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OF THE

Agricultural Experiment Station

OF THE

Alabama Polytechnic Institute

AUBURN

M. J. FUNCHESS, *Director*
AUBURN, ALABAMA

Alabama Polytechnic Institute

COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

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J. I. Wear, B.S. ..... Graduate Assistant
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*Deceased.
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Animal and Poultry Husbandry:

J. C. Grimes, M.S. — Head, Animal and Poultry Husbandry
W. E. Sewell, M.S. — Animal Husbandman
W. D. Salmon, M.A. — Animal Nutritionist
R. W. Engel, Ph.D. — Associate Animal Nutritionist
C. J. Koehn, Ph.D. — Associate Animal Nutritionist
W. C. Sherman, Ph.D. — Associate Animal Nutritionist
D. F. King, M.S. — Associate Poultry Husbandman
G. J. Cottier, M.A. — Associate Poultry Husbandman
P. D. Sturkie, Ph.D. — Associate Poultry Husbandman
**M. J. Burns, B.S. — Graduate Assistant

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

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
P. A. Swarthout, B.S. — Associate Forester (Coop. U.S.D.A.)
F. E. Johnstone, Jr., Ph.D. — Assistant Vegetable Breeder
O. A. Atkins, M.S. — Assistant Horticulturist (Coop. U.S.D.A.)
W. R. Boggess, M.F. — 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 Zoologist
A. M. Pearson, Ph.D. — Associate Biologist (Coop. U.S.D.I., and State Department of Conservation)

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T. B. Chisolm, B.A. — Assistant to Superintendent

Gulf Coast—Fairhope, Baldwin County, Alabama
Otto Brown, M.S. — Superintendent
Harold Yates, B.S. — Assistant Superintendent

Sand Mountain—Crossville, DeKalb County, Alabama
R. C. Christopher, B.S. — Superintendent
H. A. Ponder, B.S. — Assistant Superintendent

Tennessee Valley—Belle Mina, Limestone County, Alabama
Fred Stewart, B.S. — Superintendent
J. K. Boseck, B.S. — Assistant Superintendent

Wiregrass—Headland, Henry County, Alabama
J. P. Wilson, B.S. — Superintendent
C. A. Brogden, B.S. — Assistant Superintendent

CHANGES IN STATION STAFF DURING 1940

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M. J. Burns, B.S. — Graduate Assistant
P. R. Gibson, B.S. — Graduate Assistant
F. E. Johnstone, Jr., Ph.D. — Assistant Vegetable Breeder
J. O. Laws, B.S. — Assistant Soil Conservationist (Coop. U.S.D.A.)
J. N. Mahan, M.S. — Associate Agricultural Economist
D. A. Parsons, B.A. — Project Supervisor (Coop. U.S.D.A.)
H. W. Reuszer, Ph.D. — Agent (Coop. U.S.D.A.)
J. C. Rice, B.S. — Graduate Assistant
C. M. Wilson, B.S. — Graduate Assistant

Resignations:

H. R. Benford, B.S. — Graduate Assistant
W. Von Chandler, B.S. — Graduate Assistant
H. M. Darling, M.S. — Assistant Botanist and Plant Pathologist
B. T. Inman, M.S. — Associate Agricultural Economist
J. W. Langford, B.S. — Graduate Assistant

**On leave.

NEW PUBLICATIONS

Experiment Station Publications

(Bulletins, Circulars, and Mimeographed Reports)

English, L. L., and Turnipseed, G. F.—**Insect Pests of Azaleas and Camellias and Their Control.** Cir. 84: 1-18. (1940).

Clark, Carl M.—**Rural Property Tax Problems in Alabama.** Bul. 247: 1-63. (1940).

English, L. L., and Turnipseed, G. F.—**Control of the Major Pests of the Satsuma Orange in South Alabama.** Bul. 248: 1-48 (1940).

Lanham, Ben T., and Lagrone, Wm. F.—**Size of Farms, Cropland Use and Conservation Practices, Lee County, Alabama.** (Report No. 1 for Lee County, May 1940).

Lanham, Ben T., and Lagrone, Wm. F.—**Labor Requirements for Marion County Crops.** (Report No. 1 for Marion County, May 1940).

Lanham, Ben T., and Lagrone, Wm. F.—**A Small Farm in Lee County, Alabama.** (Report No. 2 for Lee County, June 1940).

Lanham, Ben T., and Lagrone, Wm. F.—**Land Use Plans for a Two-Mule Farm in Lee County, Alabama.** (Report No. 3 for Lee County, July 1940).

Lanham, Ben T., and Lagrone, Wm. F.—**Size of Farm, Cropland Use, and Conservation Practices, by Land Use Areas, Henry County, Alabama.** (Report No. 1 for Henry County, July 1940).

Mayton, E. L.—**Corn Varieties.**

Sturkie, D. G.—**Artificial Manure Production.**

Swarthout, Paul.—**Factors Affecting Pine Reproduction in Tallapoosa County.** (Office Report, U.S. Forest Service.)

Swarthout, Paul.—**Factors Affecting Pine Reproduction in Autauga County.** (Office Report U.S. Forest Service).

Tisdale, H. B.—**Cotton Varieties.**

Ware, L. M.—**Present Status of the Pecan in Alabama.** (February 1940).

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Barrons, Keith C.—**Root-Knot Resistance in Beans.** *Jour. of Heredity, 31:35. (1940).*

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Koehn, C. J.—**A Rapid Photoelectric Method for the Determination of Vitamin A and Carotene in Milk.** *Jour. Biol. Chem., 133:1 vi (1940).*

Koehn, C. J.—**Economical Rations for Dogs.** *Jour. Am. Vet. Med. Assoc., 97:592. (1940).*

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Salmon, W. D.—**The Supplementary Relationship of Vitamin B_6 and Unsaturated Fatty Acids.** *Jour. Biol. Chem., 133:1 xxxiii (1940).*

Sherman, W. C.—**Chromatographic Identification and Biological Evaluation of Carotene from Mature Soybeans.** *Food Research, 5:13. (1940).*

Sherman, W. C.—**Effect of Certain Fats Upon the Utilization of Carotene.** *Jour. Biol. Chem. Proc., 133:1 xxxix (1940).*

Smith, E. V., and Swingle, H. S.—**Effect of Organic and Inorganic Fertilizers on Plankton Production and Bluegill Bream Carrying Capacity of Ponds.** *Trans. Am. Fish Soc., 69 (1939): 257-262 (1940).*

Swingle, H. S., and Smith, E. V.—**Fish Production in Terrace-Water Ponds in Alabama.** *Trans. Am. Fish Soc., 69 (1939): 101-105 (1940).*

Volk, N. J.—**The Effect of Soil Characteristics and Winter Legumes on the Leaching of Potassium Below the 8-Inch Depth in Some Alabama Soils.** *Jour. Am. Soc. Agron., 32, No. 11: 888-890. (1940).*

