FIFTIETH ANNUAL REPORT

January 1 to December 31, 1939

OF THE

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

M. J. FUNCHESS, *Director*

AUBURN, ALABAMA

Contents

ALABAMA POLYTECHNIC INSTITUTE

COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION

TRUSTEES

His Excellency, Frank M. Dixon, Chairman ..... Ex-Officio
A. H. Collins, State Supt. of Education ..... Ex-Officio
Francis W. Hare, (First District) ..... Monroeville, Ala.
George Blue, (Second District) ..... Montgomery, Ala.
T. D. Samford, (Third District) ..... Opelika, Ala.
John V. Denson, (Third District) ..... Opelika, 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.

Ralph B. Draughon, Secretary of Board,
Auburn, Alabama

AGRICULTURAL EXPERIMENT STATION STAFF

Luther Noble Duncan, M.S., LL.D., President
M. J. Funchess, M.S., D.Sc., Director
J. W. Tidmore, Ph.D., Assistant Director
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. ..... Associate Agricultural Economist
B. T. Lanham, Jr., M.S. ..... Assistant Agricultural Economist
*E. G. Schiffman, M.S. ..... Assistant Agricultural Economist
J. H. Blackstone, B.S. ..... Graduate Assistant
J. W. Lester, B.S. ..... Graduate Assistant

Agricultural Engineering:

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

Agronomy and Soils:

J. W. Tidmore, Ph.D. ..... Head, Agronomy and Soils
N. J. Volk, Ph.D. ..... Soil Chemist
J. A. Naftel, Ph.D. ..... Associate Soil Chemist
Anna L. Sommer, Ph.D. ..... Associate Soil Chemist
G. W. Volk, Ph.D. ..... Associate Soil Chemist
J. B. Dick, B.S. ..... Associate Agronomist (Coop. U.S.D.A.)
E. L. Mayton, M. S. ..... Associate Agronomist
D. G. Sturkie, Ph.D. ..... Associate Agronomist
J. T. Williamson, B.S. ..... Associate Agronomist
H. B. Tisdale, M.S. ..... Associate Plant Breeder
R. J. Jones, Ph.D. ..... Assistant Soil Chemist
H. R. Albrecht, Ph.D. ..... Assistant Agronomist
A. A. Baxter, B.S. ..... Assistant in Agronomy
F. E. Bertram, B.S. ..... Assistant in Agronomy
J. W. McClendon, B. S. ..... Assistant in Agronomy
J. W. Richardson, B.S. ..... Assistant in Agronomy
R. W. Taylor, M.S. ..... Assistant in Agronomy
H. R. Benford, B.S. ..... Graduate Assistant
W. Von Chandler, B.S. ..... Graduate Assistant
M. E. Holt, B.S. ..... Graduate Assistant
J. W. Langford, B.S. ..... Graduate Assistant
D. T. Meadows, B.S. ..... Graduate Assistant
J. I. Wear, B.S. ..... Graduate Assistant

Animal Husbandry and Poultry:

J. C. Grimes, M.S. ..... Head, Animal Husbandry and Poultry
W. E. Sewell, M.S. ..... Assistant Animal Husbandman
W. D. Salmon, M.A. ..... Animal Nutritionist
R. W. Engel, Ph.D. ..... Associate Animal Nutritionist
C. D. Gordon, M.S. ..... Assistant Poultry Husbandman
C. J. Koehn, Ph.D. ..... Associate Animal Nutritionist
C. O. Prickett, B.A. ..... Associate Animal Nutritionist
G. A. Schrader, Ph.D. ..... Associate Animal Nutritionist
W. C. Sherman, Ph.D. ..... Associate Animal Nutritionist
J. L. West, D.V.M. ..... Assistant Animal Nutritionist
D. F. King, M.S. ..... Associate Poultry Husbandman
G. J. Cottier, M.A. ..... Assistant Poultry Husbandman
P. D. Sturkie, Ph.D. ..... Assistant Poultry Husbandman

Botany and Plant Pathology:

J. L. Seal, Ph.D. ..... Head, Botany and Plant Pathology
E. V. Smith, Ph.D. ..... Associate Botanist and Plant Pathologist
J. R. Jackson, Ph.D. ..... Assistant Botanist and Plant Pathologist
H. M. Darling, M.S. ..... Assistant Botanist and Plant Pathologist
Coyt Wilson, B.S. ..... Graduate Assistant

Horticulture and Forestry:

L. M. Ware, M.S. ..... Head, Horticulture and Forestry
C. L. Isbell, Ph.D. ..... Horticulturist
E. W. McElwee, M.S. ..... Associate Horticulturist
Keith Barrons, M.S. ..... Associate Horticulturist
O. A. Atkins, M.S. ..... Assistant Horticulturist
W. R. Boggess, M.F. ..... Assistant Forester
D. J. Weddell, M.S. ..... Assistant Forester
J. E. Bryan, Jr., B.S. ..... Assistant in Forestry
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

Veterinary Medicine:

L. E. Starr, Ph.D. ..... Animal Pathologist

Zoology-Entomology:

J. M. Robinson, M.A. ..... Head, Zoology-Entomology
L. L. English, Ph.D. ..... Entomologist
H. S. Swingle, M.S. ..... Fish Culturist
F. S. Arant, Ph.D. ..... Associate Entomologist
R. O. Christenson, Ph.D. ..... Associate Parasitologist
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.
H. A. Ponder, B.S. ..... Assistant 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.
T. B. Chisholm, B.A. ..... Assistant to 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 1939

Appointments:

W. R. Boggess, M.F. ..... Assistant Forester
J. E. Bryan, Jr., B.S. ..... Assistant in Forestry
A. W. Cooper, B.S. ..... Assistant in Agricultural Engineering
R. W. Engel, Ph.D. ..... Associate Animal Nutritionist
R. J. Jones, Ph.D. ..... Assistant Soil Chemist
J. W. Langford, B.S. ..... Graduate Assistant
D. T. Meadows, B.S. ..... Graduate Assistant
J. H. Neal, Ph.D. ..... Head, Agricultural Engineering
P. D. Sturkie, Ph.D. ..... Assistant Poultry Husbandman

Resignations:

Keith Barrons, M.S. ..... Associate Horticulturist
A. A. Baxter, B.S. ..... Assistant in Agronomy
C. D. Gordon, M.S. ..... Associate Poultry Husbandman
C. O. Prickett, B.A. ..... Associate Animal Nutritionist
G. A. Schrader, Ph.D. ..... Associate Animal Nutritionist
D. J. Weddell, M.S. ..... Assistant Forester
J. L. West, D.V.M. ..... Assistant Animal Nutritionist
R. E. Yoder, Ph.D. ..... Acting Head, Agricultural Engineering

---

*On leave.

NEW PUBLICATIONS

Articles in Scientific Journals

Barrons, Keith C.—**Horticultural Seed Growing.** *XII Int. Hort. Congress, Sect.* 4, *p* 2. (1939).

Barrons, Keith C.—**A Method of Determining Root-Knot Resistance in Beans and Cowpeas in the Seedling Stage.** *J. Ag. Res.* 57, 363-370. (1939).

Barrons, Keith C.—**Studies of the Value of Root-Knot Resistance.** *J. Ag. Res.* 58, 263-271. (1939).

Diseker, E. G.—**A Method of Measuring Runoff Velocity as Related to Soil Movement Between Terraces.** *J. Am. Soc. Ag. Eng.* 20, 195-196. (1939).

Duggar, J. F.—**Germination of Untreated Crotalaria Spectabilis Seed in Soil Supplied with Varied Amounts of Water; and Effects of Delay in Supplying Moisture.** *Assn. S. Ag. Workers. Proc.* 40, 54. (1939).

Duggar, J. F.—**Refrigeration as a Means for Improving the Germination of Lespedeza Sericea and Other Refractory Seeds.** (Abstract) *J. Alabama Acad. Sci. Proc. Vol.* 11, *Part II*, 32-33. (1939).

Jackson, J. R. and Smith E. V.—**Development of the Nut Grass Plant** (Cyperus rotundus L.). (Abstract) *Am. J. Bot.* 26, 6s, (1939).

Koehn, C. J.—**Canned Dog Food as a Source of Energy for Dogs.** *Vet. Med. February* (1939).

Koehn, C. J. and Salmon, W. D.—**The Alabama Standard for Canned Dog Food.** *Vet. Med. May* (1939).

Kummer, F. A.—**The Effect of Certain Experimental Plow Shapes and Materials on Scouring in Heavy Clay Soils.** *J. Am. Soc. Ag. Eng.* 20, 111-114. (1939).

Naftel, James A.—**Colorimetric Microdetermination of Boron.** *Ind. Eng. Chem. Anal. Ed.* 11, 407-409. (1939).

Prickett, C. O. and Stevens, Cornelia.—**The Polarized Light Method for the Study of Myelin Degeneration as Compared with the Marchi and Sudan III Methods.** *Am. J. Path.* 15, 241-250. (1939).

Prickett, C. O., Salmon, W. D. and Schrader, G. A.—**Histopathology of the Peripheral Nerves in Acute and Chronic Vitamin B_1 Deficiency in the Rat.** *Am. J. Path.* 15, 251-259. (1939).

Sherman, W. C. and Salmon, W. D.—**Carotene Content of Different Varieties of Green and Mature Soybeans and Cowpeas.** *Food Res.* 4, 371-380. (1939).

Smith, E. V. and Mayton, E. L.—**The Eradication of Nut Grass**

from Norfolk Sandy Loam Soils by the Tillage Method. (Abstract). *Assn. S. Ag. Workers. Proc.* 40, 53-54. (1939).

Swingle, H. S. and Smith, E. V.—**Increasing Fish Production in Ponds.** *Trans. Fourth N. A. Wildlife Conf.* 332-338. (1939).

Volk, N. J.—**The Determination of Redox Potentials of Soils.** *J. Am. Soc. Agron.* 31, 344-351. (1939).

Volk, N. J.—**The Oxidation-Reduction Potentials of Alabama Soils as Affected by Soil Type, Soil Moisture, Cultivation, and Vegetation.** *J. Am. Soc. Agron.* 31, 577-589. (1939).

Volk, N. J.—**The Effect of Oxidation-Reduction Potential on Plant Growth.** *J. Am. Soc. Agron.* 31, 665-670. (1939).

Ware, L. M.—**Fertilizer Requirements of the Potato on Different Soils of Alabama.** *Am. Pot. J.* 16, 259-266. (1939).

Ware, L. M.—**Influence of Summer Legumes on the Early Spring Crop of Snap Beans in South Alabama.** *Am. Soc. Hort. Sci.* 36, 509. (1939).

Experiment Station Publications

King, D. F.—**The Detection of Infertile Eggs and Its Application to Hatchery Management.** *Cir.* 82, 1-16. (1939).

Sturkie, D. G. and Grimes, J. C.—**Kudzu—Its Value and Use in Alabama.** *Cir.* 83, 1-20. (1939).

Other Publications

Atkins, O. A.—**A Native Southern Blueberry as an Erosion Resistant and New Commercial Crop.** *American Fruit Grower. December* (*p* 10) (1939).

Barrons, Keith C.—**Breeding Better Beans for the South.** *Southern Seedsman. February* (*p* 4) (1939).

Barrons, Keith C.—**Fall and Winter Vegetables.** *Southern Seedsman. June* (*p* 10) (1939).

