, W. D. and Goodman, J. G.—**Alleviation of Vitamin B Deficiency in the Rat by Certain Natural Fats and Synthetic Esters.** *Jour. Nutrition* 13: 477-500. 1937.

Schrader, G. A., Prickett, C. O., and Salmon, W. D.—**Symptomatology and Pathology of Potassium and Magnesium Deficiencies in the Rat.** *Jour. Nutrition* 14:85-109. 1937.

Schrader, G. A.—**The Determination of Semi-Macro Quantities of Glucose by the Hagedorn-Jenson Method.** *The Chemist Analyst* 26: 52-55. 1937.

Smith, E. V. and Fick, George L.—**Nut Grass Eradication Studies: I. Relation of the Life History of Nut Grass, Cyperus rotundus L., to Possible Methods of Control.** *Jour. Amer. Soc. Agron.* 29:1007-1013. 1937.

Smith, E. V. and Mayton, E. L.—**Nut Grass Eradication Studies: II. The Eradication of Nut Grass, Cyperus rotundus L., by Certain Tillage Treatments.** *Jour. Amer. Soc. Agron.* 30:18-21. 1938.

Sommer, Anna L., and Booth, Thomas E.—**Meta- and Pyrophosphate within the Algal Cell.** *Plant Physiology,* 13:199-205. 1938.

Sturkie, D. G.—**Control of Weeds in Lawns with Calcium Cyanamid.** *Jour. Amer. Soc. Agron.* 29:803-808. 1937.

Ware, L. M.—**Interrelation of Spacing of Seed Piece and Rate of Application of Fertilizer in the Production of Potatoes in Alabama.** *Am. Potato Jour. XIV*: 355-362.

Ware, L. M.—**Interrelation of Size of Seed Piece and Rate of Application of Fertilizer in the Production of Potatoes in Alabama.** *Am. Potato Jour. XIV*: 375-382.

Experiment Station Publications

Mayton, E. L.—*Cotton Spacing.* Circular 76.

Inman, Buis T.—*Purchases of Feeds and Grains in Alabama,* 1935. Circular 77.

Sturkie, D. G.—*Fertilizer and Crop Experiments on Certain Soils of the Black Belt.* Circular 78.

Sturkie, D. G.—*Experiments with Hay Crops in Alabama.* Circular 79.

King, D. F. and Cottier, G. J.—*The Value of Peanuts and Peanut Meal in Rations for Chickens.* Circular 80.

Diseker, Ellis G.—*A Device to Assist in Mowing Kudzu.* Leaflet 16.

Sewell, W. E.—*A Method of Curing Pork When the Weather is too Warm for Natural Chilling.* Leaflet 17.

Wilson, J. P.—*Suggestions for Growing Hogs in Southeast Alabama.* Special Leaflet.

AGRICULTURAL ECONOMICS

The Demand of Alabama Markets as a Basis for Adjustments in Agricultural Production within the State. Purchases of Work Stock and Commercial Feeds. (Buis T. Inman).—Work stock represent an important part of the investment and annual expense on Alabama farms. For the years 1929 to 1936, Alabama farmers purchased annually from out of the State approximately 23,800 head of work stock valued at $2,635,000. Even with these annual purchases there were only .91 head of horses and mules 2 years old and over per male farm worker over 14 years of age in 1935. The farm shortage in work stock was lessened to some extent in 1935 by the use of approximately 23,000 head of oxen. In later years the increase in purchases of tractors on large farms has relieved the work stock shortage while on small farms this shortage has been met to some extent by purchases of mules and few oxen are now used.

A study of the sales of commercial feeds shows that 283,624 tons valued at $10,582,000 were sold in Alabama in 1936. Of this amount approximately 100,000 tons were manufactured from State-grown products. The sale of commercial feeds amounted to $39 per census farm for 1936.

Farm Planning for the Future in Alabama. (Ben F. Alvord).—In farm planning attention usually should be directed first to the point where the need is greatest. That point for the Alabama farmer appears to be in cash income per farm (Table 1). Cash income from farm production, including government payments, averaged $402 in this State for the seven years 1929 through 1935. This was slightly less than 39 per cent of the average cash income per farm in the United States.

TABLE 1.—The Average Income from Farm Production and Value of Farm-Produced-Family-Used Products for Farmers of the United States and Alabama, 1929-1935.

Year	Cash income		Value-farm-produced-family-used products	
	United States	Alabama	United States	Alabama
1929	$1,650	$678	$287	$244
1930	1,252	459	243	218
1931	923	280	167	202
1932	666	222	155	162
1933	775	343	195	165
1934	928	399	156	195
1935	1,057	431	191	207
Average	$1,036	$402	$199	$199

For the same period, however, the average farmer in Alabama produced for use in his own household products of as great a value as the average farmer of the United States produced for similar use. These data indicate the great need for increasing the cash income of farmers in the State. Such an increase may depend to a considerable extent upon legal restrictions and market limitations. At least the individual farmer will not likely be entirely free to produce for markets as he sees fit. On the other hand the relative shortage in cash income emphasizes the need for increasing production for household use despite its equality with the United States average. Such increase can be brought about by the individual farmer without regard to federal policy or the action of other farmers. For this reason the Alabama farmer should still find it to his advantage to give much consideration to increasing production for his own table and household while considering his opportunity to increase his cash returns.

AGRICULTURAL ENGINEERING

Physical Effects of Tillage as Related to Plant Growth. (R. E. Yoder).—Studies extending over one growing season were conducted to determine the influence of pulverization of Cecil clay on the growth and development of the cotton plant. Emergence of the cotton plants was most rapid and complete from

highly pulverized seed-beds; poor stands were obtained on the extremely cloddy seed-beds. Crust formation occurred on plots of all degrees of pulverization. Excessively pulverized seed-beds produced small, early-maturing plants. Extremely cloddy seed-beds produced rather large, late-maturing plants. Highest yields were obtained on seed-beds with intermediate degrees of pulverization.

A close correlation was found to exist between capillary porosity of the seed-beds and the development of the cotton plants. There was a consistent tendency for seed-beds characterized by high non-capillary porosity to be associated with high yielding, early maturing cotton plants.

Dynamic Properties of Soils as Applied to the Elements of Implement Design. Development of Reduced-Friction Surfaces and Materials for Experimental Plows. (F. A. Kummer).—Results derived from the analysis of laboratory tests on adhesion of soil to metal surfaces were applied to the design and construction of a number of experimental plow shapes. The object of these tests was to find a suitable material and a suitable shape for the so-called "non-scouring" plastic soils typical of the Black Belt Section of the State. Two definite principles were employed in the design of these experimental shapes:

a. The use of mechanical means, and
b. The application of certain materials to produce better scouring.

Among the shapes employing mechanical principles to transport the soil over the moldboard, a plow bottom having a set of eight wooden rollers in place of the moldboard gave promising results. The most effective of all types tried, however, was a slat-type bottom on which the original steel slats were replaced by impregnated wooden slats. Comparative field tests revealed that the wood-slat bottom produced considerably better scouring than the steel-slat bottom, especially in the higher moisture ranges where the "adhesion phase" friction becomes extremely evident.

The Dynamics of Erosion and the Principles of Control. (E. G. Diseker).—I. *Vetch Sown in Rows Compared to Broadcast Vetch for Erosion Control.* Vetch sown broadcast on smooth plots having 5 per cent slope was 1.5 times as effective in controlling sheet erosion as was vetch sown on comparison plots in 18-inch rows; on plots having 20 per cent slope the broadcast vetch was 2.7 times as effective as the drilled vetch. All plots were on Cecil clay soil and the rate of seeding was 32 pounds of vetch seed per acre.

II. *A Method of Measuring Run-off Velocity of Water as Related to Soil Movement Between Terraces.* An attempt was made to correlate the velocity of run-off with the rate of soil move-

ment between terraces in the sheet erosion process on Cecil clay plots. The plots were planted to oats. The surface horizon soil was saturated with water immediately preceding each test. Artificial rain was then applied at a constant rate. Measurements of the rate of rise of the water in each calibrated cistern were used to calculate the rate of run-off. The time in seconds required for the rate of run-off to reach a maximum was assumed to be a measure of time required for water to travel the slope length of the plot. By dividing slope length in feet by time in seconds the average slope velocity was approximated. However, it must be pointed out that the actual path of travel of the water was greater than slope length because of the meandering flow down the slope. Hence calculated velocities are probably somewhat low. Soil and water samples were taken at one-minute intervals to determine the rate of soil losses. The calculated slope velocity on an oat plot 5 feet long with a 5 per cent slope was .20 feet per second with a soil movement of 1.5 grams of soil per liter of run-off. The calculated slope velocity on an oat plot 50 feet long with a 20 per cent slope was .41 feet per second and the soil movement was 16.5 grams of soil per liter of run-off.