Ware, L. M.—**Certain Aspects of the Alabama Field Trials of Seed Potatoes as a Requisite for Certification.** *Am. Potato Jour., 17: 13-20. (1940).*

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Atkins, O. A.—**Promising New Cash Crop for Hill Lands.** *Prog. Farmer. (January 1940).*

Barrons, Keith C.—**Sweet Corn has Promise for the South.** *Market Growers Jour. (March 1, 1940).*

Barrons, Keith C.—**Tomato Diseases Cost Money.** *Sou. Seedsman. (May 1940).*

Grimes, J. C.—**Producing Hogs on Forage and Feed Crops.** *Southern Agriculturist (January 1940).*

Isbell, C. L.—**Onions the Year Round.** *Progressive Farmer (February 1940).*

Isbell, C. L.—**How to Grow Cabbage Seed.** *Alabama Farmers Bul. (June 15, 1940).*

Isbell, C. L.—**Ten Simple Ways to Save Food.** *Progressive Farmer (September 1940).*

Isbell, C. L.—**Sweet Potatoes Until Next August.** *Progressive Farmer (October 1940).*

King, D. F.—**March in the Chicken Yard.** *Progressive Farmer (March 1940).*

King, D. F.—**Scratching for Bigger Profits to Crow About.** *Progressive Farmer (April 1940).*

King, D. F.—**Pointers the Poultryman Can Use in May.** *Progressive Farmer (May 1940).*

King, D. F.—**June Tips to Busy Farm Poultrymen.** *Progressive Farmer (June 1940).*

King, D. F.—**July in the Poultry Yard.** *Progressive Farmer (July 1940).*

King, D. F.—**On the Job with Poultry.** *Progressive Farmer (August 1940).*

King, D. F.—**Start the New Layers Right.** *Progressive Farmer (September 1940).*

King, D. F.—**Make Your Hens Lay when Prices Are High.** *Progressive Farmer (October 1940).*

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King, D. F.—**A Score Card for Poultry Raisers.** *Progressive Farmer (December 1940).*

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Salmon, W. D.—**Livestock in Relation to Human Nutrition.** *The Cattleman (June 1940).*

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Smith, E. V., and Swingle, H. S.—**Most Fish Ponds Are Too Big, Scientists Find.** *Alabama Game and Fish News (August 1940).*

Ware, L. M.—**Fertilizers for Irish Potatoes.** *Market Growers Journal (March 1, 1940).*

AGRICULTURAL ECONOMICS

The Use of Short-Term Farm Credit in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—Data from a study of 120 farms in Marion County show that practically all farmers on small units not having a relatively high income from work "off the farm" usually use some type of short-term credit—loans of less than 12 months duration, normally made for use in current crop and livestock production. Table 1 shows the amounts, interest rates, and sources of these loans for different size farms.

Table 1.—Short-Term Farm Credit Used in Marion County, Alabama, 1938.

Item	Unit	One-mule farms	Two-mule farms	Three-mule farms
Amount of loan	Dollars	52.05	113.36	153.57
Used for farm	Per cent	83.0	77.0	74.0
Length of loan	Months	8.0	8.0	8.0
Interest rate	Per cent	7.6	7.7	8.0
Source of credit:				
Local bank	Per cent	57.0	85.0	86.0
Individuals	Per cent	19.0	2.0	14.0
Federal agencies	Per cent	24.0	13.0	0.0

The average size of loan for short-term credit varies directly with the number of mules on each farm, averaging in each case slightly above $50 per head of work stock.

The percentage of short-term credit devoted to farm uses is highest on small farms. Interest rates, however, show an increase as the size of farm increases. These differences are due mainly to the source of credit—the higher the percentage of funds borrowed from Federal agencies the lower is the average interest rate.

Present and Potential Production of Farm Woodland Areas in Marion County. (Ben T. Lanham, Jr.).—A total of 56 per cent of the farm land area of Marion County is in farm woodlands. Detailed study of forestry conditions on representative farm woodland areas indicates badly depleted stands of second-growth pine and hardwood, and a high percentage of undesirable trees in practically all forest areas in the county. Farm woodlands in this county have been placed in three groups (Table 2).

Forestry technicians of the Soil Conservation Service made stand table projections to determine potential stands and potential growth rates for all major forest types in the county. Table 2 shows that only a small percentage of each of these woodland areas is stocked with productive growing stock. On pine-hardwood upland and pine-hardwood bottom type areas less than 10 per cent of the present stand of trees are desirable. Twenty per cent of the trees on old field pine forest type areas

Table 2.—Condition of Farm Woodland Areas in Marion County, Alabama.

Item	Unit	Major forest types		
		Pine-hardwood		Old field pine
		Upland	Bottom	
Portion of total woodland area in major forest types	Per cent	90.0	4.0	6.0
Portion of woodland area at present non-productive	Per cent	85.0	80.0	70.0
Present volume per acre:				
Total all classes	Cu. ft.	880.5	1,847.6	1,627.5
Sawtimber trees	Bd. ft.	230.0	743.0	655.0
All other trees	Cords	9.4	20.4	16.3
Potential volume per acre	Cu. ft.	3,085.0	3,250.0	3,500.0
Growth rate, per acre:				
Present	Cu. ft.	59.0	88.2	87.0
Potential	Cu. ft.	132.0	162.0	174.0
Estimated time to achieve potential conditions	Years	30	40	40

are desirable. Forestry technicians report that, on the average, the cubic foot volume of present stands can be more than doubled. Growth rates can also be doubled if such areas are placed under good farm woodland management practices and on sustained yield bases. To achieve these conditions, however, will require from 30 to 40 years.

Availability and Use of Farm Family Labor in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—A farm management study of Marion County farming conditions shows that two-thirds of the farms in the county are operated wholly with family labor. Of all farms included in the study, 78 per cent of the one-mule farms, 64 per cent of the two-mule farms, and 31 per cent of the three-mule farms used family labor altogether in 1938. The remaining farms in each size group supplemented family labor with either wage labor or sharecroppers.

Data for representative farms in each size group indicate an increase in labor force available as size increases, but do not show corresponding increases in the percentage of available labor used for field work on each farm (Table 3). This is attributable to differences in amount and composition of the labor force available and in the amount of cropland operated per family. Since only about one-third of the available farm family labor force is utilized on farms, this county is faced with the problem of surplus farm labor during most of the year.

Variations in Annual Work Stock Costs by Size of Farms in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—Under normal conditions total net costs of keeping mules on one-, two-, and three-mule farms in Marion County are $78.89,

Table 3.—Farm Family Labor Available and Used for Field Work on Representative One-, Two-, and Three-mule Farms in Marion County, Alabama, 1938.