Isbell, C. L.—**Pumpkins as Jack-O-Lanterns.** *Progressive Farmer. October* (1939).

McElwee, E. W.—**Growing the Aristocrats—Show Flowers.** *Southern Garden Magazine. June* (1939).

McElwee, E. W.—**Pertinent Points on the Culture of Azaleas and Camellias.** *Southern Life Magazine. September* (1939).

Smith, E. V., and Swingle, H. S.—**Plankton Basic Food for Most Fishes.** *Alabama Game and Fish News. February* (*p* 8) (1939).

Smith, E. V., and Swingle, H. S.—**The Spawning Season of Bream**

in Alabama. *Alabama Game and Fish News. September* (*p* 7) (1939).

Swingle, H. S., and Smith, E. V.—**Fertilization Increases Yield of Fish Ponds.** *Alabama Game and Fish News. May* (*p* 3) (1939).

Swingle, H. S., and Smith, E. V.—**Scientists Discuss Closed Season on Fish.** *Alabama Game and Fish News.* (*pp* 9-14) (1939.)

Ware, L. M.—**Cultivation Studies with the Irish Potato in South Alabama.** *Market Growers Journal. April* (*p* 182) (1939).

Ware, L. M.,—**The Fall Crop of Irish Potatoes.** *Market Growers Journal. August* (*p* 364) (1939).

Williamson, J. T., Wilson, J. P., and Tidmore, J. W.—**How Can I Do Better Farming?** *The Progressive Farmer. February* (1939)

AGRICULTURAL ECONOMICS

Purchases and Consumption of Specified Foods in Three Alabama Towns. (J. H. Blackstone).—A one-year study of the food habits of the residents of Andalusia, Hartselle, and Notasulga was made to determine the amount and kind of products being consumed and which of these were suited to local production. These three towns were selected because it was believed they were typical of the small towns of Alabama. Andalusia had an estimated population of 6,530, Hartselle 2,535, and Notasulga 684.

Purchases of specified fresh vegetables over the one-year period were most per person in Andalusia, amounting to $9.67; they were less in Hartselle, amounting to $7.19; and least in Notasulga where they amounted to $4.25 (Table 1).

TABLE 1.—Amount and Value of Specified Fresh Vegetables Purchased per Person in Three Alabama Towns Over a One-Year Period.

Product	Andalusia		Hartselle		Notasulga		Average of all three	
	Amount	Value	Amount	Value	Amount	Value	Amount	Value
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
Butter beans	11.93	0.71	3.69	0.22	3.59	0.20	9.20	0.55
Cabbage	13.63	0.46	16.63	0.46	9.00	0.33	14.08	0.45
Corn	24.06*	0.43	28.28*	0.58	6.00*	0.10	23.89*	0.45
Garden and field peas	27.13	1.20	6.86	0.28	8.52	0.41	20.55	0.91
Irish potatoes	48.15	1.39	56.66	1.40	17.72	0.55	48.23	1.33
Snap beans	7.24	0.58	10.28	0.63	3.19	0.23	7.75	0.57
Sweet potatoes	35.64	0.64	12.77	0.50	14.04	0.31	28.17	0.58
Tomatoes	15.59	1.21	17.67	1.01	8.32	0.65	15.62	1.12
Greens	17.47	0.71	10.02	0.52	4.56	0.37	14.60	0.63
Other	-	2.34	-	1.59	-	1.10	-	2.07
Total		9.67		7.19		4.25		8.66

*Ear corn

Relatively more gardens from which large amounts of vegetables were produced for home use, were found in Hartselle and Notasulga than in Andalusia.

Fresh vegetable purchases among white residents varied with income. The high and medium income groups bought an average of thirty different kinds of vegetables, some of which were purchased throughout the entire year. The low income group bought only about twenty-two different kinds of vegetables and these mainly during the local production period. The vegetable purchases by colored people were similar in kind to those of low income white people, but were less in variety.

Purchases of specified livestock products over the one-year period were most per person in Andalusia, amounting to $33.60; they were less in Hartselle, amounting to $29.06; and least in Notasulga where they amounted to $22.35 (Table 2). These smaller purchases in Hartselle and Notasulga were apparently attributable to the fact that relatively more families had cows, poultry, and hogs than in Andalusia.

The amount and value of the livestock products purchased varied greatly with income groups of white people. In Andalusia, the high income group spent $7.32 per person for steaks; whereas, the low income group spent only $2.01, while the average expenditure for all white and colored groups was $3.59. The high and medium income groups spent more money for meats of all kinds, and generally bought better or more choice meats. On the other hand, the low income group bought more of the less expensive meats. For example, the high income groups bought only $0.90 worth of white meat per person, while the low income group bought $3.00 worth per person. The average for all white and colored groups was $1.85 per person for this item.

TABLE 2.—Amount and Value of Specified Livestock Products Purchased per Person in Three Alabama Towns Over a One-Year Period.

Product	Andalusia		Hartselle		Notasulga		Average of all three	
	Amount	Value	Amount	Value	Amount	Value	Amount	Value
	Pounds[1]	Dollars	Pounds[1]	Dollars	Pounds[1]	Dollars	Pounds[1]	Dollars
Beef	22.96	5.68	20.35	4.92	17.51	4.04	21.93	5.37
Pork	40.71	9.12	38.22	8.30	27.83	5.98	39.18	8.65
Mutton and lamb	0.19	0.07	-	-	0.38	0.10	0.15	0.06
Other meats	1.04	0.20	2.53	0.39	1.55	0.28	1.46	0.26
Poultry	14.89	3.10	12.67	2.28	8.50	1.82	13.87	2.79
Eggs	18.72	4.34	17.30	3.79	13.01	2.75	17.95	4.08
Butter	11.33	3.49	11.80	3.05	8.97	2.52	11.29	3.31
Sweet milk	40.93	4.70	32.22	3.25	21.80	2.18	37.32	4.14
Butter milk	22.37	1.30	34.10	1.65	28.35	1.32	25.84	1.39
Cream	0.72	0.28	0.78	0.22	0.15	0.03	0.70	0.24
Cheese	5.01	1.14	4.96	1.11	5.36	1.27	5.02	1.14
Honey	1.61	0.18	0.75	0.10	0.47	0.06	1.31	0.15
Total	-	33.60	-	29.06	-	22.35	-	31.58

[1]Eggs in dozens, milk in quarts, cream in pints, all other products in pounds.

Relatively less poultry, eggs, milk, butter, and cream was bought in Hartselle and Notasulga than in Andalusia. On a per person basis, Andalusia bought 41 quarts of whole milk, while Hartselle bought 32 and Notasulga 22. It was found that a large number of families in Notasulga had their own cows, and that cows were common in Hartselle, but in Andalusia most of the milk was purchased.

AGRICULTURAL ENGINEERING

The Dynamic Properties of Soils as Applied to the Elements of Implement Design. Comparative Tests with Different Plow Shapes and Materials. (F. A. Kummer).—Plow bottoms of various shapes and materials were furnished by manufacturers according to specifications based upon results from experiments conducted at this station. The investigations of plow shapes included analyses of new and modified slat-type and solid plow bottoms and nickel and chromium plated moldboards. In addition, numerous plastics and impregnating materials having low surface tension characteristics were also tested. The plow shapes were specially constructed in accordance with the analyses of measurements taken with the apparatus developed at this station. Special emphasis was placed upon changes in curvature affecting packing on the moldboard which had been observed to be partly responsible for scouring difficulties in clay soils. It was found that under adverse plowing conditions changes in shape alone do not eliminate scouring difficulties but must be supplemented with a suitable material. The possibility of substituting a sufficiently strong material with low wetting properties has been investigated and several commercial plastics are considered to be applicable from a practical standpoint. The tests on these materials have been confined largely to laboratory methods and must be supplemented with field tests before definite recommendations can be made.

AGRONOMY AND SOILS

Response of Plants to Magnesium and Minor Elements. (Anna L. Sommer).—The study of certain Alabama soils in regard to the adequacy of their supplies of magnesium and those elements necessary in only small amounts for plant growth was continued.

Crimson clover, turnips, and peanuts were grown as test crops during the year 1939. More of the soils responded to fertilization with "minor" elements when crimson clover was used than when turnips or peanuts were used as the test crop. The clover plants on all except two of the 16 soils tested responded to applications of the minor elements. The deficiency in a number of cases was so severe that the plants died in the early stages of growth in cultures not receiving the "minor" elements either as special additions to

the purified salts or as impurities when Chilean nitrate was substituted for purified sodium nitrate. Doubtful to marked evidence of magnesium deficiency was found in all but four of the soils.

Turnips were grown for a second time on these soils because more of the soils responded to "minor" element fertilization when crimson clover was the test crop. This was the seventh crop grown on these soils under the same conditions of fertilization and there was evidence of "minor" element deficiency for all except one of the soils by the time the plants were a month old. With the remaining soil, an exceptionally good one under field conditions, there were no apparent differences until the turnips were about 2 to 2½ inches in diameter. At this time symptoms of "minor" element deficiency appeared in the leaves, and at time of harvest brown spots usually attributed to boron deficiency were found on cutting some of the turnips which had received neither additions of "minor" elements as such nor as impurities in Chilean nitrate. A number of soils which showed no response to magnesium with the first crops of turnips responded with the second. The effect of this element, however, was not nearly so marked as with crimson clover.

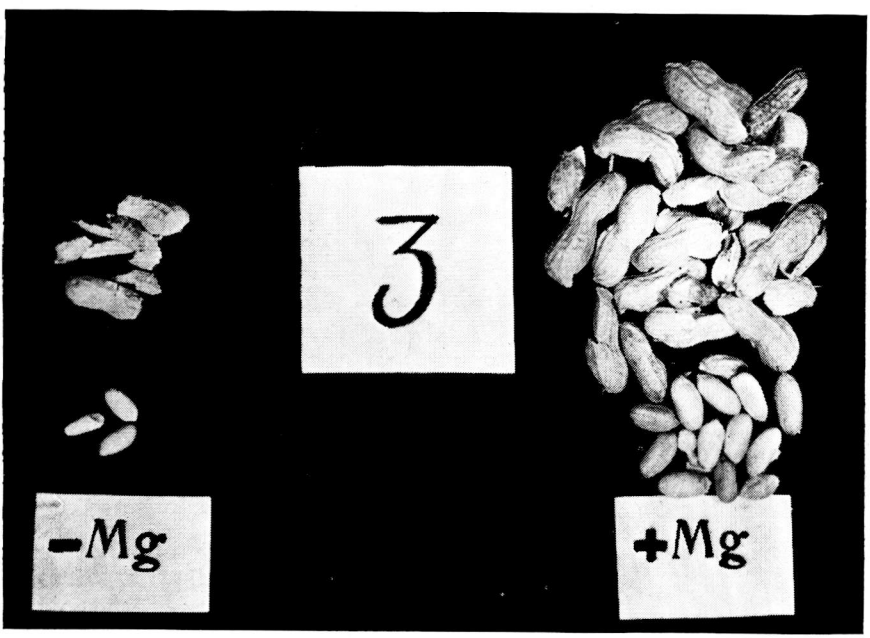

FIGURE 1.—Peanuts.
Fertilizer Treatments
Left—All purified salts + traces of "minor" elements.
Right—All purified salts + traces of "minor" elements + magnesium.

TABLE 3.—Yields of Peanuts for 4 Different Fertilizer Treatments on 17 Soils. Weight in Grams per Culture.