III. *Soil and Water Losses Measured at Terrace Outlets on Strip Cropped Areas.* Specially constructed concrete cisterns were installed at terrace outlets for measuring soil and water losses on a 3½ acre field. Part of the field consisted of a clay soil and the other portion was an extremely sandy soil. Approximately the upper half of the area between terraces was in cotton during the summer, while the remaining portion was in soybeans. During the winter months the cotton area was planted to oats and the soybean area was planted to hairy vetch. During a 13-month period only 21 rains amounting to 37.75 acre inches produced erosion. As much as two inches of rainfall of low intensity would frequently be absorbed. Most of the losses resulted from rains of high intensities, falling when the soil was practically saturated from previous rains. During the 13 months, one rain of 3.9 inches, which fell in 12 hours when the soil was quite wet, accounted for several times more soil losses than the other combined rains. The losses for the combined rains other than the 3.9 inch rain were only a few hundred pounds per acre. Greater losses occurred on clay plots than on the sandy plots.

AGRONOMY AND SOILS

Influence of Commercial 6-8-4 Fertilizer Applied at Various Rates Upon the Stand of Cotton. (J. T. Williamson, J. W. Richardson, and R. W. Taylor).—In tests conducted on 117 Alabama farms in 1936 and 1937, commercial 6-8-4 fertilizer, applied at various rates up to approximately 600 pounds per acre, did not materially influence the stand of cotton.

In these tests the farmer's fertilizer application was used for stand comparison with a 6-8-4 mixture which was applied on the same day and in exactly the same way. Stand data were obtained after cultivation was completed.

Hill counts showed that there were about three per cent more hills of cotton where the farmer's fertilizer was used than where 6-8-4 fertilizer was used. However, this stand difference was not significant because the stands were practically perfect (8,300 hills per acre) in both cases. For example, in 57 experiments, where the farmer's fertilizer and the 6-8-4 were used at average rates of 345 pounds and 576 pounds per acre, respectively, there were 8,586 hills per acre where the farmer's fertilizer was applied and 8,455 hills where the 6-8-4 was applied.

Cotton Variety Tests. (H. B. Tisdale and J. B. Dick).—The average results for three years (1935-1937) of cotton variety tests conducted on the substations and experiment fields of Alabama show that Stoneville 5, D.P.L. 11A (Deltapine), Delfos (Washington), and Cook 144 are the most satisfactory varieties producing staple around one inch in length for sections of Alabama not infested with the cotton wilt disease. Other satisfactory varieties producing staple around 15/16 of an inch in length for non-wilt-infested sections are Cook 1627 and Cleveland. Clevewilt, Cook 144, and Dixie Triumph are the most satisfactory wilt-resistant varieties that produce staple around one inch in length. Wiregrass Cook and several strains of the Auburn Cook are satisfactory wilt-resistant varieties that produce staple around 15/16 of an inch in length.

Varieties and Fertilizers in Relation to the Cotton Wilt Disease. (H. B. Tisdale and J. B. Dick).—The results of studies for 1936 and 1937 on the relation of fertilizers and varieties of cotton to the wilt disease indicate that:

1. The evidence supporting the existence of different physiological strains of the wilt organism is rather weak. A difference of virulence of the wilt organism under different conditions is indicated. The varieties of cotton tested may be grouped into four classes according to their resistance to the wilt disease; namely, resistant, highly tolerant, weakly tolerant, and susceptible.

2. The varieties of cotton tested differ in their response to applications of different amounts of potash. Resistant varieties are benefited more by moderate applications of potash than are the susceptible varieties. Susceptible varieties apparently require more potash and are indifferent to excess applications, while resistant varieties require less potash and show injury and delayed maturity as a result of excess applications. A gradation of these requirements from the most susceptible to the most wilt-resistant varieties is apparent and shows a relationship between wilt resistance and ability to use potash.

A Comparison of Sulfate of Ammonia and Nitrate of Soda for Cotton on Limed and Unlimed Land. (E. L. Mayton).—These two nitrogenous materials have been used annually for cotton on limed and on unlimed plots of Norfolk sandy loam soil since 1925. Each material has been used to supply 60 and 30 pounds of nitrogen per acre on different plots.

On limed plots sulfate of ammonia has produced slightly more cotton than nitrate of soda, but on unlimed plots it has produced an average of 300 pounds of seed cotton per acre less than nitrate of soda at the 60-pound rate and 143 pounds less at the 30-pound rate.

Since 1934 sufficient lime has been applied on one half of each plot along with the fertilizers to correct the acidity of the current sulfate of ammonia applications. These lime applications have resulted in approximately equal yields from the two sources of nitrogen during the last four years.

A Comparison of Stable Manure, Nitrate of Soda, and Vetch as Sources of Nitrogen for Cotton and Corn in a Two-Year Rotation. (E. L. Mayton).—In an experiment on Norfolk sandy loam soil the above materials have been compared since 1925. Stable manure was used at the rate of 5 tons per acre, nitrate of soda at the rate of 325 pounds per acre, and vetch was turned under around the first of April. Phosphate and potash applications were essentially equal on all plots of cotton or corn. The 13-year average results show that manure increased the yield of seed cotton 1,236 pounds per acre, nitrate of soda increased the yields 976 pounds, and vetch 978 pounds. Vetch crops on the cotton section in 1928 and 1932 were practically failures due to cold and to rabbit injury, respectively. The increases in corn yields were 31.5, 29.4, and 26.5 bushels per acre for manure, nitrate of soda, and vetch, respectively. Over the 13-year period three crops of vetch on the corn section were partially destroyed by rabbits or killed by cold.

The Effect of Some Environmental Factors on the Oil Content of Cotton Seed. (D. G. Sturkie).—The oil content of cotton seed was determined by the refractive index method of Coleman and Fellows. Determinations were made on the seed of the crops of 1933, 1934, and 1935 from plots used in fertilizer studies and for the crops of 1930, 1931, 1932, 1933, and 1934 from cotton grown on different soil types.

The results show that the oil content may be affected by soil type, soil moisture, and fertilizers. Cotton grown on soil from the Mississippi Delta always produced seed with a higher oil content than that grown on Norfolk sandy loam; cotton grown with sufficient moisture produced seed with a higher oil content than that grown with limited moisture; cotton grown without either phosphate or potash in the fertilizer produced seed with a lower oil content than cotton grown with an abundance of

phosphate and potash; and cotton fertilized with manure produced seed with a higher oil content than those from cotton that was fertilized with a complete fertilizer from commercial materials.

The results show that the oil content of the seed may be affected by a number of factors that act separately or collectively. Further studies are being made in an effort to determine whether factors other than the ones studied may not also be affecting the oil content of the seed.

Influence of Time of Planting Dallis Grass on the Stand Obtained. (D. G. Sturkie).—A plot of Dallis grass was planted on approximately the 15th of each month. Domestic seed were sowed at the rate of 40 pounds per acre. The results over a period of five years are shown in Table 2.

The results show that any planting from October to March has produced satisfactory results all of the years. Plantings made in the other months have usually given very poor stands.

TABLE 2.—The Summary of the Results of the Stands of Dallis Grass Obtained for Five Years from Planting Domestic Seed at Various Dates.

Month sowed	Condition of grass one year after sowing seed				
	Year				
	1931-1932	1932-1933	1933-1934	1934-1935	1935-1936
September	----	Poor	Poor	Poor	Poor
October	Good	Good	Fair	Poor	Good
November	Good	Good	Fair	Fair	Good
December	Good	Fair	Fair	Good	Good
January	Good	Fair	Fair	Good	Good
February	Good	Good	Fair	Good	Good
March	Good	Good	Fair	Good	Good
April	Poor	Fair	Good	Fair	Fair
May	Good	Fair	Fair	Poor	Poor
June	Fair	Fair	Fair	Poor	Poor
July	Good	Good	Poor	Poor	Poor
August	Poor	Poor	Poor	Poor	Poor

Lysimeter Studies. *Nitrogen Economy in Different Systems of Soil and Crop Management.* (J. R. Taylor, Jr., and J. W. Tidmore.)—One hundred and seventy-four lysimeter tanks varying in depth from 12 to 36 inches are now in operation. One hundred and thirty-five of these were installed during the summer of 1936 and the remaining 39 were put into operation during the summer of 1937. Sixty-four of the tanks were filled with Hartsells fine sandy loam, 63 with Decatur clay loam, and 47 with Norfolk sandy loam.

One of the principal objectives in the study is to determine the amounts of nitrogen lost from the soil by leaching when soybeans, cowpeas, and crotalaria are added to the soil in different ways. Ten thousand pounds of green soybeans per acre (69.6

pounds N) and enough cowpeas and crotalaria to give an equivalent number of pounds of nitrogen were added to the different soils. Sudan grass was grown in the tanks during the summer.