Item	Unit	One-mule farm family	Two-mule farm family	Three-mule farms	
				Operator's family	Share-cropper's family
Field workers per family	Number	3.1	4.3	4.3	4.0
Man-equivalent workers[1]	Number	2.6	3.6	3.6	3.3
Man-equivalent days available for field work per family[2]	Days	398	505	505	478
Man-equivalent days worked per family	Days	121	178	156	111
Percentage available days worked per family	Per cent	30.5	35.2	31.0	23.2
Cropland operated per family	Acres	22.5	35.8	33.7	19.6
Cropland operated per man-equivalent worker	Acres	8.6	9.9	9.4	5.9

[1]A man-equivalent worker is here defined as one who can do the usual amount of work performed by one male worker in a 10-hour work day. Man-equivalent designations range from 0 to 1.0.

[2]Man-equivalent workers per family multiplied by days suitable for field work. After correcting for weather conditions, Sundays, usual farm holidays, etc., there are 177.4 days suitable for field work. In calculating total days available per family, man-equivalent factors for children in school were adjusted to allow for time spent in school.

$89.49, and $101.73 per head, respectively, (Table 4). Only a small portion of these costs is a direct cash expense. The largest single item is feed, which constitutes two-thirds of the total in all cases. Feed costs vary from $48.00 per mule on one-mule farms to $67.20 on three-mule farms.

The combined effects of small mules, low feeding rates, high mule labor requirements, and inadequate housing facilities, are reflected in the condition and value of mules on small farms, particularly on one-mule farms.

Cropland acreage operated per mule is higher on small farms than on large farms. Mule costs per acre of cropland are consequently lower on small farms than on large farms.

Mules on small farms work a larger total number of hours per animal annually than those on large farms. The average costs of mule labor per hour worked are 12.7 cents on one-mule farms, 14.5 cents on two-mule farms, and 15.5 cents on three-mule farms. On the basis of individual crops, work stock costs for all major crops grown in this county increase as size of farm increases.

Investment in Land and Buildings by Size of Farms in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—The ratio of investment per farm in land and buildings in Marion County

Table 4.—Net Annual Costs of Work Stock per Head on 120 Cotton-Corn Farms in Marion County, Alabama.

Item	Unit	One-mule farms	Two-mule farms	Three-mule farms
Farms surveyed	Number	41	64	15
Mules	Number	41	128	45
Average weight, per head	Pounds	883	970	1077
Average age, per head	Years	13.2	12.1	9.5
Average value, per head	Dollars	60.00	68.00	84.00
Average years work life, per head	Years	17.1	17.6	18.0
Feed, per head:				
Corn, (equivalent)	Bushels	41	58	64
Hay (equivalent)	Tons	1.3	1.2	1.6
Pastures, native	Days	254	273	285
Crop aftermath	Days	37	26	14
Costs, per head:				
Feed	Dollars	48.00	56.40	67.20
Labor	Dollars	12.74	12.74	12.74
Buildings	Dollars	1.86	2.30	2.30
Pasture	Dollars	2.83	1.78	2.40
Veterinary and other cash costs	Dollars	1.86	3.89	4.66
Interest	Dollars	3.60	4.08	5.04
Depreciation	Dollars	8.00	8.30	7.39
Total	Dollars	78.89	89.49	101.73
Crop acres per mule	Acres	22.5	17.9	17.8
Mule cost per crop acre	Dollars	3.51	5.00	5.72
Mule labor per farm (total)	Hours	700	1,233	1,967
Mule costs per hour worked	Cents	12.7	14.5	15.5
Mule labor per acre:				
Cotton	Hours	51	53	53
Corn (total)	Hours	37	40	40
Summer legumes (hay)	Hours	34	41	41
Winter legumes (turned)	Hours	12	13	13
Mule costs per acre:				
Cotton	Dollars	6.48	7.68	8.22
Corn (total)	Dollars	4.70	5.80	6.20
Summer legumes (hay)	Dollars	4.32	5.81	6.22
Winter legumes (turned)	Dollars	1.52	1.88	2.02

is approximately the same for all three size groups studied (Table 5), averaging about 30 per cent investment in buildings and 70 per cent in land for the county as a whole. There are significant variations, however, in value of land per acre when studied by use for all size groups.

Cropland by far represents the best farm land in the county. Values of pasture land are low because such areas usually represent poor land once farmed but now abandoned and used as

Table 5.—Investment in Land and Buildings per Farm, and Investment in Land per Acre by Use, by Size of Farms, 120 Farms, Marion County, Alabama.

Item	Unit	One-mule farms	Two-mule farms	Three-mule farms
Farms surveyed	Number	41	64	15
Investment per farm in:				
Land	Dollars	661.66	1055.86	1739.58
Buildings	Dollars	271.38	458.89	804.15
Investment in:				
Land	Per cent	70.9	69.7	68.4
Buildings	Per cent	29.1	30.3	31.6
Land value, per acre:				
Cropland	Dollars	15.01	18.66	17.28
Pasture land	Dollars	8.29	9.52	13.45
Woodland	Dollars	4.65	5.44	8.57

pasture. Little pasture improvement has been done in such areas. Woodland areas are usually steep rocky slopes not suited for cultivation, or are low lands subject to flood damage and covered largely with species of undesirable hardwoods. Land values increase, too, as size of farm increases. This is largely due to the relative productivity of such land. Land on small farms usually represents that which has been in intensive row-crop cultivation for many years; consequently, because of erosion and loss of natural fertility, it is valued lower than land on large farms.

Farm Machinery and Equipment by Size of Farms in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—Results of a farm management study of 120 cotton-corn farms in Marion County indicate that only minimum requirements of farm machinery and equipment are maintained on most farms in this county. With a surplus of available farm family labor, little attention has been given to the possibility of substituting machinery for man labor. The small amount of machinery and equipment is of low cash value; normal annual repairs are high; and most of it has been used for more than 50 per cent of its potential years of life.

Table 6 shows the most common types of equipment found on Marion County farms, the average age and value of each item in 1938, normal rate of depreciation, normal annual repair costs, and the 1938 purchase price.

For determining the usual kinds of equipment on representative Marion County farms by size, a complete enumeration of the types and number of pieces of equipment reported per farm was recorded. Results of this enumeration are shown in Table 7. On one-mule farms it was found that only 3 implements were reported on 100 per cent of the farms; these were a Georgia or single stock, a Gee-Whiz or scratcher, and a one-horse turn plow. More than half the one-mule farms surveyed had combination planters, fertilizer distributors, and home-made

Table 6.—Average Age, Value, Rate of Depreciation, Normal Repair Costs, and Purchase Price of Usual Types of Equipment on Farms in Marion County, Alabama, 1938.