Fertilizer Treatment	Soil Numbers																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	18
All purified salts[1] + traces	0.8	4.3	0.3	1.8	2.8	1.3	1.6	1.5	4.3	4.3	2.8	3.3	0.5	4.9	1.6	0.2	2.6
All purified salts + traces + magnesium	3.5	5.4	5.8	4.0	6.0	3.3	3.9	2.5	6.4	5.1	4.2	3.9	3.4	5.7	2.6	3.6	2.3
Chilean nitrate[2]	0.7	3.2	0.6	1.9	4.8	0.8	1.3	1.3	4.2	3.8	3.1	3.6	1.3	4.8	1.7	0.5	2.8
Chilean nitrate + superphosphate[3]	5.4	4.9	5.1	5.0	6.1	4.2	2.6	2.8	4.8	5.0	5.3	5.4	2.6	7.4	2.6	4.8	3.5

[1]Potassium acid phosphate, sodium nitrate and calcium sulfate

[2]Substituted for purified sodium nitrate, phosphate and sulfate as above.

[3]This treatment consisted of Chilean nitrate, superphosphate and purified potassium chloride.

The turnip crop was followed by peanuts. With the exception of the two groups of treatments to which the "minor" element mixture had been applied, the plants were very similar in size and appearance for over two months, regardless of fertilizer treatments. In spite of the fact that the amount of boron in the first application of the "minor" element mixture was less, on gram-kilo basis, than the minimum 10 pounds per acre usually recommended for boron-deficient soils, slight boron injury symptoms appeared. In some cases the plants appeared somewhat smaller than those which had not received such applications. With a few soils, during the latter part of the growth period, plants in cultures to which no magnesium had been added or which had not received phosphate in the form of superphosphate became yellowish and the leaves turned downward. On harvesting, the dry weights of these plants were, in general, greater than those of plants of normal appearance. The yield of peanuts was, however, much less (Figure 1). Magnesium deficiency caused a marked decrease in the yield of peanuts on a number of soils (Table 3). Little apparent benefit due to the "minor" elements was observed on peanuts.

Evaluation of Calcium Silicate Slags as Agricultural Liming Materials. (James A. Naftel).—Evaluation of different sources of slags, especially those from blast furnaces of the steel and phosphate industries, has become of practical concern in the State. Three possible ways of evaluating these materials have been studied: these are (1) neutralizing value, (2) soil reaction change, and (3) yield response as compared with a standard such as $CaCO_3$. Total analyses of the slags show that the Ca and Mg content is such that, when these elements are calculated over to their equivalent in $CaCO_3$, values of 85 to 92 per cent are obtained. However, when neutralizing values are determined, these values fall to between 60 and 70 per cent; moreover, soil reaction changes generally were found to yield values of approximately two-thirds the value of $CaCO_3$. When yield response was determined, the values depended on the particular soil involved. Blast furnace slag produced notably striking responses on some light textured soils of the Coastal Plains. This was true because overliming did not occur with this material as it did with all others, and because it supplied certain secondary and minor elements for crop growth.

Effect of Lime and Boron on Yields of Successive Crops on Vaiden Clay. (James A. Naftel).—Vaiden Clay is a strongly acid highly colloidal soil from the Black Belt. Lime treatments of none, 3 tons, and 16 tons of precipitated $CaCO_3$ per acre were studied where boron was or was not applied to the soil. Successive crops were grown with liberal applications of N, P, and K fertilizers; the yields of the crops are given in Table 4. After the first crop, which is often unreliable in greenhouse cultures due to disturbed soil factors, differences were shown in plant requirement or response to the lime and boron treatments. Peanuts responded slightly to

the lime but practically not at all to the boron. Crimson clover almost failed on the unlimed soil and did fail where the soil was excessively limed without the use of boron; where boron was applied, yields were high on both the moderately and excessively limed soils. The use of excessive amounts of lime did not cause decreased yields of soybeans but an appreciable response was obtained where boron was applied. It is interesting to note that the yields of cotton, a plant normally considered as highly acid tolerant, were greatly increased by the high lime treatments and slightly increased by boron. Apparently the use of fairly large amounts of lime and small amounts of boron will increase the productivity of Vaiden clay for these crops.

TABLE 4.—The Effect of Lime and Boron on the Yields of Successive Crops on Vaiden Clay.
Average yield of duplicates in grams

Successive crop	Liming as percentage Ca saturation					
	Native	50	150	Native	50	150
	No boron added			Boron added		
Hairy vetch, dry	4.3	4.3	4.3	4.6	4.9	6.0
Peanuts, green	225	255	275	208	256	265
Crimson clover, green	19.7	157.5	0	23.7	235.1	221.5
Soybeans, green	40.2	59.8	69.8	43.5	73.7	81.3
Cotton, dry	1.9	2.6	12.1	2.3	4.1	14.0

Nitrogen Economy in Different Systems of Soil and Crop Management. (Randall J. Jones).—When summer legumes are turned under as a green manure crop, the loss of nitrogen by leaching may be very high under certain conditions. The extent of this loss by different legumes is being studied on Norfolk sandy loam, Hartsells fine sandy loam, and Decatur clay loam by means of lysimeters. Soybeans, at the rate of 5 tons per acre (green weight), were added to each soil type in various ways and were turned under at different times. Cowpeas and crotalaria were added in the same manner and in sufficient quantities to give the same amount of nitrogen as that contained in the soybeans. On some tanks, oats or vetch was grown as a winter crop and turned under in the spring. Sudan grass was grown in the summer as a test crop.

The results obtained over the 3-year period, 1937-1939, show that very little nitrate-nitrogen was leached from the Decatur clay loam under the conditions studied. Approximately 60 per cent of the added nitrogen was lost by leaching from the Norfolk sandy loam and 40 per cent from the Hartsells fine sandy loam when summer legumes were turned in the fall. Considerably less nitrogen, however, was leached from the soil when the legumes were not turned until spring. Only a small percentage of the added nitrogen from fall-turned legumes was lost when oats were grown during the winter, but the yield of Sudan grass following the oats was not increased appreciably.

TABLE 5.—Effect of Cropping System on the Loss of Nitrogen from Various Sources on Three Major Soil Types for the 3-Year Period 1937-1939.

Source of nitrogen and cropping system[1]	Norfolk sandy loam				Hartsells fine sandy loam				Decatur clay loam			
	Lbs. of nitrogen per acre				Lbs. of nitrogen per acre				Lbs. of nitrogen per acre			
	Added	Lost by leaching	Removed by Sudan grass	Gained or lost by soil	Added	Lost by leaching	Removed by Sudan grass	Gained or lost by soil	Added	Lost by leaching	Removed by Sudan grass	Gained or lost by soil
No nitrogen—No Sudan grass	—	98	—	-98	—	197	—	-197	—	70	—	-70
No nitrogen added except in seed	3	50	14	-61	3	130	45	-172	3	8	47	-52
Soybeans[2] spring turned	214	77	34	103	214	145	73	-4	214	15	89	110
Soybeans, fall turned	214	138	23	53	214	157	73	-16	214	17	112	85
Soybeans, fall turned Oats grown during winter	225	32	32	161	225	19	90	116	225	0	57	168
Soybeans, fall turned Vetch grown during winter	466	110	197	159	525	102	193	230	563	8	220	335
Vetch grown during winter	112	45	86	-19	248	53	168	27	363	7	226	130
$NaNO_3$ 36 lbs. N per acre	112	44	62	6	112	108	93	-89	112	12	109	-9
No fertilizer	3	62	7	-66	3	108	40	-45	3	10	56	-63

[1]Except where indicated otherwise, 400 lbs. superphosphate and 50 lbs muriate of potash (on acre basis) were applied annually, and Sudan grass was grown during summer months.

[2]Soybeans were harvested on the Experiment Station farm and added to lysimeters. Crotalaria and cowpeas gave similar results in all cases.

From the standpoint of nitrogen economy and crop yields, vetch was much better than oats, summer legumes, or $NaNO_3$. Sodium nitrate caused somewhat higher yields of Sudan grass than did the summer legumes.

There was little difference between soybeans, cowpeas, and crotalaria with regard to the loss of nitrogen by leaching and the yield of Sudan grass.

The data in Table 5 show the change in the nitrogen level of the different soil types and the amount of nitrogen lost by leaching and cropping under the conditions of the experiment. The gain or loss of nitrogen by the soil was obtained by subtracting the amount removed by leaching and cropping from that which was added to the soil.

Fertilizers and Varieties in Relation to Cotton Wilt. (H. B. Tisdale and J. B. Dick).—This test involved two varieties of cotton, Cook (wilt-resistant) and Half and Half (susceptible). It also involved three levels of nitrogen (0, 6, and 12 per cent); three levels of phosphorus (0, 8, and 16 per cent); and three levels of potash (0, 4, and 8 per cent). Counts of diseased and dead plants were made at intervals of 10 to 15 days throughout the three seasons.

The results for the three years (1937-1939) show that the season, the variety, and the three levels of N, P, and K had marked effects on the development of wilt. The effects of the different fertilizers on the development of wilt for the three-year period were as follows: nitrogen caused an increase in the incidence of wilt but its effect was lessened toward the end of the season; potash reduced the incidence of wilt moderately in the early season and caused further reduction toward the end of the season. The two levels of potash increased the yields and reduced the wilt in both varieties, but the eight per cent potash benefited the Half and Half more than it did the Cook. Phosphorus, on the other hand, tended to increase the incidence of wilt in both varieties gradually from early season to the end of the season. The eight per cent phosphorus increased the incidence of wilt more than did the 16 per cent, especially in the Half and Half variety. There appears to be a peculiar relationship between phosphorus and potash in their effect on development of wilt symptoms in cotton.

The increase in pounds of seed cotton per acre due to the single elements in the fertilizer was as follows: for Cook, nitrogen 504, phosphorus 198, and potash 505; for Half and Half, nitrogen 186, phosphorus 53, and potash 445.

Cotton Variety Tests. (H. B. Tisdale and J. B. Dick).—The average results for three years (1937-1939) of cotton variety tests

conducted at the Main Station, substations, and experiment fields of Alabama show that Stoneville 2 B, Stoneville 5 A, Coker 100, Deltapine A (D.P.L. 11 A) Washington (Delfos 719), and Cook 144 are satisfactory varieties for any section of Alabama which is not infested with cotton wilt. Clevewilt, Cook 144, Dixie Triumph, and Cleveland (wilt-resistant) are the most satisfactory wilt-resistant varieties that produce a staple of around one inch in length. Wiregrass Cook and Auburn Cook are good yielding wilt-resistant varieties that produce a staple of about 15/16 of an inch in length. It is advisable to plant only wilt-resistant varieties in Central and South Alabama because of the prevalence of the disease in those sections.

Cotton Breeding. (H. B. Tisdale and J. B. Dick).—Efforts are being continued in the breeding and improvement program to produce superior strains of cotton which possess such economic characters as high yield, high lint percentage, greater staple length, and more wilt resistance. In 1939, 632 individual plant selections were tested in plant-to-row tests located at Auburn and three of the substations, and 151 promising new strains were tested in five strain tests.

One outstanding new strain of wilt-resistant Cook cotton (Register Number 1347) has been developed recently and is now ready for distribution. This strain is a high yielding, rapidly fruiting wilt-resistant cotton with staple around 15/16 of an inch in length and easy to pick. Strains of Cook 144 Wilt-Resistant developed by the Alabama Station are now extensively grown in the wilt-infested areas of Alabama.