Results to date show that more nitrogen was lost by leaching from the tanks receiving soybeans and cowpeas than from those receiving crotalaria. On the Norfolk soil, where soybeans and cowpeas were left on top of the ground during the winter and turned in the spring, approximately 14 per cent of the added nitrogen was lost by leaching. When these crops were turned in the fall approximately 38 per cent of the added nitrogen was lost.

Very little of the added nitrogen was lost by leaching from the Decatur Soil. The losses from the Hartsells soil were intermediate between those from the Decatur and Norfolk soils.

The Relation of Soil Types and the Distribution of Soils Susceptible to Boron Deficiency by Over-Liming. (James A. Naftel).—The earlier work on lime-induced boron deficiency was conducted on a light-textured Coastal Plains soil and it seemed important to determine the distribution of soils susceptible to such injury. Accordingly, 20 soils of widely different origin and properties were obtained for greenhouse cultures. Included in these were one soil from West Virginia and two from Vermont which had been reported to give negative results when excessively limed; no satisfactory explanation had been given for the results on these soils. Excessive lime caused boron deficiency on Cecil sandy loam, Davidson clay, and Davidson loam of the Piedmont Plateau, Eutaw clay of the Black Belt, Norfolk sandy loam and Ruston sandy loam of the Coastal Plains, DeKalb silt loam of West Virginia, and on the A-1 and A-2 horizon of a podsol soil from Vermont. On all of these soils the addition of boron partially or completely overcame the injurious effect of excess lime; on other soils an excess of lime had little effect on the growth of plants; and on a few the added boron was slightly harmful. The optimum rate of boron varied with soil texture and organic matter content. The effects of lime and boron on two soils are shown in Figure 1.

Oxidation-Reduction Potentials of Soils. (N. J. Volk).—Existing methods for the determination of oxidation-reduction (redox) potentials in soils were found inadequate for the studies contemplated at this station. A method of analyses, to be satisfactory, must meet the following requirements:

1. Bacterial action must be inhibited so as to prevent reduction of the soil after it has been removed from the field.

2. The oxidation of reduced compounds existing in the soil must be prevented.

3. Substances existing as solid matter in the soil must not be appreciably dissolved.

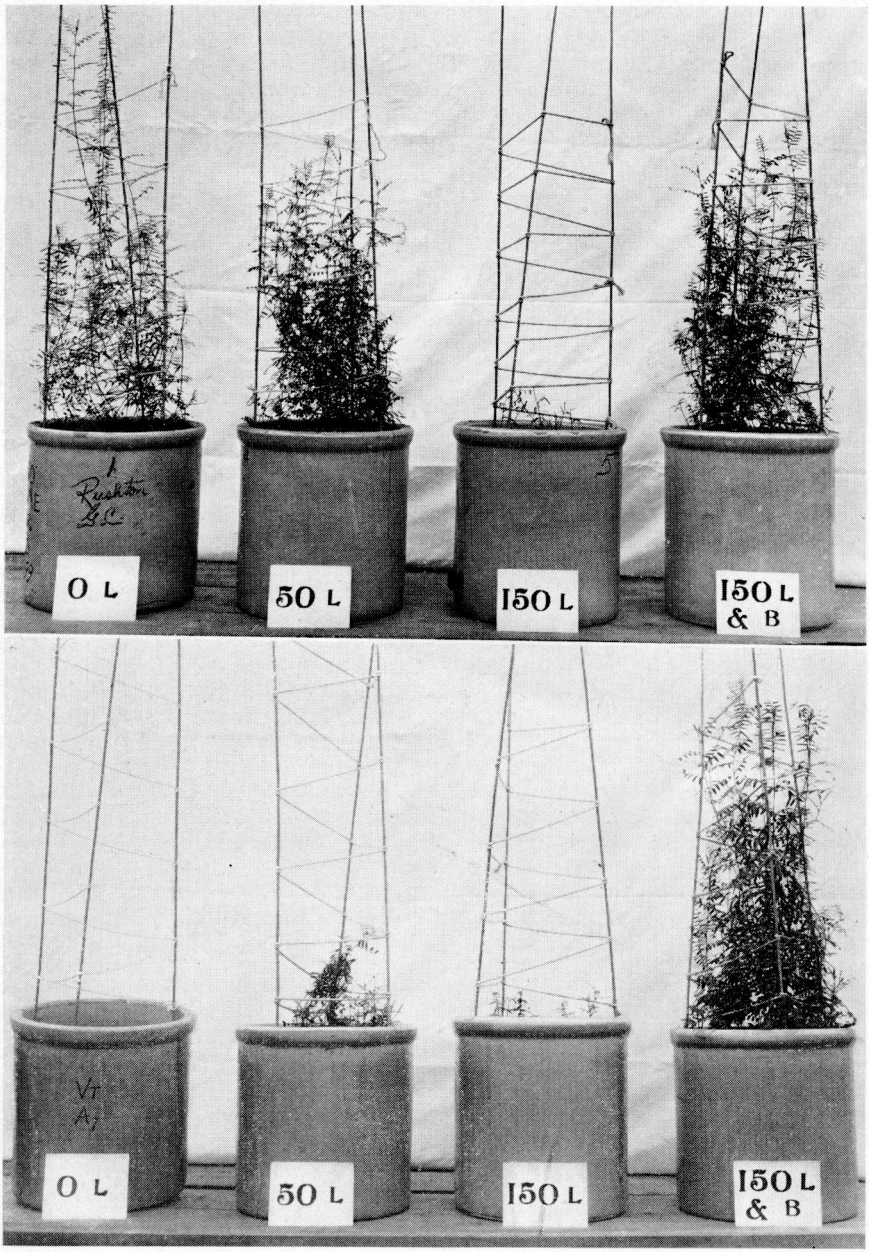

FIGURE 1.—The effect of lime and boron on hairy vetch.
Above: Ruston sandy loam; below: A-1, Podsol from Vermont. From left to right, no lime, 50% saturated, and 150% saturated all without boron, and 150% saturated plus boron.

4. The redox potential obtained must be the same as that existing in the soil in its natural state, or be comparable to it so that one soil can be compared with another.

It was found that samples of soil suspended in water out of contact with air, saturated with nitrogen gas, and cooled to between 1 and 3 degrees centigrade would remain nearly constant in potential (Eh) for several days. Thus, samples of soil were kept under the above conditions until actual laboratory analyses were begun. All analyses were made in an atmosphere of nitrogen, using quadruple blank platinum wire electrodes and glass electrodes simultaneously for the determinations of Eh and pH, respectively. Results not agreeing within 5 millivolts were discarded and the analyses repeated with new electrodes.

Forty-four areas of soil scattered over the northern three fourths of Alabama were studied for seasonal fluctuations in Eh and moisture. They were sampled every two weeks for one year and at three depths; namely, 0 to 8 inches, 8 to 16 inches, and 16 to 24 inches. The vegetative cover was three types, (a) cultivated crops, (b) grass, and (c) woodland.

A summary of all the results shows that the arable Alabama soils vary in Eh only about 60 millivolts during the entire season and that this variation is directly related to the moisture content of the soil. That is, as the soil moisture rises the Eh rises and vice versa. This is believed to be due at least in part to variations in the amount of oxygen carried into the soil by rains and to a depletion of oxygen by bacterial action during the periods between rains.

Since Alabama soils as a whole vary only about 60 millivolts during the entire season it seemed quite possible that such small changes would not appreciably affect plant growth if oxygen was supplied. To test this, a series of sand cultures was set up with different plants; nutrient solutions were used having identical nutrient values, ample oxygen present, but varying in potential from 285 to 524 millivolts. These nutrient solutions were forced through the sand cultures at such a rate that their Eh was not changed; thus, plants could be grown at potentials varying from 285 to 524 with a reasonable degree of accuracy. When properly used, hydroquinone was found to be satisfactory for changing the potential of the nutrient solution. It changed the Eh as follows:

Composition of Solution	*Eh of solution at pH* 6.0
Nutrient solution + no hydroquinone	524
Nutrient solution + 10 p.p.m. hydroquinone	357
Nutrient solution + 20 p.p.m. hydroquinone	338
Nutrient solution + 40 p.p.m. hydroquinone	320
Nutrient solution + 80 p.p.m. hydroquinone	307
Nutrient solution + 160 p.p.m. hydroquinone	290
Nutrient solution + 320 p.p.m. hydroquinone	285

Thirteen different plants were grown in the greenhouse at different potentials as described above and in no case could a difference in growth be detected by weighing or by observation. The plants grown were sorghum, Sudan grass, sunflower, corn, cotton, alfalfa, vetch, crotalaria, blackeyed peas, soybeans, string beans, tomatoes.

It is concluded from these experiments that Eh is not a factor in plant growth on arable Alabama soils. This conclusion seems reasonable because of the fact that different elements in the same state of oxidation or reduction have different potentials, and therefore it cannot be said that any given soil is in an oxidized or reduced state unless the relative concentrations of the active substances contributing to the observed Eh are known.