Type of equipment	Records	Average age (1938)	Average value (1938)	Rate of depreciation	Normal annual repairs[1]	Purchase price[2] (1938)
	Number	Years	Dollars	Per cent	Dollars	Dollars
Wagon (one-horse)	20	16	24.77	3.4	3.05	60.00
Wagon (two-horse)	73	12	40.78	4.2	3.09	90.00
Planter (combination)	98	8	11.79	5.9	1.03	22.00
Fertilizer distributor	79	6	4.25	10.0	.69	8.50
Disc harrow	26	12	22.64	4.5	1.42	50.00
Section harrow	30	10	11.81	4.5	1.27	22.00
Joe (top) harrow	82	9	2.23	5.6	.84	4.00
Gee-Whiz (scratcher)	154	7	4.31	7.1	1.48	7.50
Georgia (single) stock	223	7	1.51	6.7	2.45	2.50
Drag (home-made)	56	3	2.06	12.5	.17	5.00[3]
Turn plow (one-horse)	166	8	4.34	5.9	1.51	8.25
Turn plow (two-horse)	75	9	10.58	5.0	2.04	18.00
Cultivator (two-horse)	10	13	28.29	4.5	1.91	40.00
Middle buster (two-horse)	32	9	8.63	5.3	1.70	15.00
Mowing machine	12	11	43.93	3.6	4.33	95.00
Hay rake (two-horse)	11	10	23.12	5.0	1.25	45.00
Stalk cutter (two-horse)	21	6	15.92	5.9	.90	60.00

[1]Normal repairs include purchases of new plow points to replace old ones and also sharpening of old points in addition to all general repairs.
[2]This is the cash price of specified types of equipment. If purchased "on time", an additional 10 per cent should be added for interest and carrying charges.
[3]Estimate.

Table 7.—Number and Percentage of Farms Reporting Specified Types of Equipment in Marion County, Alabama, 1938.

Type of equipment	One-mule farms		Two-mule farms		Three-mule farms	
	Total No. reported	Per cent[1] reporting	Total No. reported	Per cent[1] reporting	Total No. reported	Per cent[1] reporting
Farms surveyed	41	100.0	64	100.0	15	100.0
Wagons (one-horse)	19	44.2	1	1.6	—	—
Wagons (two-horse)	3	7.0	55	88.7	15	100.0
Planters (combination)	27	62.8	54	87.1	17	113.3
Fertilizer distributor	29	67.4	41	66.1	9	60.0
Disc harrow	4	9.3	13	21.0	9	60.0
Section harrow	6	14.0	17	27.4	7	46.7
Joe (top) harrows	21	48.8	49	79.0	12	80.0
Gee-Whiz (scratcher)	44	102.3	87	140.3	23	153.3
Georgia (single) stock	57	132.6	122	196.8	44	293.3
Drag (home-made)	23	53.5	31	50.0	2	13.3
Turn plow (one-horse)	46	107.0	91	146.8	29	193.3
Turn plow (two-horse)	5	11.6	51	82.2	19	126.7
Cultivator (two-horse)	—	—	9	14.5	1	6.7
Middle buster (two-horse)	6	14.0	22	35.5	4	26.7
Mowing machine	—	—	8	12.9	4	26.7
Rake(two-horse)	—	—	7	11.3	4	26.7
Stalk cutter (two-horse)	5	11.6	12	19.4	4	26.7

[1]The percentage of farms reporting specified types of equipment is more than 100 in cases where the average is more than one piece of the specified type of equipment per farm. For instance, the percentage of two-mule farms reporting Georgia stocks is 196.8, which means an average of approximately two Georgia stocks per farm.

drags. Assuming that implements reported on 50 per cent or more of the farms are usual, the representative one-mule farm would be equipped with a planter, a fertilizer distributor, a Georgia stock, a Gee-Whiz, a one-horse turn plow, and a home-made drag. The total value of such a setup in 1938 was $28.26, and normal annual repairs $7.33 or 26 per cent of the estimated investment.

Using the same assumption as on one-mule farms for calculating usual equipment, the representative two-mule farm was found to have two Georgia stocks and one of each of the following pieces of equipment: two-horse wagon, planter, fertilizer distributor, Joe harrow, Gee-Whiz, one-horse turn plow, two-horse turn plow, and a home-made drag. The total estimated value in 1938 was $83.36, and normal annual repairs $15.75, or about 20 per cent of the estimated investment.

The representative three-mule farm had three Georgia stocks, two Gee-Whizzes, two two-horse turn plows, a two-horse wagon, a planter, a fertilizer distributor, a disc harrow, a Joe harrow, and a one-horse turn plow. The 1938 value of this setup was $114.10, and normal annual repairs $22.44, or 20 per cent of the estimated investment.

Credit Advances to Sharecroppers in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—A study of 24 sharecropper families in Marion County for the crop year 1938 indicates that credit advances to sharecropper families are only about half as much when made in provisions as when made in cash or in a combination of cash plus provisions (Table 8). One fourth of the cropper families studied received advances in 1938 in the form of provisions; whereas, two-thirds of the remaining families received advances in cash. The average per family for all groups was $72.83. This figure is approximately 50 per cent higher than the average size of short-term loans made to other farmers in the county who received credit from local banks, individuals, and Federal lending agencies.

There are only minor variations in the number of acres of share cotton per family for these groups, but enough to emphasize further the difference between advances by provisions and

Table 8.—Credit Advances per Sharecropper Family by Type of Credit, 24 Sharecropper Families, Marion County, Alabama, 1938[1].

Type of credit advanced	No. of families	Credit advances per family[1]			Acres of share cotton per family	Credit advanced per acre of share cotton
		Cash	Prov.	Total		
Cash	13	$88.15	$ .00	$88.15	4.7	$18.76
Provisions	6	.00	41.67	41.67	4.9	8.50
Cash and provisions	5	58.00	30.00	88.00	4.6	19.13
Total and av.	24	$57.41	$15.42	$72.83	4.7	$15.83

[1]These figures do not include the cost of the cropper's share of fertilizer, ginning, etc.

other types. Since cotton is the only major cash crop in the county, the amount of credit advanced per acre of share cotton (Table 8) indicates the wide variation which exists in ability of sharecroppers to repay advances at the end of the crop-growing season.

Approved Soil-Building Practices Carried Out in Marion County. (W. F. Lagrone and Ben T. Lanham, Jr.).—A study of the organization and management of farms in Marion County for the crop year 1938 shows that large farmers in this county received payment for only about 60 per cent of the soil-building practices which they carried out under provisions of the 1938 AAA program due to excess of approved practice units over their soil-building allowance. Small (one-mule) farmers, on the other hand, did not take up all their soil-building payments, and only in rare instances did individual farmers in this size group earn more practice units than their farm allowance. In addition, 17 per cent of these small (one-mule) farmers received no soil-building payments at all. (Table 9).

Table 9.—Per Cent of Soil-Building Units Earned Through Use of Specified Practices by Size of Farms, Marion County, Alabama, 1938.

Approved practices	One-mule farms	Two-mule farms	Three-mule farms	Four-mule and over	County total
Summer legumes interplanted	48	42	41	35	41
Seeding winter legumes	25	28	25	28	727
Green manure and cover crops	17	18	18	17	18
Application of phosphate	8	9	12	15	11
All other practices	2	3	4	5	3
Total	100	100	100	100	100
Per cent of farms reporting one or more practices	83	90	93	98	89

Practice units earned vary between size groups when expressed in terms of a comparable unit such as units earned per 100 acres of cropland. For instance, one-mule farmers earned in 1938 an estimated 32 units, two-mule farmers 42 units, three-mule farmers 44 units, and farmers with four or more mules 75 units per 100 acres of cropland. This greatly emphasizes the advantage of superior resources with which larger farmers can carry out conservation practices—not only a larger quantity, but also practices of greater value to soil maintenance and improvement.