The Amount of Potash Required to Maintain a Constant Level of Replaceable Potash in Different Alabama Soils. (N. J. Volk).—Results from the plots receiving low rates of potash on the substations and experiment fields indicate that need for greater amounts of potash is increasing in the case of certain soils. This would indicate that not enough potash is being applied in some cases to meet the demands of the crops and that the crops have been gradually lowering the general potash level in the soil by drawing upon the supply of native replaceable potash.

Analyses of a large number of plots before and after 8 years of fertilizing show that where no winter legumes were grown in the rotation, more than 24 pounds of potash (K_2O) had to be applied annually to 6 out of the 8 soils studied in order to maintain a constant level of potash in the soil. On the other hand, where legumes were grown in the rotation it took more than 24 pounds of potash annually for only 2 soils out of the 8 studied. The tests stress the value of winter legumes in conserving soil potash.

The Relation Between the Amount of Native Replaceable Potash in Three Alabama Soils and the Increased Yield of Seed Cotton

Produced by Added Potash. (N. J. Volk).—A number of substation plots were analyzed in the spring of 1938 before fertilizer was applied. Fertilizer was applied to these plots in the spring of 1938 and yield records of seed cotton were obtained the following fall.

The results indicate that fairly accurate interpretations could be made as to whether or not Norfolk FSL (Wiregrass) would respond to added potash as indicated by the concentration of native replaceable potash in the soil; i.e., soils containing less than 150 to 165 pounds of replaceable potash per acre should respond to additional potash. In the case of Hartsells FSL (Sand Mountain), a fairly accurate interpretation could be made for soils containing less than 150 or more than 225 pounds per acre of native replaceable potash per acre; i.e., soils containing less than 150 pounds of replaceable potash per acre should respond to additional potash, soils containing over 225 pounds should not respond, while soils containing between 150 and 225 pounds may or may not respond to additional potash. For Decatur clay (Tennessee Valley) it is evident that soils containing less than 375 pounds of native replaceable potash per acre should respond to additions of potash.

It is evident, especially for Hartsells FSL and Decatur clay, that the **magnitude** of the response to added potash cannot be predicted with any degree of accuracy.

The Effect of Winter Legumes on the Leaching of Potassium. (N. J. Volk).—The soils of a large number of substation and experiment field plots were analyzed for replaceable potassium before and after 8 years of fertilizing and cropping. Two systems of cropping were used, one with a winter legume in the rotation and one without a winter legume in the rotation.

The results show that for the 8 soils studied, an average of 20.2 per cent of the potash applied to soils not having a winter legume in the rotation was lost by leaching; and that only 3.1 per cent was lost where winter legumes were present in the rotation. This amounted to a saving of 17.1 per cent of the potash applied or about 40 pounds of potash over the 8-year period.

The Response of Cotton to Magnesium and Rare Elements in South Alabama. (N. J. Volk).—In studying the effect of rare elements on cotton rust in South Alabama, two mixtures of fertilizer were used. One contained rare elements plus magnesium and the other contained only rare elements. Of 16 fields tested, all but two showed a marked response to magnesium with an average increased yield of 87 pounds of seed cotton per acre. Only one field showed a significant response to rare elements.

Top-Dressing Cotton with Potash. (J. T. Williamson, F. E. Bertram, J. K. Boseck, R. C. Christopher, H. A. Ponder, J. W. Richardson,

and R. W. Taylor).—The average results of 383 tests with farmers on various Alabama soils over a five-year period show that 100 pounds of muriate of potash per acre applied as a top-dressing in addition to the fertilizer used by each farmer increased the yield of seed cotton by 45 pounds when used alone and by 39 pounds when used with 100 pounds of nitrate of soda. Top dressing with potash proved most effective on Norfolk, Greenville, Cecil, and Decatur soils but even on these soils the increase was too small to justify the 100-pound application.

A Comparison of Field Crop Response and the Amount of Phosphorus in Soil as Determined by Various Tests for Available Phosphorus. (Garth W. Volk).—Several methods for rapidly determining readily available phosphorus in soils have been checked against 397 experimental plots located on the Hartsells, Decatur, Dewey, Norfolk, Orangeburg, Ruston, Kalmia, Greenville, Hanceville, Cecil, Clarkesville, and Holston soil series. The Universal, Purdue, Hellige-Truog, Spurway, Hester, and .002 N H_2SO_4 methods were used in this study.

There was no correlation between crop response and the amount of phosphorus as determined by the Hester method. The extractant used in the Spurway method appeared to be too weak since 95 per cent of the soils gave zero to low readings; whereas, additions of phosphorus produced decided crop response on only 62 per cent of the soils. The agreement of crop response with the amount of phosphorus was 83.1 per cent by the .002 N H_2SO_4 method, 82 per cent by the Purdue method, 74.9 per cent by the Universal method, and 74.1 per cent by the Hellige-Truog method. These methods are not sufficiently accurate to indicate whether a soil will need 50, 100, 150, or more pounds of superphosphate per acre, but they will indicate with a fair degree of accuracy whether the soil needs no additional phosphate or a full rate of 250 to 300 pounds of 16 per cent superphosphate.

Varietal and Species Differences in Resistance of Vetches to Aphid Injury. (H. R. Albrecht).—Heavy aphid infestation occurring in the early spring of 1937, 1938, and 1939 presented opportunities to determine species and varietal differences in resistance to aphid injury among the vetches.

Most of the common vetches (Vicia sativa) under observation have proved quite susceptible to aphid attack. These include a number of promising U. S. D. A. lines such as No. 02830, 18141, 20570, 32195, and 34947 (Williamette vetch). Purple vetch (**V. purpurea**), Monantha (**V. monantha**), bitter (**V. ervillia**), and Hungarian (**V. pannonica**) also proved very susceptible to aphid injury.

Two common vetches, Nos. 16462 and 29935 have proved to be very resistant to aphid injury, as have woollypod vetch (**V. dasycarpa**), smooth and hairy vetch (**V. villosa**), wild or Augusta vetch

(V. augustifoli), **(V. melanops)**, and **(V. hybrida)**. Three sative vetches, Nos. 18134, 18005, and 71116 seem intermediate in resistance.

Stem tips, flowers, and immature pods of even the resistant vetches were injured by aphids. Studies made with caged plants indicate that aphids are in some part responsible for the low yields of vetch seed in Alabama.

Soybean Virus Disease Studies. (H. R. Albrecht).—A progressively higher incidence of soybean virus disease has been noted in the soybean breeding nursery during the past four summers. The general prevalence of the disease in 1939, particularly, afforded an opportunity to study the differences in varietal resistance to soybean virus.

The extremely susceptible varieties include several which are commonly grown in Alabama: Mammoth yellow, Chiquita, Avoyelles, Biloxi, Laredo, and Tokio. The Otootan, Tanner, and Easycook varieties have been classified as being moderately susceptible. Practically all varieties under observation have proved to be at least slightly susceptible, but a few strains such as U. S. D. A. No. 85468, have thus far been found to be free of disease symptoms. Most of the better edible varieties of soybeans are extremely susceptible to virus.

A few inbreds, noticeably more resistant to virus than the parent lines from which they were selected, have been isolated. These must be tested further before their resistance can be established. The inbred lines have generally produced more seed than their more susceptbile sibs, particularly when the latter have shown severe disease symptoms. An attempt is being made to determine which insects are responsible for the spread of the disease.

The Effects of Inoculation on Yields of Peanut Hay and Nuts. (H. R. Albrecht).—An experiment designed to test the effect of inoculation on yields of peanut hay and nuts was conducted on a Norfolk light sand. Twelve inoculation and fertilizer treatments were included in the tests. The plots were either unfertilized or fertilized with triple superphosphate, 20 per cent superphosphate, or basic slag. All plots received muriate of potash, and half the superphosphate plots were limed.

In each case, except on the unfertilized plots, inoculation led directly to increased hay and nut yields. The greatest increases in yields due to inoculation were obtained on plots receiving basic slag. The phosphate plots, unless they were limed, yielded no more than the unfertilized plots. Although the inoculated fertilized plots outyielded their uninoculated counterparts in each instance, the differences did not always prove significant when subjected to statistical analysis.

The Influence of Soil Moisture and Fertilizer Applications on the

Oil and Protein Content of Cotton Seed. (D. G. Sturkie).—An analysis of the cotton seed of the crops of 1937 and 1938 showed that a higher oil and lower protein content was associated with favorable moisture conditions. Conditions of drouth resulted in low oil and high protein content of seed. Applications of nitrogen decreased the oil and increased the protein content while applications of phosphorus and potash increased the oil and reduced the protein. The absence of either phosphorus or potash in a fertilizer reduced the oil and increased the protein.

The Effect of Continuous and Intermittent Cropping of Vetch on the Yield of Vetch and of Crops Following. (E. L. Mayton).—In an experiment on Norfolk sandy loam soil, vetch has been grown every year, every second year, and every third year on different plots cropped to a two-year rotation of cotton and corn. On adjacent check plots no vetch has been grown. Over a six-year period, 1934-1939, the total pounds of vetch turned under has been approximately equal under the three systems of cropping. The amounts in pounds per acre of green vetch has totaled 20,540 from six crops; 22,152 from three crops; and 19,324 from two crops. The average annual increase in pounds of seed cotton and bushels of corn per acre were as follows: vetch every year 640 pounds and 17.2 bushels; vetch every second year 597 pounds and 11.9 bushels; vetch every third year 445 pounds and 12.7 bushels.

Oat Variety Test. (E. L. Mayton).—During the last ten years various varieties of oats have been tested for yield at three of the substations and at the Main Station. Hastings' Hundred Bushel, Red Rustproof 43A, Red Rustproof, and Appler have been the four highest producing varieties in these tests. Their average production has been approximately 50 bushels per acre. The four above varieties are rust-resistant. The Coker and Fulghum varieties produced 5 to 10 bushels per acre less in these tests but they matured from two to three weeks earlier; these two varieties are rust-susceptible and in some years were seriously damaged.

ANIMAL HUSBANDRY AND POULTRY

A Study of the Transmission of Factors Related to the Economical Production of Swine. (J. C. Grimes).—In this project a study is being made of the individual variation in economy of feed utilization in swine. Breeding stock from eight litters, designated as the superior strain, are being selected on the basis of the most economically gaining animals. Breeding stock from a like number of litters designated as the inferior strain are being selected on the basis of the least economically gaining animals. The superior and the inferior strains had a common ancestry at the beginning of the experiment.

The results of this year's test agree rather closely with those of

the previous year in that the pigs in the superior strain were heavier at birth and at weaning age, required fewer days to reach a weight of 225 pounds, and consumed less feed for a unit of gain than the pigs in the inferior strain.

The feed required per 100 pounds gain was less for pigs in both strains in 1939 than in 1938. However, even the superior strain of the F_3 generation of pigs required 17 pounds more feed per 100 pounds gain in 1939 than the F_1 generation of pigs required in 1937 (Table 6). This may be explained in part by the fact that the F_1 generation of pigs consisted of eight litters which were selected as being the best phenotypically of 15 litters, while there was no opportunity for such selection in the F_3 generation.