A study of active soil oxygen would likely prove to be more profitable than a study of Eh, and it is planned to continue the study in that direction.

Elements Required in Small Quantities for Plant Growth in Soils. (Anna L. Sommer).—Corn and turnip plants were grown in 16 different soils. All cultures received applications of nitrogen, phosphorus, potassium, calcium, and sulfur. The different fertilizer treatments were as follows: 1. The above elements were furnished by the addition of purified salts; 2. The same as 1 but with the addition of very small amounts of boron, zinc, fluorine, bromine, iodine, molybdenum, copper, manganese, cobalt, and nickel; 3. The same as 2 but with the addition of magnesium; 4. Chilean nitrate was substituted for purified sodium nitrate; 5. Chilean nitrate, superphosphate, and purified potassium chloride; 6. All purified salts excepting superphosphate; 7. All purified salts excepting potassium chloride (commercial muriate); 8. Superphosphate, muriate of potassium, and purified sodium nitrate. In the case of corn, only one soil gave a superior crop when the trace elements were added. No additional yield was obtained by the addition of magnesium. In the case of the second crop, turnips, several soils responded to the addition of the trace elements. In some cases there was a marked increase in dry weight and in some cases where there was no significant increase in dry weight only those cultures to which these elements had been added showed no discoloration or other abnormalities when the turnips were cut. The trace elements added as impurities in commercial fertilizers were insufficient to protect the plants where the deficiency was marked. No additional improvement was obtained by the addition of magnesium.

ANIMAL HUSBANDRY, DAIRYING, AND POULTRY

A Study of the Transmission of Factors Related to the Economical Production of Swine. Variation in the First Generation. (J. C. Grimes).—An attempt is being made to increase the efficiency of gains in a herd of Duroc Jersey hogs by selecting and

mating the hogs in each generation that make the most economical gains. Eight litters, consisting of 70 pigs, were fed in individual pens to a weight of 225 pounds during the past year. The birth weight of pigs in the different litters varied considerably. The lightest litter averaged 1.9 pounds per pig at birth and the heaviest litter averaged 3.11 pounds per pig at birth. The slowest gaining pig of the 70 required 267 days to reach a weight of 225 pounds and the fastest gaining pig required only 162 days to reach a weight of 225 pounds. The greatest amount of feed required by any pig to make 100 pounds of gain was 413 pounds and the smallest amount required by any pig was 307 pounds.

There was quite a variation among individual pigs within the same litter both in length of time required to reach 225 pounds in weight and in the amount of feed required for 100 pounds of gain. The least variation in the amount of time elapsing from birth to 225 pounds in weight in any litter was 17 days, and the greatest variation in any litter was 73 days. The smallest variation in feed required for 100 pounds of gain in any litter was 32 pounds, and the greatest variation was 91 pounds.

Beef Production in East Alabama. (J. C. Grimes).—Seventy acres of land consisting mainly of waste land, abandoned cotton land, and woodland was used as a pasture for beef breeding cows during the summer of 1936 and 1937.

This pasture furnished grazing for an average of 19 cows from April 1 to November 1 each year. The grasses and clovers in this pasture were volunteer and consisted mostly of hop clover, lespedeza, carpet grass, and Dallis grass.

The average annual return in the form of beef (live weight) produced from this herd was 5,699 pounds worth $359.16. The average annual cost of winter feed was $98.52. After the winter feed cost was deducted the average return per acre of land was $3.72.

During the winter of 1936 each cow consumed 169 pounds of velvet beans, 80 pounds of cottonseed meal, and 1.77 tons of sorghum silage. The cost of these feeds was $6.29 per cow. During the winter of 1937 each cow consumed an average of 80 pounds of cottonseed meal, 635 pounds of peanut hay, and 1,284 pounds of silage. The cost of these feeds was $4.19 per cow.

Peanut Hay as a Roughage for Fattening Steers. (J. C. Grimes).—Farmers in Southeast Alabama make a large amount of peanut hay as a by-product of commercial peanut production. This hay varies a great deal in quality, much of it being weather damaged and stemmy. Most of this hay is sold to speculators for from $4.00 to $6.00 per ton. It is then transported to other parts of Alabama and to the surrounding states where it is resold to consumers. The transportation charges on this hay are usually more than the first cost of the product.

As a general rule the most profitable way to market cheap feed such as this hay is to feed it on the farm where it is grown. An experiment was started December 4, 1936 to determine (1) the value of peanut hay as a roughage for fattening beef steers and (2) the value of grinding peanut hay for fattening steers.

Thirty head of feeder steers, grading from common to medium were purchased, divided into three uniform lots and fed for a period of 112 days as follows:

Lot I. Silage and cottonseed meal (check).
Lot II. Ground peanut hay and cottonseed meal.
Lot III. Unground peanut hay and cottonseed meal.

The same amount of cottonseed meal was fed in each of the three lots but the roughage in each lot was fed according to the appetites of the steers.

The silage fed in Lot I was made of sorghum cane after most of the heads had been removed. It was, therefore, rather low in quality. The peanut hay used was of medium quality. All lots of steers received marble dust and salt, free choice.

The steers in Lot II made the largest daily gains, sold for the highest price per pound, and returned the greatest profit above feed cost of any lot.

Peanut hay and cottonseed meal as used in this experiment gave very good results for fattening steers. The gains were considered very satisfactory in both the ground and unground hay lots. While the relationship of the price of feed to the price of cattle which existed during this experiment was more favorable to the cattle feeder than can usually be expected, the results suggest that farmers who raise peanut hay should be able to feed it to steers at a profit during the average year.

After paying for the steers, the cottonseed meal, and the mineral, the return for each ton of hay fed in Lot II was $27.17 and in Lot III, $23.47. Although the silage and meal fed steers returned a profit above feed cost they gained rather slowly during the experiment, probably due in a measure to the fact that the silage contained very little grain.

In this experiment ground hay was worth $3.70 more per ton than unground hay for fattening steers.

Peanut Hay for Wintering Beef Breeding Cows. (J. C. Grimes).—In order to determine the value of peanut hay for wintering beef cows, 18 cows were divided into three lots of six cows each and fed as follows from December 4, 1936 to March 1, 1937, inclusive.

Lot I. Peanut hay alone.
Lot II. Peanut hay and one pound of cottonseed meal per head daily.
Lot III. Sorghum silage and one pound of cottonseed meal per head daily (check).

All cows had access to marble dust and salt. The cows were dry during the winter and all of them dropped calves in March and April. All calves were born alive and grew normally, although some of the calves were rather small at birth.

The cows in Lot I which received 12 pounds of peanut hay per head daily lost 40 pounds each during the winter. Cows in Lot II, which received 11 pounds of peanut hay plus one pound of cottonseed meal per head daily, gained 6 pounds each during the winter. Cows in Lot III, which received 40 pounds of silage and one pound of cottonseed meal per head daily, lost 91 pounds each during the winter.

When peanut hay was charged at $5.00 per ton, silage at $2.00 per ton, and cottonseed meal at $30.00 per ton the cost of wintering cows for 87 days was as follows: on hay alone, $2.54 per head; hay and cottonseed meal, $3.60 per head; and silage and cottonseed meal, $4.64 per head.

Eleven pounds of peanut hay and one pound of cottonseed meal per head daily were considered the most satisfactory ration used when the cost of the ration and the condition of the cows were taken into account.

Kudzu as a Grazing Crop for Beef Cattle. (J. C. Grimes).—A four-acre kudzu pasture which was planted in February 1932, was grazed with beef cows and heifers during the summers of 1934 to 1937 inclusive. The animals were turned into the pasture during June and were removed the last part of July or the first part of August. The pasture was stocked at the rate of 1.25 animal units per acre.

By referring to Table 3 it will be seen that one acre of kudzu furnished grazing for one cow for a period of 73.5 days each summer. The average amount of beef produced from one acre each season was 115 pounds, live weight.

Apparently the stand of plants has not been damaged by the grazing. In fact, the carrying capacity of the pasture and

TABLE 3.—Summary—Grazing Kudzu with Beef Cattle.

Year	1934	1935	1936	1937	Four-year average
Number of acres kudzu grazed	4	4	4	4	4
Dates grazed	6/26-8/27	6/3-8/3	5/28-7/27	6/17-8/9	--
Animal units carried per acre[1]	1.25	1.00	1.25	1.50	1.25
Cow days grazing per acre per season[2]	82	54	77	81	73.50
Beef produced (gain) per acre, pounds	82	86	130	163	115.00

[1]An animal unit is the equivalent of one mature cow.
[2]A cow day is the equivalent of one mature cow for one day.

the amount of beef produced per acre have increased each season.