Although interplanting corn with summer legumes leads in importance in total units earned in this county, it decreases in relative importance as size of farm increases. Seeding winter legumes and the use of green manure and cover crops show little relative change in importance by size groups. The application of phosphate and most other practices, however, are

used to a much greater extent on large farms than on small farms.

The per cent of farmers reporting one or more practices increases as size of farm increases, ranging from 83 per cent for one-mule farmers to 98 per cent for farmers with four or more mules per farm.

Farm Costs of Operating Automobiles and Trucks in Marion County. (Ben T. Lanham, Jr., and W. F. Lagrone).—Records were taken in 1938 on 20 farms in Marion County which utilized automobiles and trucks in connection with usual farm operations and practices. Records on automobiles showed that in 1938 the average farmer operating such a vehicle possessed an automobile which was 6 years old, valued at $217.19, and which was depreciating at the rate of 12.5 per cent annually. Normally, the farmer drives 3,275 miles per year at a cost of 5.6 cents per mile, 42 per cent of which is for farm use (Table 10).

Table 10.—Farm Costs of Automobiles and Trucks[1] per Farm Reporting, Marion County, Alabama, 1938.

Item	Unit	Auto	Trucks[1]
Records	Number	19	4
Average value: 1938	Dollars	217.19	287.50
Average age: 1938	Years	6	4
Rate of depreciation	Per cent	12.5	16.7
Normal use per vehicle	Miles	3,275	4,625
Operating cost per mile	Dollars	.056	.053
Costs, per vehicle			
Fuel cost	Dollars	47.25	79.09
Normal repairs	Dollars	10.44	12.50
License	Dollars	9.39	15.00
Tires	Dollars	11.00	7.31
Taxes	Dollars	5.39	7.21
Total cash costs	Dollars	83.47	121.11
Depreciation	Dollars	100.00	125.00
Total costs	Dollars	183.47	246.11
Farm share	Per cent	42	57
Farm costs	Dollars	77.06	140.28

[1]All trucks are "pick-up" trucks.

Operating expenses total $83.47 per car and depreciation makes up an additional $100.00. The farm share of these expenses is $77.06.

Records on four "pick-up" trucks were obtained. These averaged 4 years of age in 1938 and were valued at $287.50, with a depreciation rate of 16.7 per cent or approximately $125 per year. They were driven an average of 4,625 miles per year at a cost of 5.3 cents per mile. Total operating cost per truck per year was $121.11 plus $125 depreciation. Fifty-seven per cent of this cost or $140.28 was charged against the farm for farm use.

Physical Reactions of Tillage Tools Causing Compression and Arch Formation, and **Analyses of Plow Moldboard Shapes and Materials.** (F. A. Kummer).—A new method of measuring and studying compression and arch action was developed. By this method the soil is placed in a glass-faced metal box and an external force in the form of a plunger, whose shape is similar to that of the tool to be tested, is applied to the surface of the soil. The penetration of the plunger causes particle movements within the soil mass which can be observed through the glass plate. Each moving soil particle traces its own path across the coated glass surface, thus making it possible to detect the relative magnitude and direction of even the smallest movement. Graphical analyses of records thus obtained make it possible to determine the force distribution and the area of greatest compression produced in the soil by differently shaped tillage tools or plungers.

An attempt was made to establish certain constants for the formulas which govern the design of moldboard curvatures for various soil conditions. A method of geometrical vector analysis was used to include variations resulting from different soil conditions. These were determined by slider-friction tests and the resulting coefficient of friction was introduced to modify the curvatures accordingly. The establishment of design constants by this method should aid materially in the standardization of existing shapes.

Contour Furrows for Water Conservation on Pasture Land. (J. H. Neal, A. W. Cooper, and E. L. Mayton).—One year's results indicate that it does not pay to contour furrow a hillside pasture of the type used in this experiment. The pasture has a sandy loam soil with slope from four to seven per cent. Results show that although one-half the runoff water is saved by contour furrowing, it does not increase the herbage yield because only five per cent runoff occurs on the check plots with no contour furrows. At the time this small amount of water is saved by the contour furrows, it is not needed.

Collection of Runoff and Soil Losses from Terrace Outlets on Strip Cropped and on Clean Cultivated Areas. (E. G. Diseker).—Soil and water losses from terrace outlets were collected from a 3½ acre field. Nichols terraces served as boundaries between plots. For three consecutive years prior to 1938 this area had been strip cropped with cotton, soybeans, and oats during the cultivating season and was strip planted to oats and vetch during the fall and winter seasons. During the past two cultivating seasons the entire area has been planted to cotton, which followed vetch. The plots vary in size from 0.2 to 0.7 of an acre and the slopes between terraces range from 5

to 25 per cent. The soil in these plots varies from a Bradley sandy loam to a Cecil clay (eroded).

Greater quantities of soil and water moved down the slopes into the terrace channels and out the end of the channels when the entire area was clean cultivated to cotton than when there was an alternate strip of cotton and a cover crop on each terrace interval. The greater portion of this soil remained in the terrace channel, which caused breaking of the terrace. Runoff and soil losses from the clay plots were 2.6 times as great as those from the sandy plots. Occasionally heavy losses occurred from the clay plots during a given rain, whereas the losses were negligible from the sandy plots. Most of the losses resulted from intense rains, especially those that occurred when the soil was loose and practically saturated. Five times as much soil was lost from the field during the cultivating season as was lost during the non-cultivating season. The runoff and soil losses in 1940, per unit of one inch of erosion producing rainfall, were three times as great as those in 1939, and four times as great as those in 1938. (The areas were in strip crops in 1938). Numerous small gullies were formed running from the lower side of one terrace down to the upper side of the next terrace; the terraces were broken several times. Under the present system of clean cultivation during the summer months, it appears that the soil fertility and terraces will be difficult to maintain on slopes from ten to twenty-five per cent.

A Comparison of Crimson Clover and Hairy Vetch as Soil Conserving Crops. (J. H. Neal and C. H. Bailey).—This experiment was started in September 1938. The cover crops were turned under in April, and cotton was planted on May 12. The cotton received the equivalent of 600 pounds of 6-8-4 fertilizer per acre, the nitrogen being applied by a weighed amount of the cover crops. All plots received the same fertilizer applications and cultivation, with the exception that clover supplied the nitrogen for one set of plots and vetch supplied the nitrogen for the other set. After the cotton was harvested, vetch and clover were again planted between the cotton rows in October. Since the clover did not germinate well, it had to be replanted about a month later.