While the number of animals involved has been too small to justify conclusions, it is interesting to note that the records to date have not shown any correlation between the number of the pigs in the litter and the birth weight of the pigs. Neither has there been any correlation between the number of pigs in the litter and the amount of feed required to make a unit of gain, nor the length of time required to reach a weight of 225 pounds. There has been a tendency for pigs in smaller litters to be heavier at weaning age (Table 7). This has been due, no doubt, to the increased supply of milk available for each pig in the smaller litters during the suckling period.

Heavy feed consumption has been associated with rapid gains and to a large extent with cheap gains. The feed consumption for each 100 pounds of gain has increased rapidly as the length of time from birth to a weight of 225 pounds has increased above 200 days (Table 8).

TABLE 6.—Average Results Obtained with Pigs in the F_1, F_2, and F_3 Generations.

Generation	Year	Strain	Number litters	Average weight, pounds			Average number days to 225 lbs. weight	Average feed per 100 lbs. gain	Average number pigs farrowed alive per litter	Average number per litter reaching 225 lbs. weight
				Birth	Weaning	72 days of age				
F_1	1937	(1)	8	2.61	23.38	30.47	196.95	355.75	9	8.75
F_2	1938	Superior	8	2.58	32.46	44.46	191.36	386.63	6.62	6.25
F_2	1938	Inferior	8	2.32	27.14	36.41	225.61	413.03	9.12	7.87
F_3	1939	Superior	8	2.59	24.90	31.02	211.81	372.75	7.50	4.62
F_3	1939	Inferior	8	2.30	18.45	21.78	239.23	389.67	8.25	5.50

(1) The most economically gaining pigs in the F^1 generation were used as parent stock for the superior strain and the least economically gaining pigs were used for the parent stock for the inferior strain.

TABLE 7.—Relation of Size of Litter to Birth Weight, Weaning Weight, Time to Reach 225 Pounds, and Feed per 100 Pounds Gain.

Size of litter	Average number live pigs born per litter	Number litters	Average birth weight	Average weaning weight	Average number days to 225 lbs. weight	Average feed per 100 lbs. gain	Percentage of pigs reaching 225 lbs. weight
1 - 3 Inc.	2.67	3	2.18	30.75	206.00	381.81	100
4 - 6	4.75	4	2.04	27.25	204.67	379.71	63
7 - 9	8.14	21	2.61	26.60	206.56	374.56	88
10 -12	10.64	11	2.42	22.69	222.36	391.31	78

TABLE 8.—Relation of Rate of Gain to Daily Feed Consumption and to Feed Consumed per Unit of Gain, 1937, 1938, and 1939.

Number days from birth to 225 lbs. weight	Average number days	Number pigs in group	Average feed consumed daily	Feed consumed per 100 lbs. gain
161 - 180	173.64	39	3.755	362.16
181 - 200	189.91	78	3.516	358.33
201 - 220	209.21	62	3.45	374.16
221 - 240	229.84	33	3.38	390.54
241 and over	274.75	48	3.16	432.00

The Value of Shelter for Fattening Steers in Alabama. (J. C. Grimes).—Tests have been conducted during two winters to determine the value of an open shed shelter for fattening steers in Alabama. The average results of these tests show a slight increase in the rate and economy of gains and the selling price of steers furnished shelter. The profit per steer above feed cost was approximately one dollar more each winter for the steers provided with shelter than for those fed in the open.

The Relative Value of Ground and Unground Peanut Hay as a Roughage for Fattening Steers. (J. C. Grimes).—The average results for three years showed that common grade steers weighing about 500 pounds each, when fed all the unground peanut hay they would eat and approximately five pounds of cottonseed meal per head daily for a period of 112 days, gained an average of 1.25 pounds daily. The steers consumed 1,027 pounds of hay and 370 pounds of cottonseed meal for each 100 pounds gain. A second group of steers fed a similar ration except that the hay was ground gained an average of 1.61 pounds daily and consumed 813 pounds of hay and 288 pounds of cottonseed meal for each 100 pounds of gain.

After paying for the steers and the cottonseed meal and crediting all the profits to the hay, the returns for each ton of unground hay fed was $16.34, and for each ton of ground hay $20.66. On this basis the ground hay was worth $4.32 more per ton than the unground hay.

Studies of the Vitamin B Complex. The Supplementary Relationship of Vitamin B_6 and Unsaturated Fatty Acids. (W. D. Salmon).—On a fat-free diet supplemented with carotene, calciferol, thiamin, riboflavin and factor 2, rats made very little growth and consistently developed a severe erythematous dermatitis on the nose and feet as well as a generalized scaliness and fissuring of the skin and a severe hematuria. The addition of synthetic vitamin B_6 (Merck) or the substitution of yeast extract in place of factor 2 produced a marked stimulation of growth and prevented the

erythema. The severity of the scaly condition of the skin was decreased. The hematuria was not prevented.

The addition of methyl linolate or corn oil (without vitamin B_6) prevented the hematuria as well as the erythema and scaliness of the skin but produced relatively little growth. The further addition of vitamin B_6 resulted in a marked increase in the rate of growth.

When the carbohydrate of the vitamin B_6-free diet was entirely replaced with fat, part of which was corn oil, there was no erythema or scaliness of the skin apparent except in occasional cases. The growth rate was very low, however, and the hair coats were greasy and unkept. The addition of vitamin B_6 to the high fat diet markedly increased the rate of growth and resulted in an essentially normal appearance of the animals.

The results show that although vitamin B_6 and the essential fatty acids can to a certain extent mutually alleviate the deficiency of each other, the presence of both in the diet is necessary for normal nutrition of the rat. They likewise show that vitamin B_6 is not primarily concerned with carbohydrate metabolism.

The Vitamin A Content of Milk and Storage Tissues of Dairy Cows as Related to Pasture and Feeding Practices. (C. J. Koehn).—

I. *The Photoelectric Determination of Vitamin A and Carotene in Milk.* The following method was devised for the photoelectric determination of carotene and vitamin A in milk.

One hundred grams of milk was placed in an Erlenmeyer flask with 100 ml. of aldehyde-free ethyl alcohol and 50 ml. of 60 per cent KOH. The flask was then placed on a water bath and the contents boiled for 10 minutes. This completely saponified the fat and dissolved the proteins. After the mixture was cooled, it was transferred to a separatory funnel and extracted once with 350 ml. and once with 100 ml. of peroxide-free ether. The combined ether extracts were washed three times with 200 ml. of water and then dried over anhydrous sodium sulfate. The ethereal solution was evaporated to dryness on a water bath under reduced pressure of nitrogen, and the residue dissolved in 10 ml. of chloroform. A 1.0 ml. aliquot was diluted to 10 ml. and the light absorbed by the carotene at 44 millimicrons was measured with a photoelectric colorimeter. Another 1.0 ml. aliquot was taken and the amount of light absorbed at 620 millimicrons by the blue compound formed in the reaction between vitamin A and antimony trichloride was measured.

II. *The Relation of Colorimeter Reading to Vitamin A Activity of Milk in Terms of International Units.* A sample of butter was assayed with rats and its vitamin A activity was compared with beta carotene, the international standard. The vitamin A content of the same sample of butter was then determined with the photo-

electric colorimeter and the analyses compared with the biological assay. The results of the chemical analysis were calculated from calibration data obtained with the U. S. P. reference cod liver oil for vitamin A and with pure crystalline beta carotene. It was found by solvent fractionation that 9.3 per cent of the yellow color of the butter was due to xanthophyll. Chromatographic analysis showed that all of the carotene in the butter was beta carotene, the most active form. On the basis of the chemical analysis it appeared that the butter contained 38.2 international units of vitamin A, 35 per cent of which was due to beta carotene. On the basis of the biological assay, however, the butter was much more active. Since beta carotene has the same vitamin A activity regardless of its source, this increase in activity must be due to a difference in the vitamin A itself. It appears that the vitamin A of butter is about two and one-half times as active as that of cod liver oil. This work, however, does not preclude the possibility that there are substances in milk which interfere with the chemical determination of vitamin A which do not occur in cod liver oil.

III. *Seasonal Variation of the Carotene Content of Pasture Grasses.* Monthly determinations were made of the carotene content of lespedeza (common), white clover, Bermuda grass, and carpet grass growing in a permanent pasture. These determinations were made from late summer until December. The clover was consistently highest in carotene and retained its carotene longer than the others as the season progressed. The carpet grass was next, although definitely inferior to the clover. Bermuda and lespedeza, although they contained considerable carotene in the summer, dried up and lost much of their carotene early in the fall. All of the plants were low in carotene during the winter.

IV. *Seasonal Variation of the Vitamin A Content of Milk.* Samples of milk taken monthly from the College herd showed a continuous drop in vitamin A content from August to December. The vitamin A content of the December milk was a little over half that of the August milk. Two groups of cows kept in a lot with restricted grazing, receiving in addition a standard ration of grain mixture and either Lespedeza sericea or alfalfa hay, showed a still greater drop in the vitamin A content of their milk. The vitamin A content of the group receiving Lespedeza sericea hay dropped 50 per cent in four months while it dropped 66 per cent in the group receiving alfalfa hay. Chemical analysis of the hays showed that the alfalfa hay contained less carotene or pro-vitamin A than the lespedeza hay. Both hays were of poor quality, however.

Studies on the Nutrition of Dogs. (C. J. Koehn).—There has been a demand for a dry dog food formula which is simple, composed of ingredients readily available to the average hunter, and which is well balanced nutritionally. The following two formulas have met these requirements:

Formula I		Formula II	
Yellow corn meal	58 per cent	Yellow corn meal	46 per cent
Wheat shorts	20 per cent	Wheat shorts	20 per cent
Meat scraps	20 per cent	Peanut meal	29 per cent
Salt	1 per cent	Bone meal	2.5 per cent
Cod liver oil	1 per cent	Limestone	0.5 per cent
		Salt	1 per cent
		Cod liver oil	1 per cent

These rations may be mixed with water and fed as such or may be baked in the form of bread. Baking gives a substantial increase in the efficiency of such rations.

Pathological Conditions Associated with Lack of Vitamin B Complex. Histopathologic Observations on Rats Fed a Diet Deficient in Essential Fats. (R. W. Engel).—These studies were made to determine whether or not any anatomical changes in the kidneys could be associated with the hematuria which accompanies fat deficiency.

Tissues were obtained from rats receiving fat-free diets. Rats receiving a supplement of corn oil served as controls. A total of twenty animals were used.

The routine procedure was to stain sections of kidney, liver, adrenal, spleen, heart, and lung with hemotoxylin and Eosin. Sections of kidney, liver, and adrenal were also stained with Maximov's stain for fat. Formalin fixed frozen sections of liver were examined for fat with the scarlet red stain.

The gross appearance of the kidneys from animals with hematuria varied from a slight surface paleness to rather severe connective tissue surface scars.

Microscopically, the primary kidney lesion appeared to be in the glomeruli. In the milder cases hyalinized masses had formed in scattered glomeruli in the renal columns. In more severe cases calcium deposits were present in such damaged areas. In chronic cases (twenty weeks on experiment) vast areas of the tubular system were replaced with connective tissue and calcified hyaline masses. The corn oil supplements prevented these kidney lesions except for small foci of congestion and hemorrhage in the cortex.

Varying degrees of congestion and vacuolization were present in the liver cells of all these animals. In some cases there was hydropic degeneration in the adrenal cortex. The lungs had foci of hemorrhage in some cases while heart muscle and spleen were normal in all cases.