Kudzu as a Grazing Crop for Hogs. (J. C. Grimes).—One Duroc Jersey sow with her six suckling pigs and four shoats were placed on one acre of kudzu pasture June 9, 1937. In addition to the kudzu this group of hogs received a total of 10 pounds of corn and tankage daily during the first 14 days. After the first 14 days no feed was fed and the animals were forced to live on what they obtained in this kudzu field. The sow and pigs were removed from the kudzu pasture on July 9 after having been in this field for 30 days. The four shoats remained in the field 30 days longer, or until August 9. Plenty of kudzu was available throughout the period.

The weights of the animals at the beginning and the close of the test are given below:

Animal	*Initial Weight*	*Final Weight*
Sow	215 pounds	149 pounds
Six suckling pigs	70 pounds	141 pounds
Shoat No. 31	72 pounds	75 pounds
Shoat No. 29	59 pounds	43 pounds
Shoat No. 55	39 pounds	45 pounds
Shoat No. 53	34 pounds	43 pounds

It was observed that the hogs did not relish the kudzu. They ate all the weeds which they could find in the pasture before they began eating the kudzu.

The Use of Ice in Curing Meat on the Farm. (W. E. Sewell).—In 10 tests conducted throughout the year, pork from hogs weighing approximately 200 pounds was successfully cured by boning the meat, chilling it with ice and dry curing. The chilling period was 24 hours followed by packing the meat dry in a curing mixture composed of salt 20 pounds, sugar 5 pounds, and saltpeter 4½ ounces. The meat was repacked at the end of three days. Except for rancidity, which developed in some of the meat cured in July and August, the method was successful in each trial. Tests of the length of time required for this cure showed that one week was sufficient.

In six tests, pork cut from 200-pound hogs by standard methods and chilled with ice required four weeks for successful dry curing. In these tests meats given a preliminary chilling treatment with ice, cured successfully when held at temperatures as high as 50° F. for the remainder of the curing period.

Studies of the Vitamin B Complex. *The Relation of Unsaturated Oils and Fatty Acids to Rat Acrodynia or Vitamin B_6 Deficiency.* (W. D. Salmon).—Rats receiving a fat-free diet supplemented with carotene, vitamin D concentrate, thiamin, riboflavin, and a limited amount of aqueous extract from brewer's yeast

which had been heated 24 hours at 120°-130° C (dry heat) developed a severe form of erythematous dermatitis. The addition of corn oil, linseed oil, wheat germ oil, soybean oil, or the fatty acids of linseed oil cured or prevented the dermatitis. If the heated yeast extract was omitted the oils were much less effective in curing the condition than when the yeast extract was included. The methyl esters of linoleic or linolenic acids appeared to be less effective in curing the dermatitis than the natural oils. These esters, however, entirely prevented the onset of the dermatitis, when they were fed with the heated yeast extract.

Cod liver oil and coconut oil had relatively little activity.

The use of corn starch instead of sucrose as the carbohydrate in the basal diet did not prevent the onset of the dermatitis unless the heated yeast extract was supplied.

Nicotinic acid alone or in combination with the other supplements had no effect on the dermatitis or the growth of the rats.

Pathological Conditions Associated with Lack of Vitamin B Complex. *Studies of the Peripheral Nerves in Acute and Chronic Vitamin B_1 Deficiency in the Rat.* (C. O. Prickett, W. D. Salmon and G. A. Schrader).—The effect of a deficiency of Vitamin B_1 upon the peripheral nerves of rats was studied by the polarized light method. There was a significant difference between an acute and a chronic deficiency in their effects upon the peripheral nerves. In the acute deficiency the nerves showed little observable departure from the normal other than a variable edema affecting both the myelin sheath and the axis cylinder. In the chronic deficiency the peripheral nerves showed marked departures from the normal; in the most severe cases some of the fibers became completely isotropic and others showed marked enlargement and large bulbous areas along their course. Figure 2 shows these changes.

A Study of Quality in Soybeans and Cowpeas for Human Food. (W. C. Sherman). I. *Carotene Content of Green and Mature Soybeans and Cowpeas.*—Fifty-two varieties of soybeans and nine varieties of cowpeas, in the green and mature stages, were analyzed for carotene. The fresh green soybeans ranged from 257 to 705 micrograms per 100 gm. sample, with an average of 428; the mature soybeans ranged from about 20 to 243 micrograms of carotene per 100 gm. sample. The average carotene content of the fresh green cowpeas was only 186 micrograms per 100 gm. fresh sample, with a variety range from 140 to 230; the mature cowpeas varied from about 10 to 50 micrograms per 100 gm. The carotene values represent total carotene since no attempt was made to separate the individual components.

Most varieties of soybeans in the fresh green state are a very good source of vitamin A, having about three or four times as much carotene as cowpeas. So much of the carotene of cow-

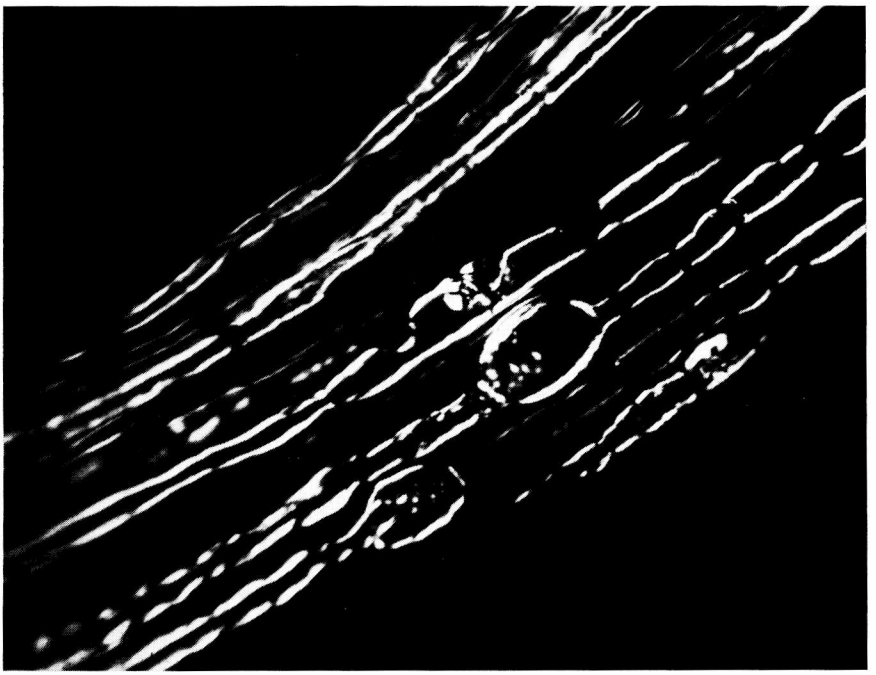

FIGURE 2.—Enlargement and segmentation of fibers in peripheral nerve of rat in chronic vitamin B_1 deficiency. 10 micron section, Polarized Light method.

peas is destroyed during the ripening and maturing that the mature cowpeas are of practically no value as a source of vitamin A. Many varieties of soybeans, however, retain significant amounts of carotene when mature.

II. *The Effect of Oils on the Utilization of Carotene.*—Young rats which were fed a vitamin A-free, low-fat diet until they developed ophthalmia and ceased growing gave a less pronounced growth response to beta carotene administration than was obtained when mature soybeans were fed as a source of vitamin A, although the soybeans were fed at levels supplying equivalent amounts of carotene. The rear feet and the fur on the backs of the carotene-fed rats developed a scaly condition which was not apparent in the animals receiving soybeans.

Certain fats, which had been treated with fuller's earth to remove carotene, greatly increased the growth response of vitamin A-deficient rats to carotene administration, and the scaly condition was entirely cured or prevented. Best growth was obtained when the carotene was supplemented with soybean oil and linseed oil. Corn, cottonseed, and wheat germ oils produced slightly less growth than the former oils but all five of the

oils entirely alleviated the scaliness. Coconut oil or butter fat, however, had no apparent beneficial effect on growth or scaliness. The most active oils, soybeans and linseed, were fractionated by means of saponification. The non-saponifiable fractions of these oils were inactive, but the methyl esters of the mixed fatty acids of soybean oil cured the scaliness and increased the growth.

Studies on the Nutrition of Dogs. (C. J. Koehn). I. *Studies on Dry Dog Rations.*—Various dry rations were formulated and fed to dogs to determine the simplest and most economical ration which would be nutritionally complete. A ration composed of yellow corn, skimmilk powder, bone meal, and salt will not allow continued growth in dogs. This is contrary to a widespread belief that dogs can be raised on corn bread and buttermilk alone. Dogs may be raised on this mixture if they are allowed to forage for themselves, but this is not the case when dogs are confined in a kennel. Such a mixture is low in protein and deficient in the essential amino acid cystine. When 20 per cent of wheat shorts was included in the above mentioned ration at the expense of the yellow corn, much better growth was obtained. This growth was probably due to the relatively high cystine content of the shorts. Maximum growth, however, was not obtained until the protein content of the ration was raised by the addition of protein concentrates. When soybean meal, fish meal, meat scrap, or cottonseed meal was used in such an amount as to raise the protein content to 20 per cent, the dogs developed normally. No toxic effect was observed when the ration contained 27 per cent of cooked cottonseed meal. These rations, except when containing fish meal as a source of protein, must be supplemented with cod liver oil or some other source of vitamin D to prevent rickets.