The results for the first two winters were in favor of crimson clover. The vetch plots lost 1½ and 2 times as much soil as the clover plots for the respective years, and lost 20 to 50 per cent more runoff. Since the clover was a month later than the vetch in getting started this past fall, the vetch was slightly superior.

During the summer when all plots were in cotton, there were no appreciable differences in the erosion losses from the clover and vetch plots.

Cotton yields on the clover plots were 5 to 10 per cent higher than on the vetch plots.

Cotton Rust. (N. J. Volk).—Field and greenhouse experiments show that cotton rust is caused by a lack of potassium. The severity of the rust appears to be enhanced by an excess of phosphorus and alleviated by the presence of sodium.

Available Potassium in Soils. (N. J. Volk).—Three crops, soybeans, vetch, and peanuts, grown consecutively on 10 important Alabama soils have obtained zero to 63 per cent or an average of 24 per cent of their potash from non-replaceable forms. All crops were supplied with ample nitrogen, phosphorus, lime, and rare elements but no potassium. This is one of several factors which make it difficult to predict from the results of chemical tests just how much potassium should be added to a given soil to obtain optimum returns.

A Survey of the Agricultural Lime Resources in Alabama. (J. A. Naftel).—The location and distribution of agricultural lime resources in the State heretofore have not been determined and summarized. This survey is important at present since the agriculture in Alabama is changing from an acid tolerant type to a lime-requiring type of farming and the demand for lime necessarily is increasing. In the past, agricultural lime has been obtained from the mineral belt of North Central Alabama and even from other states. This not only added to the cost of lime but in many instances a supply of lime was not accessible to farmers.

From this survey it was found that about thirty geologic formations and several by-product sources of lime are found in the State. The locations of these are shown on the map in Fig. 1. There are potential supplies of lime in a majority of the counties. Although most of the sources of lime are high calcic, ample supplies of dolomitic or magnesic sources are available. Particularly noteworthy is the supply of soft limestone in the southern part of the State which can be worked into suitable agricultural lime at extremely low cost.

It may be concluded from this survey that lime resources in the State are sufficient and widely distributed and should supply agriculture with relatively low cost lime.

A Comparison of the Relative Values of Superphosphate, Rock Phosphate, and Collodial Phosphate for Crop Production. (Garth W. Volk).—Since considerable quantities of collodial and rock phosphate are being used for various crops in this section, the relative values of these phosphate fertilizers were compared with superphosphate.

An experiment was started in the greenhouse in which Sumter, Eutaw, Cecil, Decatur, Hartsells, and Norfolk soils were

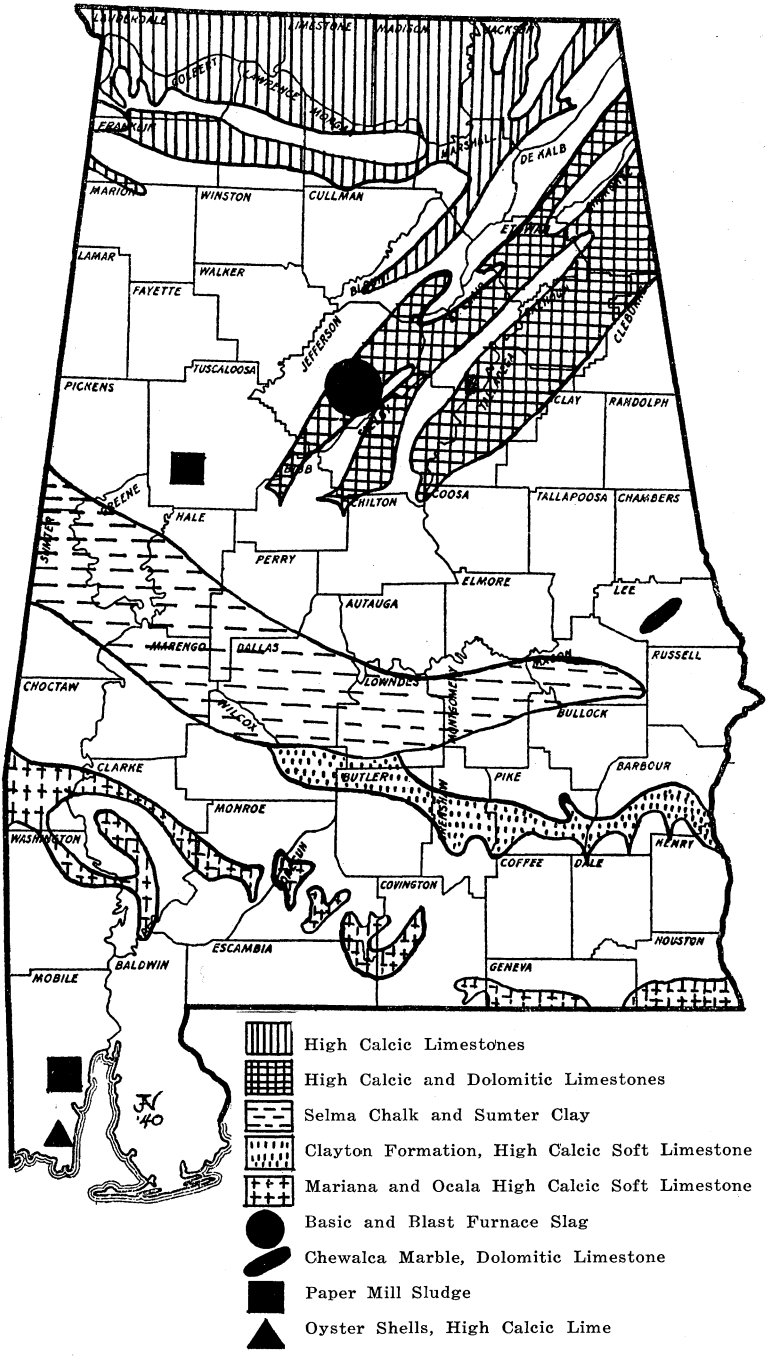

FIGURE 1.—Areas in Alabama where agricultural lime may be found.

treated with rock, colloidal, and superphosphate at the rate of 600 pounds of 16 per cent superphosphate per acre. Rock and collodial phosphates did not increase significantly the yields of vetch or sorghum on Sumter, Cecil, Hartsells, or Norfolk soils; whereas superphosphate increased the yields of vetch over ten times and the yields of sorghum two to twenty-three times. On Eutaw clay, superphosphate produced about 100 per cent and 140 per cent and on Decatur clay loam about 350 per cent and 128 per cent more vetch and sorghum than did the other phosphates.

Since the above experiment compared these fertilizers on an equivalent P_2O_5 basis and a unit of P_2O_5 is considerably cheaper in the rock and colloidal phosphates, another experiment was started in which the phosphate was varied from 8 per cent to 64 per cent on a 600-pound per acre basis. This experiment was conducted on Hartsells very fine sandy loam and Cecil clay. All rates of superphosphate produced from 50 per cent to 310 per cent more sorghum on the Hartsells soil and from 180 per cent to 1000 per cent more sorghum on the Cecil soil than rock or two brands of colloidal phosphate. From 50 per cent to 67 per cent more vetch was produced by all rates of superphosphate on Hartsells soils than for the other phosphates. There was practically no difference in the effects of rock or two brands of colloidal phosphate on the yield of vetch.