Further studies are necessary to determine the cause of the mild kidney congestion and hemorrhage in corn-oil treated animals.

The Determination of Vitamin A and Carotene with the Photoelectric Colorimeter. (C. J. Koehn and W. C. Sherman).—The U. S. P. reference cod liver oil when assayed biologically was found to

have the assigned potency of 3000 I. U. of vitamin A per gm. This same oil had an average L (1%, 1 cm. 620 millimicrons) of 3.45 as determined with the Evelyn photoelectric colorimeter. Colorimeter readings were made on solutions of vitamin A and carotene in chloroform and skellysolve solution over a wide range of concentrations in order to obtain factors for converting values of 2-log G into I. U. of vitamin A. It was found that 2-log G was not a strictly linear function of concentration of vitamin A or carotene. It was therefore necessary to keep the concentration of the solution within definite limits. Concentrations which gave galvanometer readings between 30 and 70 caused errors of less than 3 per cent.

The following constants were obtained: $K_1 = 45.60$ for converting 2-log G_{620} into I. U. of vitamin A, $K_2 = 3.19$ and $K_3 = 2.65$ for converting 2-log G_{440} into micrograms of beta carotene in chloroform and skellysolve solutions, respectively. A correction factor was also derived for the light absorbed by the blue color produced in the reaction between beta carotene and antimony trichloride. Beta carotene was found to have an average L (1%, 1 cm. 440 millimicrons) of 1645 and 1980 in chloroform and skellysolve solutions, respectively.

The Effect of Unsaturated Fatty Acids Upon the Utilization of Carotene. (W. C. Sherman).—Natural fats which were high in unsaturated fatty acid content gave a better growth response than was obtained with fats low in unsaturated fatty acids when fed with carotene to young rats which had been depleted of vitamin A on a low-fat diet. However, when the unsaturated fatty acid, linoleic (methyl ester) was fed with low levels of carotene the vitamin A deficiency was intensified and growth was inhibited. The interference of linoleic acid with carotene utilization disappeared when sufficiently large doses of carotene were given or when the two supplements were fed a few hours apart, in which case the methyl linolate improved the growth. This antagonism could also be prevented by feeding a small amount of soybean oil with the carotene and methyl linolate.

Methyl linolate did not cause direct destruction of the carotene prior to its ingestion by the rats and did not decrease the efficiency of absorption of carotene. It appears, therefore, that linoleic acid interferes with the metabolism of carotene on vitamin A and that certain oils contain factors which protect against this interference.

Value of Kudzu and Other Summer Green Feeds for Poultry. (G .J. Cottier and D. F. King).—Kudzu, Brabham cowpeas, Otootan soybeans, Lespedeza sericea, and Bermuda grass were compared as summer grazing crops for laying hens for a period of four and one-half months during the summer of 1939 (Table 9). Kudzu produced the largest amount of green feed per acre and was affected less by drought than the other crops studied. The kudzu, however, did not stand continuous grazing. In a palatability test, they were

consumed as follows: kudzu 29.99 per cent, cowpeas 26.86 per cent, soybeans 30.42 per cent, and Lespedeza sericea 12.74 per cent. The highest egg production was obtained in the Bermuda grass lot while the lowest production was in the Lespedeza sericea lot. Lespedeza sericea made considerable growth but was somewhat unpalatable. Palatability was increased by clipping the sericea 15 days before grazing was started.

TABLE 9.—Summary of Results of Summer Green Feed for Poultry.

Lot No.	Crop grazed	Average No. eggs per bird per month	Average weight of eggs	Average body weight	Mortality	Average yield per A.	Palatability (amount consumed)
			Grams	Grams	Per cent	Lbs.	Per cent
1	Kudzu	12.58	50.49	1805	20.00	10,905	29.99
2	Bermuda grass	14.57	50.96	1815	6.67	—	—
3	Lespedeza sericea	11.74	50.50	1811	9.94	1,452	12.74
4	Cowpeas	13.43	48.37	1837	6.67	2,420	26.86
5	Soybeans	12.40	49.31	1797	13.34	1,346	30.42
6	Control No green feed	8.41	47.89	1686	40.00	—	—

Detecting Infertile Eggs Previous to Incubation. (D. F. King)—The work on this project was devoted to a study of the variations found in the germ cell of infertile eggs. Forty-one per cent of the infertile eggs showed a white ring in addition to the germ spot. The average size of this ring was 5.27 mm. This white ring is probably causing considerable error in detecting infertile eggs with a candling machine. An accurate measurement of infertile germ cells revealed that only nine per cent of the cells had a diameter of over 3.0 mm. In general individual hens were found to lay the same type of infertile eggs from day to day. On an average only 22 per cent of the eggs laid by a certain hen varied from the type she had been regularly laying. There was no relationship between size of infertile eggs, as measured by weight, and the size of the germ cell.

Effect of Period of Illumination on Fertilizing Ability of the Male Fowl. (D. F. King).—It has been found that for the first three or four weeks after the males have been exposed to large amounts of light there is a decided decrease in the percentage of infertile eggs obtained from these males. The stimulating effect of the light although quite definitely present is of short duration. The average per cent infertile eggs produced over an eight-week period shows there is nothing to be gained by exposing the males to light in excess of 12 hours per day.

The Inheritance of Resistance to Fowl Paralysis. (Paul D. Sturkie).—From an analysis of data covering a period of four years

of breeding for resistance to fowl paralysis, it was found that the total first year laying house mortality had decreased from 89.43 per cent in 1935 (none-culled) to 34.4 per cent in 1938 with 20 per cent culled. Approximately two-thirds of the mortality in 1935 resulted from paralysis; whereas, in 1938 only 17 per cent resulted from this cause. The percentage mortality and percentage culled or sold respectively for the 4 years are as follows: 1935 - 89.43 and none culled; 1936 - 54.39 and 36.54; 1937 - 45.68 and 37.85; 1938 - 34.4 and 19.26.

Not only has the total percentage mortality decreased through the years, but the average age of survival has steadily increased. In 1935, the number of days lived after laying the first egg was 149, as compared with 155 in 1936, 162 in 1937, and 177 in 1938. This increase in survival age has had the effect of increasing the average egg production of pullets from 64 eggs per bird in 1935 to 151 in 1938. This represents a saving of 87 eggs per bird or a difference in gross income of about $1.50 per bird. This figure does not take into account the saving resulting from the increased number of birds alive at the end of the laying year.

HORTICULTURE AND FORESTRY

Selectivity of Trees as a Factor in Spacing Pine Plantings. (L. M. Ware and J. E. Bryan, Jr.)—In artificial plantings of pines it has been recognized all the while that many trees not needed for final crop trees must be set at the beginning to provide suitable conditions for natural pruning and shaping of the trees which are to be finally left. Less consideration has been given to the need of having a large number of original trees from which vigorous, well-shaped, disease-free trees, spaced for maximum growth and quality, might be selected for intermediate and final crop trees. Records on trees in a spacing experiment at the Main Station show the importance of an adequate number of trees to permit selection for vigor and quality.

Complete records were made in 1939 on trees in a loblolly and in a slash spacing experiment after eight seasons of growth. The spacings were 4′ x 4′, 6′ x 6′, 8′ x 8′, 12′ x 12′, and 16′ x 16′. Each individual tree was classed with respect to vigor, divided trunk, shape, and disease; its position in the plot was also mapped. Four degrees of vigor were recognized corresponding in general to the usual forest classification of dominant, co-dominant, intermediate, and suppressed trees. Complete records, therefore, permitted a classification of each vigor class into three general quality classes. The data on position permitted mapping of each area to determine the adequacy of vigorous, high-quality trees for most complete use of the area involved and for proper training of the stems left after thinning to intermediate and final crop trees.

A condensed form of these data is given in Table 10.

TABLE 10.—Number of Trees in Various Vigor and Quality Classes at Different Spacings
Number of Trees Per Acre.

Spacing	Original number set	Trees of low vigor or suppressed (1)	Trees remaining of medium and high vigor (2)	Medium and vigorous trees remaining after elimination of diseased trees (2)	Medium and vigorous trees left after elimination of diseased and poorly shaped trees (2)	Vigorous trees left after elimination of diseased and poorly shaped trees (3)
Slash Pine						
4 x 4	2720	1918	802	760	591	250
6 x 6	1210	758	452	404	310	204
8 x 8	680	381	299	283	244	155
12 x 12	300	84	216	184	164	108
16 x 16	170	44	126	112	94	66
Loblolly Pine						
4 x 4	2720	1974	746	698	607	307
6 x 6	1210	783	427	390	312	179
8 x 8	680	332	348	324	230	124
12 x 12	300	86	214	200	158	94
16 x 16	170	20	150	134	98	46

(1) Suppressed and intermediates; (2) dominant and co-dominant; (3) dominant trees.

The number and position of final trees are not rigid requirements; however, it may be assumed for maximum growth and highest quality in the final crop of saw logs and in the trees intended for intermediate products which require grades, such as poles and piling, that about 150 trees per acre of high vigor and good form should be available at approximate positions which would insure good use of the area and a reasonably uniform stand of trees. Of this number about 75 should be for final saw logs. In a younger stand after the first thinning is made there probably should be about 150 to 200 additional trees left. These last trees need not necessarily be of such high quality but should be of a good vigor. They serve the purpose of shaping other trees and will furnish firewood, pulpwood, and fence posts if treated.

Although there is not available today seed sources of pines selected for high quality and vigor as with field crops, there yet remains a very excellent opportunity in intensively handled pine plantings of obtaining the same results by the selectivity afforded by a large number of trees.

It is apparent that two levels might be set with respect to requirements for the crop trees constituting the final and last intermediate harvests. With a more rigid requirement the crop trees would come from high quality trees in the dominant group. With a less rigid requirement the crop trees would come from both dominant and co-dominant groups with the same quality requirement.

On a basis of the more rigid requirement it would appear that a 6′ x 6′ spacing offers the necessary number of high quality trees for selection of 150 crop trees reasonably well spaced. At this spacing there were 204 trees per acre of vigorous, well spaced slash pines, and 179 loblolly pines. There were 36 positions even at this spacing which by chance had no vigorous well-formed trees within a radius of 14-18 feet.

An 8′ x 8′ spacing furnished the number of trees required per acre, but there were 48 positions where good trees should have been present but were not. Therefore, on a basis of the highest requirement for vigor and quality an 8′ x 8′ spacing failed to give the adequate number of well-spaced trees for either species. The 8′ x 8′ spacing did give a sufficient number of trees at the lower requirement level.

The 12′ x 12′ and the 16′ x 16′ spacings failed to give an adequate number of trees at either level considering positions without good trees.

The 4′ x 4′ spacing gave more vigorous, high quality trees than were necessary and there was at this spacing a large number of weak and suppressed trees.

Yields of Eight-Year-Old Slash and Loblolly Plantings. (J. E. Bryan, Jr. and L. M. Ware).—In an effort to arrive at accurate

figures for the cubic foot and cordage yields of pine plantations, complete measurements were taken of eight-year-old slash and loblolly pines spaced 4′ x 4′, 6′ x 6′, and 8′ x 8′ and from these measurements volume tables for each species and spacing were constructed. Longleaf plantings of the same age were examined, but not a sufficient number of trees had begun height growth to warrant measurements for a volume table.

Every tree one inch dbh and over was included in the computations of total yields. Since the wood was small and round, 77 cubic feet of solid wood was considered a cord.