II. *A Comparison of the Nutritional Requirements of Dogs and Rats.* In order to set up a biological standard for commercial canned dog foods, it is necessary to evolve a simple test for determining the nutritive value of the food using a small laboratory animal such as the rat. This brings up the question as to whether or not data obtained by the use of the rat can be applied to canine nutrition.

Rats receiving different brands of commercial canned dog foods showed a great variation in growth. Certain of these same dog foods were fed to fox hounds to determine whether comparable results would be obtained. It was found that those foods which produced the best growth in rats produced normal, healthy dogs, whereas those foods which produced the poorest growth in rats did not sustain life in dogs. There is, therefore, some correlation between the growth rate of rats receiving a dog food and the nutritive value of that food

for dogs. Whether or not this correlation is close enough to draw fine distinctions is being determined.

III. *The Preparation of Samples of Canned Dog Food for Chemical Analysis.* Since there is no official method for the sampling and determination of the moisture content of commercial canned dog foods, the following method was devised. The contents of four cans of the dog food to be analysed were homogenized in a Hobart mixer. This emulsified the separated layer of oil and distributed the larger particles of food evenly throughout the mass. Three 100-gram samples of this material were dried to constant weight at 102 ± 0.5° C. and the percentage of moisture calculated. The three samples were then combined, finely ground, thoroughly mixed and redried at 102° C. for three hours. The material was cooled in a desiccator and stored in tightly stoppered bottles. This composite sample was used for all subsequent proximate chemical analyses and the percentage composition reported on the wet basis calculated from the average moisture content of the three individual samples. The accuracy of this method of sampling was shown by very close checks of the samples.

The Supplemental Value of Peanuts to the Chick and Laying Rations. (G. J. Cottier and D. F. King).—The object of this experiment was to study the effect of peanut products on interior egg quality. A hen on an all-mash ration is not consistent in the nature of fat she deposits in her eggs. Hens on the same ration vary in the nature of fat they deposit in their eggs. No correlation existed between the amount of fat in the feed and associated measurements of interior quality of eggs. Incubated eggs had slightly higher readings than eggs not incubated.

The Inheritance of Resistance to Fowl Paralysis (Neurolymphomatosis). (C. D. Gordon).—Data collected during the past two years seem to indicate that certain individuals and families are definitely more resistant to fowl paralysis than others, and that selection of resistant individuals and lines tends to reduce the incidence of the disease. Artificial inoculation studies indicate that a definite infection causes the various manifestations of paralysis.

BOTANY AND PLANT PATHOLOGY

The Mycosphaerella Disease of Winter Peas, and Diseases of Winter Peas and Vetches Caused by Ascochyta Species. (J. L. Seal).—The life cycles of these organisms have been satisfactorily worked out, showing that they may live from year to year in the soil, in old vetch and pea plants, and in and on the seed. Seed produced under dry conditions of the western states are fairly free of the organisms, but carry enough that under favor-

able conditions the diseases may spread and become epidemic. Organisms living from year to year under local conditions may frequently play an important role.

Crop rotation and seed treatment offer only partial control of the organisms. Permanent control seems to be based upon finding a winter hardy, highly disease-resistant plant. Workers at other stations have reported varieties of canning peas that show resistance to these organisms. Albrecht (Agronomy Department) and the writer have made a systematic search for species, sub-species, and varieties of Pisum and have tested them for resistance. These tests have been made under greenhouse and field conditions, some varieties having been tested a number of times. Under greenhouse conditions the symptoms of these diseases varied considerably from the symptoms produced by the organisms in the field. So far as could be determined there was no marked difference among the various varieties as to resistance to the organisms. In the field, however, winter hardiness was markedly different and in general the varieties that showed the greater winter hardiness showed less disease. Some selections of Austrian winter peas showed more winter hardiness and less disease than any of the canning or field varities.

The Seasonal Activity of the Bulbs of Wild Garlic as Related to its Control by Creosote-Kerosene or Other Sprays. (E. V. Smith).—Wild onions began germinating in late August and continued until less than 2 per cent of the bulbs were dormant in December. Although primordia of new bulbs were discernible in the mother bulbs in December none was found outside the tissues of the mother bulbs before February. Consequently there is a period of six to eight weeks in the middle of the winter when few bulbs are dormant. Most effective spraying with a 10-90 mixture of creosote and kerosene can be done during this period, since this mixture is a contact spray. It reaches the bulbs by "creeping" down the heavily cutinized leaves. Experiments indicated that a 5-95 mixture was practically as effective as the 10-90 mixture but neither pure kerosene nor 10 per cent creosote emulsified in water gave satisfactory results.

The Life History of Nut Grass, Cyperus Rotundus L., as Related to Possible Methods of Control. Tillage Eradication Methods on Norfolk Sandy Loam Soil. (E. V. Smith, Botany and E. L. Mayton, Agronomy and Soils).—The active growing season of nut grass at Auburn extends from about the first of April until about the last of October. Practically complete eradication of nut grass was effected by plowing (flat-breaking) the soil at intervals of 1, 2, 3, or 4 weeks during two successive growing seasons or by breaking the land once in the spring with a "twister" and plowing thereafter with a "sweep" at intervals of two weeks during two successive growing seasons.

Oats or other winter crops may be grown on land being plowed during the summer for nut grass eradication.

HORTICULTURE AND FORESTRY

The Effect of Various Sources of Nitrogen upon the Yield of Vegetable Crops. (L. M. Ware).—In 1934, an experiment was started to determine the behavior of the more common vegetable crops when fertilized with different sources of nitrogen, with different combinations of nitrogen, and with different acid-forming materials to which have been added varying amounts of dolomitic limestone to effect different degrees of neutralization. The standard application of fertilizer supplied 90 pounds per acre of nitrogen. The first application was made in the fall of 1934; applications have been repeated for the fall and spring of 1935, 1936, and 1937. The records given in the table on turnips and tendergreen were taken from the fall crop of 1936. Other records were from the spring crop of 1937. Four hundred and fifty pounds of nitrogen per acre had been applied to each plot by the fall of 1936 and 540 pounds per acre by the spring of 1937.

The results with different vegetable crops show rather convincingly that the source of nitrogen may become the determining factor in the yield of certain vegetable crops where the same material or combinations of materials have been used continuously on the same soil for some time. The behavior of the crops seems to be very closely related to the degree of acidity developed in the soil by the various materials. As a general observation it may be said that the base-forming materials, nitrate of soda and calcium cyanamid and also the combinations that leave a basic soil reaction such as basic slag with ammonium sulphate, have given satisfactory yields; acid-forming materials have given quite unsatisfactory yields with the crops reported. The use of dolomitic limestone as a neutralizing material has in practically every instance increased the yield when used with acid-forming materials. In many cases, however, the yield from different acid-forming materials, although the potential acidity has been neutralized, has not been as high as from nitrate of soda. In the case of spinach very unsatisfactory yields came from the use of either ammonium sulphate or urea regardless of the amounts of limestone used.

Muscadine Grape Studies. (Hubert Harris and L. M. Ware).—In 1933 a planting of the newer varieties along with the older varieties of both brown and purple types of muscadines was established. The plants were spaced 20 feet apart in 12-foot rows permitting 173 vines per acre. A vertical trellis system consisting of four wires was used for support.

TABLE 4.—Yields of Different Vegetables Fertilized with Different Sources and Combinations of Sources of Nitrogen.