The Effect of Ammonium Sulfate on the Availability of Rock Phosphate for Crop Production. (Garth W. Volk.)—In greenhouse pot tests it was found that when ammonium sulfate was mixed with rock phosphate and the mixture applied to a soil, considerably more sorghum was produced than when sodium nitrate was used with rock phosphate. Besides producing more plant growth, chemical analyses of the sorghum showed that more calcium and phosphorus were removed from the soil. Since ammonium sulfate produces considerable acidity in soils, another experiment was started in which lime was mixed thoroughly with the soil and with the fertilizer before application in the drill. Ammonium sulfate continued to produce more sorghum when lime was mixed with the soil but failed to produce more sorghum when lime was mixed with the fertilizer. In the latter case the acidity produced by ammonium sulfate was probably neutralized before it had any solvent effect on the rock phosphate. Superphosphate (16 per cent) produced more sorghum with either source of nitrogen than the rock phosphate.

Diseases Which Are a Factor in the Elimination of White Clover from Alabama Pastures During the Summer. (H. R. Albrecht).—Although diseases have seldom been recognized as factors contributing to the elimination of white clover from Alabama pastures during the summer, observations made in plots at Auburn and in a number of pastures nearby indicate that

white clover can become generally infected and frequently largely destroyed by one or several of the following organisms: *Sclerotium rolfsii, Sclerotinium trifoliorum, Colletotrichum trifoli, Stagonospora meliloti, and Botrytus sp.*

Sclerotium rolfsii proved to be the most destructive of the five diseases studied; most of the extensively damaged plants had in almost every instance been severely attacked by this organism. The other organisms had in many cases attacked the plants severely but with the exception of *Botrytus sp.*, it is doubted that any plants were extensively damaged by them. Plants which were damaged the least were not generally attacked severely by any disease although evidences of infection were noted on most plants.

Severely diseased plants did not maintain themselves well during periods of severe drought. Those which did survive until fall when the organisms became more or less inactive were slow to renew growth.

White Clover Seed Studies. (H. R. Albrecht).—Germination tests conducted in November 1940 on open-pollinated spring-harvested seed from 401 white clover selections revealed that scarification of white clover seed before planting may in some cases be advisable.

Germination varied from zero to 44 per cent; 190 lots germinated only zero to 5 per cent, and 109 lots from 6 to 10 per cent. The proportion of nonviable seed varied from zero to 44 per cent, the higher incidences of faulty seed generally occurring in those lots of higher germination.

Seed lots with different percentages of hard seed were scarified with emery cloth prior to a second series of germination tests. Germination was increased appreciably in all lots, in one case from zero to 99 per cent.

Scarified and unscarified seed from 8 plants were planted in flats in the greenhouse and differences in stands up to 88 per cent were noted in two weeks. Subsequent counts indicated that these differences gradually diminished.

The germination and planting tests indicated that scarification of spring-harvested white clover seed may be required to insure stands when the seed is to be planted the fall following harvest. The planting tests reveal, furthermore, that scarification will assure more complete stands in shorter periods of time.

Corn Variety Tests. (E. L. Mayton).—The average results of variety tests conducted on the substations and experiment fields over the three-year period 1938-1940 show that for all sections of the State, Paymaster, Douthit, and Mosby are the highest yielding varieties of white corn, and Hybrid Golden Prolific G. C., and Indian Chief are the highest yielding yellow varieties.

The Response of Kudzu to Fertilizer Treatments. (E. L. Mayton).—In an experiment on Norfolk sandy loam soil the four-year average results of fertilizer treatments on an established stand of kudzu show that there was a response to phosphate applications. There were no definite indications that treatments of potash and lime were beneficial.

The Effect of Method of Preparation of Land for Cotton on the Properties of the Fiber and the Composition of the Seed. (D. G. Sturkie).—Analyses were made on the fiber and seed of cotton produced in land preparation studies made at the Prattville Field and the Tennessee Valley Substation. No significant differences in the length of lint, fineness of lint, weight of seed, oil content of seed, protein content of seed, or percentage of fuzz on the seed resulted from any of the treatments used.

Cotton Breeding. (H. B. Tisdale and J. B. Dick).—Work on the improvement of Cook 144, Stoneville, and Deltapine varieties of cotton by the straight line method, and work on the development of new varieties and strains of wilt-resistant cottons by the hybridization method were continued in 1940.

Two wilt-resistant strains of the Deltapine variety were isolated following five years of planting and selecting on wilt infested soil. One of these strains produces plants about 6 inches taller and is a little later in maturity than the other strain. They possess a high degree of wilt-resistance, and are high yielding strains producing medium size bolls and lint around 1 inch or better in length.

New strains of Stoneville 2B and 5A have been developed at the Sand Mountain and Tennessee Valley Substations which are apparently superior to the parent varieties in yield and percentage of lint. One strain of Stoneville 2B is being increased and distributed by the Sand Mountain Substation. The strain of Stoneville 5A will be further increased at the Tennessee Valley Substation for distribution.

Comparisons of Fertilizers of Different Analyses Applied at Different Rates for Cotton. (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 from 396 fertilizer experiments with cotton conducted in cooperation with Alabama farmers during the years 1937-40, inclusive, show that complete fertilizers containing as high as 9 per cent nitrogen and 8 per cent potash gave the highest profits when used at the rate of 300 pounds per acre. However, at the rate of 600 pounds per acre a 6-8-4 fertilizer was the most profitable.

ANIMAL AND POULTRY HUSBANDRY

A Study of Hereditary Factors Associated with Economy of Gains in Swine. (J. C. Grimes).—Eight unrelated pairs of Duroc-Jersey hogs were mated in the fall of 1935. The pigs from these matings were placed in individual pens when they were 72 days of age and remained there until they reached a weight of 225 pounds. An accurate feed record was kept on each pig. The most economical gaining male and the most economical gaining female pig in each litter were used as foundation stock for eight lines which have been selected through three generations for economy of gains. They are designated the superior strain. Likewise the most uneconomical gaining male and the most uneconomical gaining female pig in each litter were used to start eight lines which have been selected through an equal number of generations for expensive gains. They are known as the inferior strain.

On the average, hogs in the superior strain have required 27 days less time to reach 225 pounds in weight and 34 pounds less feed for each 100 pounds of gain than hogs in the inferior strain.

There has been a very definite relation between the daily feed consumption and the rate and economy of gain. Pigs which consumed the most feed daily gained the fastest and the cheapest. The most economical gains have been made by pigs that have reached a weight of 225 pounds in about six to six and one-half months. There has been a tendency for the "medium chuffy" type of pigs to gain faster and cheaper than the "long rangy" type.