The 4′ x 4′ plantings gave by far the largest yields per acre. It should be pointed out, however, that there were 2720 trees per acre originally planted at the 4′ x 4′ spacing as compared to only 1210 trees at the 6′ x 6′ spacing and 680 trees at the 8′ x 8′ spacing.

There were 690, 229, and 169 cull and dead trees at the 4′ x 4′, 6′ x 6′, and 8′ x 8′ spacings, respectively.

At the 4′ x 4′ spacing, both species made growth slightly over two cords per acre per year.

At the 6′ x 6′ spacing, each species produced approximately 1.4 cords per acre per year.

Considering both spacings, the cordage of the two species was approximately the same.

The soil approached a Norfolk sand.

Table 11 shows the average volume per tree and the cordage of eight-year-old plantings of slash and loblolly for each of three spacings.

TABLE 11.—Number of Trees, Average Volume per Tree, and Cordage of 8-Year-Old Slash and Loblolly Pines at Different Spacings.

	Slash				Loblolly			
Spacing in feet	Trees per acre 1″ dbh and over	Ave. cu. ft. per tree	Cu. ft. per acre	Cords per acre	Trees per acre 1″ dbh and over	Ave. cu. ft. per tree	Cu. ft. per acre	Cords per acre
4 x 4	2024	0.648	1311.38	17.03	2049	0.683	1398.90	18.17
6 x 6	981	0.920	902.78	11.72	977	0.849	829.89	10.78
8 x 8	511	0.825	421.26	5.47	592	1.062	628.81	8.17

Influence of Harvesting Small Amounts of Sweet Potatoes During the Period of Root Production on Total Yield. (C. L. Isbell).—An experiment was conducted in 1938 and 1939 to obtain information as to the influence of harvesting small amounts of sweet

potatoes twice each week through the period of root production on total yield of potatoes and to compare the influence of harvesting by grabbling vs. digging. Treatments and results obtained are presented in Table 12.

TABLE 12.—Yield of Sweet Potatoes under Different Methods of Harvesting.

Method of harvesting	Year	Harvests made during period of root production			Yield per plot in lbs. (Final harvest)	Total yield in pounds	
		Per cent of plants harvested	No. of potatoes harvested	Yield in lbs. harvested		per plot	per acre
Checks — only final harvest made	1939	0	0	0	543.54	544	17,265
	1938	0	0	0	481.60	482	19,486
	Average	0	0	0	512.57	513	18,375
Plot harvested by grabbling 2½ pounds on Mondays and Fridays	1938	25.20	123	84.36	379.61	464	16,633
	1939	19.63	88	69.51	467.44	537	19,250
	Average	22.41	106	76.93	423.52	500	17,956
Plots harvested by digging 2½ pounds on Mondays and Fridays	1938	18.10	160	84.86	375.95	461	16,520
	1939	14.44	121	71.74	429.77	502	17,979
	Average	16.27	140	78.30	402.86	481	17,249

Footnote: Harvests began in 1938 on July 29 and ended on November 18. In 1939, harvests began July 31 and ended October 30. Final harvests were made on November 30 in 1938 and November 14 in 1939.

It is shown in the table that harvesting either by grabbling or digging small quantities after the roots reached usable size reduced the yield very little. The reduction in total yield was 2.28 per cent for those harvested by grabbling and 6.13 per cent for those harvested by digging. Harvesting small quantities of potatoes during the late summer and fall would furnish a supply for practically four months in the year when the average farmer does not have them for table use. Most farmers lose a considerable quantity of their sweet potatoes by spoilage soon after the general harvest. In view of these facts, it would be a good practice for more farmers to set sweet potato plants early and grow the crop under conditions favorable for high yields and then harvest small quantities as needed for home use or to supply local markets when prices are good.

Influence of Short-day Treatments on the Flowering of Kalanchoe. (E. W. McElwee).—Preliminary results from an experiment started in 1939 indicate that Kalanchoe, a red-flowered pot plant normally blooming in February, can be brought into bloom for Christmas sale by completely shading the plants with black cloth. Shading the plants with black cloth from September 15 to De-

cember 15 brought 50% of the plants into bloom by December 23, an additional 42% were in bloom by January 3, and the remaining 8% were in bloom by January 9. Shading the plants from October 1 to December 23 brought 18% into bloom by December 23, an additional 27% were in bloom by January 3, and the remaining 55% were in bloom by January 9. Shading the plants from October 15 to December 23 brought 24% into bloom by December 23, and the remaining 76% were in bloom by January 9. Only 10% of the plants that were not shaded came into bloom by January 26. The bud development of the remaining 50% was such that the plants are expected to be in bloom by February 10.

Shading caused a 26% increase in the height of the plants at the time of blooming, but did not affect the color of the flowers.

These preliminary results indicated that the plants should be shaded earlier than September 15, probably about September 1, when it is desirable to have a large percentage of the plants in bloom by Christmas.

Response of Chrysanthemums to Artificially Controlled Day Length. (E. W. McElwee).—To be able to control the time of flowering of chrysanthemums is important to the commercial grower for several reasons: (1) It enables him to use a few good varieties instead of a large number of varieties, often of inferior quality, to secure the succession of flowers required throughout the season. (2) It enables him to bring good varieties into bloom in early September to replace the flowers now being shipped into Alabama from California. (3) It enables him to retard the flowering of good varieties until Christmas and January at which time there is a very definite demand for good varieties. At present there are only a few inferior varieties available during this season of the year.

Early flowering varieties of chrysanthemums bloom as much as 9 days later and late flowering varieties bloom as much as 18 days earlier, under Alabama conditions, than under more northern conditions. Since the difference in time of flowering of chrysanthemums has been shown to be due to differences in the length of day, an experiment was started in 1936 to study the adaptability to Alabama conditions, of the short-day and long-day treatment now being used under northern conditions to control the time of flowering of the chrysanthemums.

The short-day treatment consists of complete shading or darkening of the plants from 5:00 P.M. to 7:00 A.M. each day with black sateen. The long-day treatment consists of supplying additional illumination to the plants from 100 watt Mazda lamps from 5:00 P.M. to 10:00 P.M. each day.

Table 13 shows the response of three representative varieties taken from a four-year average of the 33 varieties under various shading and light treatments.

TABLE 13.—Response of Representative Varieties of Chrysanthemums to an Artificially-Controlled Day Length.

Treatment	Duration of treatment	Irene an early variety		New York a mid-season variety		Tonquin a late variety	
		Date of bloom	No. days blooming advanced or retarded	Date of bloom	No. days blooming hastened or retarded	Date of bloom	No. days blooming hastened or retarded
Check	Normal treatment	Oct. 20	0	Oct. 30	0	Nov. 22	0
Short-day (shaded, blooming date advanced)	July 15 to bloom	Sept. 10	40	Sept. 23	37	—	—
	Aug. 1 to bloom	Sept. 26	24	Oct. 3	27	Nov. 4	18
	Aug. 10 to bloom	Sept. 25	25	—	—	Nov. 10	12
	Aug. 20 to bloom	Oct. 4	16	Oct. 10	20	Nov. 16	6
	Sept. 1 to bloom	Oct. 11	9	Oct. 23	7	Nov. 22	0
Long-day (additional illumination. blooming date retarded)	Sept. 1 to Oct. 8	Nov. 30	41	Dec. 9	40	Jan. 4	43
	Aug. 16 to Oct. 20	Dec. 7	48	Dec. 10	41	—	—
	Sept. 1 to Oct. 20	Dec. 6	47	Dec. 10	41	Dec. 20	28

The normal length of the flowering period of the varieties tested was from October 20 to November 22, a period of 5 weeks. Through the use of shading, these varieties were brought into flower as early as September 10 or 40 days earlier than normal. Through the use of additional illumination the flowering of some varieties was retarded until as late as January 4, a period of 6 weeks; consequently, by employing both of these treatments the cutting period of these same varieties has been extended from a normal period of 5 weeks to 15½ weeks.

The most practical additional illumination treatments tested were the treatments starting between September 1 and September 10 and ending between October 20 and November 1. The flowering of 15 out of the 19 varieties used in these treatments was delayed until Christmas or later.

Influence of Fertilizer Rates, Organic Material, and Irrigation on the Yield of Turnips. (L. M. Ware).—In 1938 a study was started to determine the influence of certain intensive practices on the yield of several vegetable crops. The experiment is being conducted in concrete bins, each one filled with thoroughly composited soil. Two rates of fertilizer applications are being used with and without irrigation and added organic material.

Yields of turnips are given in Table 14 for the fall of 1938 and

TABLE 14.—Influence of Fertilizers, Irrigation, and Organic Matter on Yield of Turnips.

Treatment number	Fertilizer lbs. per acre 6-8-4	Number irrigations per week	Organic material added	Yield—pounds per acre		
				1938	1939	2-year average
1	0	0	0	305	0	152
2	500	0	0	1373	5935	3654
3	1000	0	0	2353	7546	4949
4	500	1	0	2873	10065	6469
5	1000	1	0	3827	12168	7997
6	500	0	Sericea*	3675	9806	6740
7	1000	0	Sericea*	4160	9553	6856
8	1000	0	0	2173	6480	4327
9	500	1	Sericea*	4887	15636	10263
10	1000	1	Sericea*	4890	18025	11458
11	1000	2	Sericea*	5477	17057	11267
12	1000	1	Vetch*	5477	15252	10364
13	1000	0	0	2494	7246	4870
14	1000	1	Cowpeas*	4809	16014	10412
15	1000 Minus N	1	Sericea*	1796	9622	5909

*Introduced Lespedeza sericea—two tons dry material before each of three crops each year. Vetch and cowpeas grown in place.

1939. Rainfall in 1938 was low early in the season but was adequate during the latter part of the growing period. In 1939 rainfall was low during the whole growing period. It should be noted that although irrigation and organic material each increased the yield of turnips, yet it was only when a combination of both irrigation and organic matter was given that maximum yields were obtained. This would indicate the need of maintaining a high organic matter content on areas where a grower expects to incur the high cost of irrigation. The yield of turnips for the two seasons at the 1000-pound rate was increased about 62% by irrigation and about 38% by organic matter. There was an increase however of about 132% for a combination of irrigation and organic material.

SPECIAL INVESTIGATIONS

Effects on Germination and Stands of Scalding Crotalaria Seed. (J. F. Duggar).—The scalding of crotalaria seed at 150°F. for 20 minutes has again proved highly effective in both incubation tests and in field plantings.

TABLE 15.—Germination of Scalded Versus Untreated Crotalaria Seed Incubated in November-December, 1939, at 27°-30° C.

Seed incubated 28 days		Per cent cumulative germination within				Sum of germ'd and hard seeds
From crop of	Untreated or scalded	7 days	14 days	21 days	28 days	
1939	Untreated	3	4	4	4	95
do	Scalded	73	79	81	85	87
1938	Untreated	5	5	5	5	99
do	Scalded	77	77	77	78	83
1937	Untreated	1	1	1	1	98
do	Scalded	89	89	89	90	97

From a planting made at the same time as corn, about May 1, in a single drill in each six-foot middle, 8 pounds of untreated seed per acre resulted in a stand of only 5160 crotalaria plants and a yield of only 83 pounds of shelled seed per acre. Six pounds (dry weight) of seed, first scalded as above and promptly planted, afforded a stand of 31660 plants and a yield of 319 pounds of shelled seed per acre.