Treatment		Pounds per plot[2]							
Sources of Nitrogen	Degree of neutralization[1]	pH of soil fall 1936	Lettuce	Carrot	Cabbage	Beets	Spinach	Turnip	Tender-green
Nitrate of soda	none-basic	5.8	19.4	12.9	15.1	16.2	5.0	25.4	21.3
Calcium cyanamid	none-basic	6.3	19.9	14.7	19.1	12.8	1.0	16.5	18.0
Ammonium sulphate	none	5.0	1.6	1.5	12.0	0.1	0.0	13.5	13.3
Ammonium sulphate	50%	5.3	6.9	5.4	11.3	4.1	0.0	25.8	16.3
Ammonium sulphate	100	5.4	11.9	9.9	15.3	7.4	0.6	20.8	20.3
Ammonium sulphate	150	5.6	12.4	10.2	14.3	10.7	0.6	19.5	16.0
Urea	0	5.4	10.5	10.5	9.6	6.8	0.8	20.4	16.5
Urea	100	5.4	17.3	12.9	15.3	16.8	0.7	21.9	19.0
Urea	200	5.8	15.3	9.0	15.0	12.3	0.5	24.8	21.5
Ammonium sulphate + basic slag	Basic	6.4	15.3	11.5	18.6	17.4	3.7	23.0	18.0
Urea + basic slag	Basic	6.8	12.3	3.5	11.7	16.8	4.7	20.2	21.0
Ammonium sulphate + nitrate of soda	50	5.4	13.4	8.8	10.5	13.3	5.0	20.5	23.5
Ammonium sulphate + nitrate of soda	100	5.5	21.6	14.5	14.5	16.6	5.4	28.6	20.8
Ammonium sulphate + nitrate of soda	150	5.5	16.1	11.3	18.9	16.2	2.9	16.5	20.0
Ammonium sulphate + calcium cyanamid	50	5.8	12.4	10.0	14.4	9.1	0.3	26.3	26.8
Ammonium sulphate + calcium cyanamid	100	6.0	14.5	14.7	20.3	13.5	0.9	30.3	26.8
Ammonium sulphate + calcium cyanamid	150	5.9	21.5	16.3	13.9	14.2	1.1	29.7	25.5
No N		5.7	6.9	7.1	4.2	6.9	0.4	15.8	16.3

[1]The degree to which the theoretical acidity developed by acid-forming materials has been neutralized by dolomitic limestone or varying amounts of base-forming materials.

[2]Average yield in pounds per 21.75 linear feet of space repeated in quadruplicates.

In the table are given the dates of ripening, the yields for the third and four years, and the cost of harvesting for each of the 17 varieties under test.

The average yield of the dark varieties has been approximately 50 per cent above the yield of the light or brown varieties. Yields by the fourth year ranged from 1.2 tons to 5.2 tons per acre, while the cost of harvesting ranged from $7.32 to $24.00 per ton. The Hunt and Memory ranked first in yield and were low in cost of harvesting. The cost of harvesting was lowest for the November, a variety ripening very uniformly and over a short period permitting clusters to be harvested at a picking.

TABLE 5.—Ripening Dates, Yields, Cost of Harvesting, and Size of Clusters of Different Muscadine Varieties at Auburn.

Variety	Harvest dates 1937	Yields per acre[1] (pounds)		Average number berries		No. harvest required	Cost per ton to harvest[2]
		1936	1937	per quart	per cluster		
Purplish Varieties							
Misch	Aug. 16-Aug. 30	2,919	6,010	244	9.0	6	$15.40
Hunt	Aug. 16-Aug. 30	4,458	10,378	231	8.5	7	12.78
Irene	Aug. 23-Sept. 10	1,377	6,787	176	5.5	5	8.40
LaSalle	Aug. 19-Aug. 30	2,498	5,036	358	9.8	6	13.36
Memory	Aug. 19-Sept. 10	5,886	8,773	198	5.3	6	10.97
Qualitas	Aug. 23-Sept. 10	2,844	6,595	202	7.0	6	9.09
San Jacinto	Aug. 19-Sept. 10	3,678	7,718	245	10.5	6	13.33
Thomas	Aug. 19-Sept. 2	2,550	7,486	268	10.0	6	14.14
James	Aug. 23-Sept. 2	1,917	4,521	342	8.0	5	12.78
Eden	Aug. 19-Aug. 26	2,263	4,598	390	10.8	5	9.93
Flowers	Aug. 23-Sept. 10	2,908	6,150	293	10.0	6	10.51
Brown or Light Varieties							
Brownie	Aug. 23-Sept. 10	1,261	3,913	417	17.5	5	$24.04
San Rubra	Aug. 26-Sept. 10	2,550	5,233	326	12.0	4	12.09
Scuppernong	Aug. 23-Sept. 10	760	2,652	240	5.0	5	15.27
Stuckey	Aug. 30-Sept. 10	1,202	3,019	170	7.5	5	12.25
Lucida	Aug. 30-Sept. 10	1,597	3,621	127	10.0	4	8.15
November	Sept. 10-Sept. 17	4,055	3,528	238	12.2	2	7.32

[1]173 plants per acre.
[2]Rate of pay 10 cents per hour.

Influence of Short-day and Long-day Treatment on the Flowering of Chrysanthemums. (E. W. McElwee).—The behavior of a few common varieties will serve to illustrate the general response of chrysanthemums to short-day and long-day treatments. When the variety Rose Glory was shaded with black cloth from 5 p. m. to 7 a. m. in three lots, the first beginning August 1, the second beginning August 15, and the third beginning September 1, each being shaded until the flowers showed color, flowering occurred on September 23, October 5, and October 11, respectively. This variety flowered normally on October 20. When the plants were lighted by 100-watt Mazda lamps from sundown

to 10 p. m. from August 30 to October 20, flowering occurred on November 26. These two treatments, combined with the normal treatment, extended the cutting period for this variety from approximately 12 days to 78 days. The earliest of the 15 varieties on test was Rose Glory which normally flowers on October 20 and the latest variety, Orchid Beauty, which flowered on November 15. These varieties were cut when given normal treatment from October 20 to November 27 or over a period of 38 days. When the short-day treatments were combined with the normal treatment, these varieties were cut from September 23 to November 27, an extension of the cutting periods to 65 days. When the short-day and long-day treatments were combined with the normal treatment, these varieties were cut from September 23 to January 5, an extension of the cutting period to 104 days.

Influence of Different Periods of Artificial Illumination on Flowering of Asters. (E. W. McElwee).—Results obtained in 1936 indicated that asters flowered earlier when the seedling plants were given additional illumination than when the plants were shaded with black cloth during the later stages of growth. Following this lead, an experiment was started in 1937 in which early-flowering to late-flowering varieties of asters were planted at different times and given additional illumination for 4 to 8 weeks at different times during the seedling stage to determine the planting date, time of applying additional illumination, and the length of application necessary to give the best results in earliness and quality of flowers.

The following results were obtained in this experiment:

1. The early-flowering varieties showed the least amount of response to treatment with additional illumination. Progressively greater response was shown by later flowering varieties.

2. The earliest flowers were produced by plants that were planted February 3 and given additional illumination immediately for 4 weeks and planted in the cloth house April 14. As a result of this treatment early-flowering varieties averaged 49 days, mid-season varieties 57 days, and late-flowering varieties 85 days earlier in flowering than the same varieties in the check treatment. This treatment, however, materially reduced the number of flowers per plant, stem length, and per cent of salable flowers.

3. The most satisfactory results were obtained from seed planted February 17, given 4 to 6 weeks of additional illumination from March 3 and 17 and planted in the cloth house April 14. In this treatment, early-flowering varieties averaged 33 days, mid-season varieties 46 days, and late-flowering varieties 74 days earlier in flowering than these varieties in the check treatment. This treatment did not materially reduce the production or the quality of the flowers.

Underplanting Hardwoods with Pines. (D. J. Weddell).—During January, 1933, a series of experimental pine plantings was established under a rather heavy stand of hardwoods. The hardwoods, mostly oak and hickory, were approximately 6 feet high at the time the pines were planted. Plots of the 4 most important southern pines—slash, loblolly, longleaf, and shortleaf—were established.

During January, 1937, after the pines had had four seasons growth, certain of the plots had all of the competing hardwood vegetation removed, the hardwoods by this time being approximately 12 feet tall. Height records for all the plots in the experiment were taken at the time the cleaning was made and again in December, 1937. The average height for each plot, at the time of cleaning and one year later was determined.

The following table presents the growth records for the 4 pine species and also shows a comparison of the underplanted pines with others of the same age growing in the open.

TABLE 6.—Height and Growth of Pines Planted Under Hardwoods and Planted in Open Field.

Species	Aver. height 1937 underplanted pines		Growth in 1937 underplanted pines		Average height of trees grown on adjacent open field—1937
	Cleaned	Uncleaned	Cleaned	Uncleaned	
	feet	feet	feet	feet	feet
Shortleaf	2.77	2.52	0.78	0.64	4.80
Longleaf	0.37	0.38	0.23	0.22	2.17
Loblolly	4.86	5.01	1.34	1.60	7.93
Slash	5.91	4.26	1.23	1.13	7.67

Although severely handicapped by the competing vegetation, pines have shown considerable ability to overcome this disadvantage. The results so far indicate the possibility of changing a hardwood stand to a more valuable pine stand. In changing an area from hardwoods to softwood it would appear that a skeleton planting of 150 to 200 trees per acre instead of the usual 680 to 1,200 trees would probably be the desired practice. By planting only a relatively few trees per acre the cost of planting, thinning, and cleaning would be materially reduced and still the area would be carrying enough trees for the final crop.

SPECIAL INVESTIGATIONS

Germination of Crotalaria Seed Planted in Dry Soil. (J. F. Duggar).—Unscarified seed of *Crotalaria spectabilis* were planted in extremely dry soil which was covered when rain threatened. Most seeds that had lain unsprouted in dry soil came up promptly when water at varied rates and intervals was supplied, beginning about two to four weeks after planting. The germination percentages were 45, 57, and 84 per cent in three tests in 1937

and were 61 and 63 per cent in two tests in 1936. These results were in strong contrast to a maximum below 8 per cent in most tests of both years for seed supplied with varied amounts of moisture from date of planting.

These results suggest that the best time to plant crotalaria may prove to be when the soil is too dry to induce **prompt** germination.

Hot Water Treatment of Crotalaria Seed as a Substitute for Scarification. (J. F. Duggar).—Treatment of unhulled seed of *Crotalaria spectabilis* with hot water greatly hastened and intensified germination in soil fairly well supplied with moisture; temperatures of 135, 150, 160, 170, and 180° F. were tested for periods varying from two hours to ten minutes. The most effective temperature was 150° F.; seed thus treated for 20 minutes gave in 28 days a total germination of 95 per cent and for 40 minutes 97 per cent. One hour's treatment at 150° F. slightly reduced and two hours' treatment practically ruined the germination capacity of the seed.

From crotalaria seed, treated at 150° F. for 20 minutes, there were separated and planted fractions that showed varied visible effects the second day after treatment. Those seeds having short sprouts when planted came up to the extent of 58 per cent; those planted as hard, black, and unswollen seeds, 80 per cent; and the check lot not scalded, only 4 per cent. This was within a period of 30 days after planting in Norfolk soil which was never permitted to become extremely dry.

Frequency of Cutting Lespedeza Sericea. (J. F. Duggar).—On Norfolk sandy upland a stand of sericea planted in 1934 averaged in its second and third years of root growth the following acre yields of nearly pure sericea hay or of seed:

From a single, late, annual mowing, 586 pounds of unhulled seed;

From two annual cuttings, each made at a height of about 18 inches, a total of 5,789 pounds of hay annually; and from cutting sericea whenever it reached a height of about twelve inches, that is three times a year, 4,692 pounds.

ZOOLOGY-ENTOMOLOGY

Vegetable Weevil. (J. M. Robinson).—Records on egg deposition of the vegetable weevil showed variations from 6 to 302 eggs per beetle from November 21 to December 31. The average number of eggs per beetle was 85 over the 41 day period.

In laboratory experiments, sodium fluosilicate, magnesium arsenate, lead arsenate, killed 50 per cent of the larvae in 20 hours and 100 per cent in 30 hours; cube root killed 50 per cent of the larvae in 20 hours and 100 per cent in 40 hours. Calcium

arsenate and derris killed 50 per cent of the larvae in 30 hours and 100 per cent in 44 hours. Even though cube and derris killed at a slower rate, they are within a satisfactory period of time, particularly when the difference of safety to human beings is considered.

Life History and Control of the Cowpea Curculio, Chalcodermus aeneus. (F. S. Arant).—Laboratory and field tests were conducted to determine the efficiency of pyrocide to the cowpea curculio. A mixture of pyrocide and talc, 1-4½, was more efficient in laboratory experiments than undiluted pyrocide. A 1-4½ and a 1-9 mixture of pyrocide were equally effective in field experiments, but these materials produced only 25.94 per cent control.

The Control of Citrus Insects with Oil Emulsions. (L. L. English).—Bordo-oil was more effective than Bordo or Bordo-sulphur as a pre-growth spray for depressing purple scale, (*Lepidosaphes beckii* Newm.). Bordo-sulphur, lime sulphur plus wettable sulphur, and Bordo, as post-bloom sprays, all depressed purple scale. Bordo, however, was the least effective. All plots receiving fungicides produced less "scaly" fruit than those from which the fungicides were omitted, indicating that Bordo mixture is not conducive to the propagation of purple scale, as commonly believed. It merely does not depress scale as much as fungicide combinations containing sulphur or oil. The maximum control of purple scale, 97 to 98 per cent scale-free fruit, can be produced with two applications of oil. Further tests with 25 spray programs for the control of sour scab and the principal insect pests substantiate the results previously reported. Two fungicides, one oil spray, and one sulphur application, either dust or spray, were necessary for the production of clean fruit. Two applications of oil (July and September) materially retarded ripening of the fruit and apparently reduced the yield. Frequent application of lime sulphur plus wettable sulphur produced the earliest maturing fruit and gave the best control of scab. These treatments did not satisfactorily control purple scale and red spider. For the control of sour scab, two applications of 1-1-100, 2-2-100, 4-4-100, and 6-6-100 Bordo combined with 5 pounds of wettable sulphur per 100 produced 4.5, 3.2, 3.0, and 1.5 per cent scabby fruit, respectively. The untreated check produced 11.4 per cent scabby fruit.

The Toxicity of Derris to White Fly Larvae and Purple Scale. (L. L. English).—In outdoor laboratory experiments, positive toxicity of derris to white fly larvae and purple scale was demonstrated by comparing the effectiveness of the powdered root with an extracted "marc" of the same sample. The data indicate that a dosage as high as 4 parts of derris to 1,000 parts of dilute oil emulsions may depress the efficiency of the spray be-

cause of the effect of the derris on the emulsion. Among several emulsions tested as carriers for derris the most effective was prepared from a 41 (Saybolt) viscosity oil and dried blood albumen spreader by the California Tank-mix method. Two years work on triplicate plots in the field failed to substantiate the laboratory experiments.

The Effect of Oils on Satsuma Trees. (L. L. English).—Potted satsuma trees were used to test the effect of oils of various viscosities when applied at concentrations which are effective against purple scale. The five oils ranged in viscosity from 41 to 99 seconds, Saybolt, while the degree of refinement was essentially uniform. The experiments showed that the greatest defoliation and highest quantity of dead wood were produced by the oils of intermediate viscosity, i. e. 54 to 64 seconds. The data also indicate that it would be less harmful to trees to spray with a 41 viscosity oil at a concentration of 7 per cent than to spray with a 99 viscosity oil at a concentration of 2 per cent.

Farm Ponds. (H. S. Swingle (Zoology-Entomology), E. V. Smith (Botany), and G. D. Scarseth (Agronomy and Soils)).—Greenhouse experiments with cultures of various plankton algae indicated that 4, 6, or 8 p.p.m. of N and 2 p.p.m. of P produced nearly maximum growth and came the nearest to complete utilization of both elements. Increase in potash concentration above 2 p.p.m. of the element did not result in increased plankton production.

When ammonium sulfate was used as the source of nitrogen, the addition of lime was necessary to prevent excessive acidity. From 12 to 16 p.p.m. $CaCO_3$ were required to keep the acidity above pH5 when 6 p.p.m N were used. The use of either basic slag or calcium carbonate gave good results when used at this rate. Increased amounts of basic slag greatly decreased plankton growth, apparently because it removed carbon dioxide from the water.

Experiments conducted in concrete pools, using different rates of fertilizer, indicated that small applications at short intervals throughout the growing season gave much greater plankton production than heavier applications at longer intervals. Of all the methods tested, the most economical was to apply small amounts of fertilizer at weekly intervals until the water became green with plankton, and then to make further applications only when necessary to maintain this green growth. The following amounts of fertilizer per acre per application gave good results in these experiments:

40 lbs. sulfate of ammonia
60 lbs. superphosphate (16%)
5 lbs. muriate of potash
30 lbs. basic slag

The above materials were applied by broadcasting over the surface of the water.

The unfertilized storage pond produced mixed species of fish at the rate of 134 pounds per acre, while the fertilized brood pond produced these same species at the rate of 578 pounds per acre.

Fertilized pools produced the fresh-water shrimp (Palaemonetes exlipes) at the rate of from 300 to 495 pounds per acre. The food of these shrimp was found to be almost entirely phytoplankton.

The application of fertilizers to the soil of the pond bottom before flooding with water appeared to show some promise as an economical method of fertilization.

The rate of growth of bluegill bream was found to be governed largely by the food available and the number of bream present in a pond. In stocking new ponds with fry or fingerling bream it was found necessary to limit the number of bream if rapid growth was desired. If the pond was fertilized, 1,500 bream per acre were the maximum needed, while for unfertilized ponds, 400 bream per acre were sufficient.

From an unfertilized pond (1.8 acres) stocked with 10 brood bluegill bream, 10 brood crappie, and 10 brood yellow bullhead catfish, the following numbers of each species were recovered when the pond was drained in the fall: bluegill bream, 20,615, crappie 3,848, catfish 668. At the rate at which this pond can support these various species, there are enough bream to stock over 50 acres of unfertilized water, enough crappie to stock over 75 acres, and enough catfish to stock over 10 acres.

Chub-sucker minnows appeared unsuitable for shallow ponds, as the majority of them died during hot weather when the water temperature reached 89° F.

Naias, an under-water plant, was without value as a food for small bream. Myriophyllum, Cabomba, and bladderwort would not grow in the alkaline water of the concrete pools.