Effects on Germination of Exposing Untreated Crotalaria Seed on the Soil Surface. (J. F. Duggar).—Unhulled crotalaria seeds in very thin muslin containers were exposed on the surface of the dry soil in summer for varied periods.

TABLE 16.—Germination in 1939 in Incubator of Untreated Crotalaria Seed Previously Exposed on Soil Surface in Summer.

Days seed exposed on surface of soil	Seed[1] from crop of	Protected against rains	Per cent cumulative germination on incubation for				Sum of germ'd and hard seed.
			7 days	14 days	21 days	28 days	
0	1938		5	5	5	5	99
7 days	1938	Yes	74	75	75	75	89
14 days	1938	Yes	93	93	93	93	95
0	1937		2	2	2	2	96
3½ days	1937	Yes	74	75	75	75	98
8 days	1937	Yes	86	86	86	86	97
14 days	1937	Yes	72	73	73	74	99
21 days	1937	Yes	87	88	88	89	98
24 days	1937	Yes	80	86	86	86	98
7 days	1937	No	80	80	80	80	100

[1]Exposed the following summer on soil surface.

The very remarkable increase in germination in the laboratory from previous exposure on the soil surface for periods tested (from 3½ to 24 days) is attributed to the repeated alternations of temperature from night to afternoon of hot summer days.

Stages and Frequency of Mowing Sericea. (J. F. Duggar).—On Norfolk upland soil sericea afforded in the sixth year since planting larger yields of both hay and seed than in any earlier year, although annual fertilization had been identical.

On the several plots cut at a height of 12 inches the 1939 average was 6500 pounds of pure sericea hay; for the plots cut twice annually at a height of 18 inches, the yearly yield was 7563 pounds per acre.

The calculated protein yields were 922 pounds per acre in 1939 from the 12-inch mowings and 1042 pounds from the 18-inch mowings. The latter is fully equal to the amount of protein in one and one-fourth tons of 40-per-cent cottonseed meal.

ZOOLOGY-ENTOMOLOGY

The Relative Efficiency of Rotenone Containing Insecticides in the Control of Vegetable Insects. (F. S. Arant).—Derris, cube, timbo, and *Tephrosia* (devil's shoestring from the U. S. Bur. Plant Ind.), mixed with talc or sulphur to 0.5 per cent rotenone content, were highly effective against the Colorado potato beetle, *Leptinotarsus decimlineata* (Say), in laboratory tests. Cube gave 10 per cent lower kill than the other three dusts. Cube was also less effective than the other insecticides against medium-size larvae of the Mexican beetle, *Epilachna varivestis* (Muls). The net mortality

from cube at the end of 72 hours was 70 to 79 per cent as compared with 100 per cent from derris, timbo, and Tephrosia.

Rotenone-containing insecticides were almost entirely ineffective against half-grown larvae of the velvetbean caterpillar, *Anticarsia gemmatilis* (Hbn.). When results were measured in terms of speed of kill, the order of effectiveness of various materials was as follows: sodium fluosilicate is greater than cryolite is greater than calcium and lead arsenate is greater than derris, timbo, and cube. The M. L. D. of commercial lead arsenate was tentatively estimated as 0.13 mgs/gm. and of sodium fluosilicate as 0.21 mgs/gm. These doses are equivalent to 0.09 milligrams of pure $PbHAsO_4$ and 0.14 milligrams of pure Na_2SiF_6.

The median lethal doses of insecticides containing approximately 1 per cent rotenone, fed in leaf sandwiches to last-instar larvae of the Catalpa sphinx, *Ceratomia catalpae* Bud., were as follows: Tephrosia, 0.066; derris, 0.068; timbo, 0.112; cube, 0.168 mgs./gm. All four insecticides were more toxic to small larvae than to larger larvae in the same instar.

Because of the adhesiveness of the talc, derris-talc mixtures were more effective in laboratory tests against adults of the Harlequin bug, *Murgantia histrionica* (Hahn), than derris-sulphur mixtures or derris alone. Talc mixtures of derris, timbo, and Tephrosia, at 0.2 per cent rotenone content, caused 100 per cent mortality in 48 hours, as compared with 88.6 per cent mortality from cube-talc dust of the same concentration.

Derris-talc dusts were effective against small nymphs of the southern green stink bug, *Nezara viridula* (L.), but were ineffective against large nymphs and adults.

Pyrethrum and 1 per cent nicotine dust were faster in their action on the turnip aphid, *Rhopalosiphum pseudobrassicae* (Davis), than 0.5 per cent rotenone-talc dusts, but derris and cube were as effective at the end of 30 hours as pyrethrum and nicotine. Timbo appeared less effective.

Rotenone insecticides were not very effective against *Apantesis phyllira* (Drury). Other insecticides were effective in the following order: acid lead arsenate is greater than sodium fluosilicate is greater than calcium arsenate.

Only one of 13 samples of wild *Tephrosia virginiana* roots, collected locally, gave a positive reaction to the Durham test; much stronger reactions were produced by samples from the U. S. Bureau of Plant Industry and from Texas A. and M. College. In the few tests made, the toxicity of a sample to the Mexican bean beetle appeared proportional to the depth of color in the Durham test.

Derris-talc dusts containing 1 per cent rotenone were effective

in controlling the pickleworm, *Diaphania nitidalis* (Stoll), and melonworm, *D. hyalinata* (Linne), on small field plots; the control in cantaloupes varied from 82 to 100 per cent; in squash it was 92 per cent. A derris dust containing 25 per cent sulphur was effective against the insects, but caused such severe burning to cantaloupe foliage that an average of only 0.87 of a ripe edible fruit per plot was produced as compared with 1.25 edible fruits per plot on the checks and approximately 12.50 on the plots dusted with derris and talc. Derris mixtures containing 0.5 per cent rotenone were less effective than dusts containing 1 per cent rotenone. Cube appeared to be inferior to timbo and derris. Heavy applications of dusts were made, 14 to 30 pounds per acre, and no attempt was made to determine the minimum effective rate of application.

Studies on the Occurrence, Epidemiology, and Inter-Host Relationships of Nematode Parasites of the Chicken (*Gallus gallus*) in Alabama. (R. O. Christenson).—Ten species of parasitic worms have been found in 525 birds examined, six species being nematodes and four cestodes. The 298 chickens autopsied, or examined in part, gave a list of six species of helminthes of economic importance, namely: *Ascaridia galli* (153 chickens); *Heterakis gallinae* (180 chickens); *Capillaria columbae* (29 chickens); *Cheilospirura hamulosa* (12 chickens); *Raillientina cesticillus*, and *Hymenolepis carioca*, the latter two being cestodes and the rest nematodes. Ninety-one chickens had cestodes, some with mixed infestation of the two species listed. The occurrence of *Capillaria columbae* as a common parasite in the intestines of Alabama chickens is noteworthy. Two hundred twenty-five mourning doves were examined and three species of parasites were found: *Capillaria columbae* (1 dove); *Orinthostrongylus quadriradiatus* (5 doves), and *Aporina delafindi* (4 doves). *Ascaridia numidae*, heretofore reported only once in the United States (Louisiana), was found in the Guinea hen. It is apparently common in Guinea hens in certain parts of Alabama, and appears to be a nematode of considerable economic importance. Other parasites of the Guinea hen recovered are *Heterakis gallinae* and *Raillietina numidae*.

The eggs of *Heterakis gallinae* and *Ascaridia galli* have been subjected to temperature experiments. The thermal death point in the former species in preliminary tests was between 134-136°F.; that of the latter species between 136-140°F. At temperatures below the thermal death point eggs of *Heterakis gallinae* were killed in four hours and forty-five minutes at 47°C (117°F), and within three hours at 55°C (131°F). The eggs of both *Ascaridia galli* and *Hetrakis gallinae* were viable after 181 days of incubation in 2% potassium dichromate cultures at room temperatures. No appreciable mortality was noted although some eggs had hatched in the cultures.

The Control of Azalea and Camellia Insects. (L. L. English).—A spray containing 0.83 per cent oil and 1½ pounds derris root (5 per

cent rotenone) per 100 gallons was effective in the control of the azalea lacebug *Stephanitis pyrioides* (Scott). A 3 per cent nicotine dust and a dust containing 0.75 rotenone were ineffective. Successful control of the azalea mealybug *Eriococcus azaleae* (Comst.) was obtained by spraying the last of May and the last of September with a spray containing 1.24 per cent oil and 0.20 per cent of Black Leaf 40. Scale insects and mites on azaleas and camellias were controlled by the use of oil sprays. Promising results were obtained with methyl bromide as a fumigant for coccids on camellias.

Citrus Insect and Disease Control. (L. L. English).—Of nine spray schedules tested on field plots, the highest production of clean fruit was obtained with a schedule containing applications of Bordeaux-sulphur in March and April, oil in July, and sulphur dust in August. Three years' result on the control of sour scab on satsumas with several concentrations of Bordeaux supplemented with wettable sulphur are given in Table 17.

TABLE 17.—Data on the control of sour scab *Sphaceloma fawcetii* (Jenkins).

Plot No.	Treatment[1] Pre-growth and post-bloom	Per cent scabby fruit 3-year average
1	Wettable sulphur, 5 lbs. per 100 gal. water	16.8
2	Bordeaux, 1-1-100 plus 5 lbs. wettable sulphur	7.8
3	Bordeaux, 2-2-100 plus 5 lbs. wettable sulphur	4.8
4	Bordeaux, 4-4-100 plus 5 lbs. wettable sulphur	5.0
5	Bordeaux, 6-6-100 plus 5 lbs. wettable sulphur	3.9
6	None	18.9

[1]All plots received an oil spray in July and a sulphur spray in August.

Derris as a Toxic Supplement to Oil Emulsions for the Control of Purple Scale. (L. L. English).—In tests on potted trees derris was more effective as a toxic supplement when used with an emulsion made of Mineral Seal oil, and diglycol oleate than when used with either component of the emulsion. A spray containing gum karaya, Mineral Seal oil, and derris was more effective than a spray containing dried blood albumen spreader, Mineral Seal oil, and derris. Field tests on purple scale with derris sprays were negative. The reasons for this discrepancy between field tests and small-tree tests are being investigated. Emulsions made of Mineral Seal oil and diglycol oleate were injurious to bean plants but not to satsuma foliage or fruit.

Farm Fish Ponds. (H. S. Swingle & E. V. Smith).—In an overstocked, unfertilized 2-acre pond, only 28 bluegill bream, 8 white crappie, 9 large-mouth black bass, and 212 yellow bullheads reached a legal size during a 3-year period. The total weight of the fish in this pond was 478 pounds; the legal-sized fish constituted slightly less than 25 per cent of the total weight.

A 1.3-acre pond properly stocked in February 1939, with fingerling bream and bass contained 623 pounds of fish when drained in December 1939. Approximately 81 per cent of this weight was in the form of legal-sized bream and bass.

A total of 580 pounds of fish was obtained when a pond at the Sand Mountain Substation was drained in January 1939. Seventy pounds was removed the previous summer by fishing. This 1-acre pond was stocked during January 1936, and was fertilized with a mixture of commercial 6-8-4 fertilizer and nitrate of soda.

A mixture of soybean meal and superphosphate (3-1) gave the highest production of bluegill bream of any of the organic fertilizers tested.

Bream production was slightly increased when tadpoles were present in the pond, but was not materially increased by the presence of fresh-water shrimp.