The number of pigs in the litter was not related to the birth weight of each pig or to the rate and economy of gain. Pigs born in litters of about five to eight appeared to make better records than those born in very large or very small litters.

Studies of the Vitamin B Complex. The Relation of Pyridoxine (Vitamin B_6), Pantothenic Acid, and Linoleic Acid to the Cure of Rat Acrodynia. (W. D. Salmon).—Rats receiving a fat-free diet of purified casein, sucrose, and salts, supplemented with carotene, calciferol, a-tocopherol, thiamin, riboflavin, and choline developed severe acrodynia. There appeared to be more generalized fissuring of the epithelium than when the diet contained liver filtrate or calcium pantothenate.

After severe acrodynia developed it was not improved by the addition of either calcium pantothenate or methyl linolate alone. The addition of pyridoxine alone produced some increase in weight and, except in the most severe cases, appeared to initiate healing of the dermatitis. The healing process was not completed, however, unless calcium pantothenate and methyl linolate were also added.

Additional evidence was obtained of a relationship between pyridoxine and linoleic acid. The hematuria which is consistently associated with a deficiency of linoleic acid (or other essential fatty acid) was invariably delayed by the feeding of pyridoxine. In the absence of pyridoxine, hematuria frequently developed after the rats had received a fat-free diet for 6 to 8 weeks. When the diet was supplemented with adequate pyridoxine, hematuria rarely appeared in less than 16 weeks and often required 24 weeks or longer. Moreover, hematuria occasionally occurred in rats receiving 0.10 ml. of corn oil if the diet was free from pyridoxine. When rats were restricted for several weeks to a diet which was free from essential fatty acids and pyridoxine, and then received pyridoxine, they almost invariably developed hematuria within a few days. This hematuria sometimes was transient and recovery lasted for several weeks before any exacerbation occurred.

Choline Deficiency in Young Rats. (R. W. Engel).—A diet was formulated which consistently produced a fatal toxicosis due to choline deficiency in young rats in from 8 to 10 days. This diet consisted of alcohol extracted casein 6, alcohol extracted peanut meal 30, sucrose 54, lard 6, and salts 4 per cent; and was supplemented with adequate amounts of carotene, calciferol, thiamine, riboflavin, pyridoxine, and calcium pantothenate.

The toxicosis was characterized by inactivity, labored breathing, tremors, and coma. In some cases vertigo was present; frequently hemorrhage occurred into the posterior chamber of the eye.

Necropsy revealed extremely large hemorrhagic kidneys, the hemorrhage originating in the cortex. Severe congestion was present throughout the viscera with hemorrhage frequently occurring in the lungs, heart muscle, lymph nodes, and adrenal glands. Hydrothorax was usually present and occasionally ascites. Massive deposits of fat occurred in the liver; thymic atrophy was common.

At least 5 mgm. of choline per rat per day was required to completely protect the animals from this toxicosis.

Effect of Calcium Pantothenate and Other B-Vitamin Factors on Liver Fat. (R. W. Engel).—Weanling rats fed a synthetic diet supplemented with carotene, calciferol, thiamine, riboflavin, pyridoxine, corn oil, and choline chloride, had a low content of liver fat at the end of three weeks. The addition of a pantothenic acid fraction (filtrate factor 2) of liver or of rice polish produced approximately a 100 per cent increase in liver fat, the response from rice factor 2 being slightly lower. The addition of crystalline calcium pantothenate produced similar increases in liver fat. These results indicate that the pantothenic acid contained in the liver and rice concentrates was responsible

for the increases in liver fat which resulted when these substances were present in the diet.

When thiamine or riboflavin was omitted from the diet containing either factor 2 or calcium pantothenate, very low levels of liver fat resulted at the end of three weeks. The lack of pyridoxine in the diet had no effect on liver fat over a three-week experimental period. However, at the end of a seven-week experimental period there was a marked increase in the liver fat in the rats not receiving pyridoxine.

Low levels of liver fat in rats on diets lacking in thiamine, riboflavin, or calcium pantothenate was correlated with a low level of food intake. This was not the case in pyridoxine deficiency since low food consumption was accompanied by increasing amounts of liver fat.

A Comparison of the Nutritive Value of the Protein of Cowpeas and Soybeans. (W. C. Sherman).—Not only do soybeans contain considerably more protein than do cowpeas (39 per cent as compared with 21 per cent for cowpeas), but the protein of soybeans is also superior in nutritional quality. The biological value of the protein of several varieties of mature soybeans and cowpeas both raw and heated was tested in feeding experiments with rats. The soybeans and cowpeas were mixed into diets at a level to supply 10 per cent protein. Both paired feeding and ad-libitum methods of feeding were employed. With both methods of feeding the soybeans showed a marked superiority over the cowpeas in terms of grams gain in weight per gram of protein consumed. The biological value of the protein of soybeans and cowpeas was improved by heating as well as by the addition of the amino acid cystine.

Experiments were also conducted with green vegetable soybeans and cowpeas. The green soybeans gave about 35 per cent better growth than was obtained with paired-fed rats receiving green cowpeas. The proteins of the raw green soybeans had a high biological value which was not appreciably increased by heating.

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

I. **Seasonal Variation in the Vitamin A Content of Milk.**—The vitamin A content of milk produced by the College dairy herd was determined throughout the year at monthly intervals. It was found that there was a definite cycle in which the vitamin A content dropped to a low level in February and reached a peak in June, then dropped again. The milk contained 5,000 international units of vitamin A per quart in June and 1,500 in February. In only one month of the year, June, was there enough vitamin A in a quart of milk to meet the daily human requirement. This is significant because during the winter months other sources of vitamin A are also less plentiful than in the summer.

The consumer can readily distinguish winter milk because of its pale color. He cannot identify winter butter, however, because of the artificial coloring matter used by creameries to give all creamery butter the appearance of summer butter.

The fact that the vitamin A content of the milk quickly drops after it reaches its maximum, shows that the cows do not store enough vitamin A in the summer to maintain a uniform content of vitamin A in the milk.

II. **The Effect of Winter Pasture on the Vitamin A Content of Milk.**—The vitamin A content of milk was considerably increased by allowing the cows to graze on a winter pasture. This pasture, consisting of Abruzzi rye, Italian rye grass, and white Dutch and crimson clover, was seeded early in September. Cows from the College dairy herd, whose milk contained 1,500 international units of vitamin A per quart, were turned into this pasture on the second of February. Within a week the vitamin A content of the milk of these cows rose to 5,100 units of vitamin A per quart, which was higher than the richest summer milk produced by the herd. The vitamin A content of the milk rose steadily to 6,500 units per quart in May. The difference in appearance of the milk produced on the winter and permanent pastures was very striking. The milk produced on the winter pasture had a rich yellow cream layer, while the herd milk had a white cream layer.

III. **Carotene Content of Various Dairy Feeds.**—The dairy cow receives all of her vitamin A in the form of carotene. Samples of all types of feeds were analyzed, therefore, in order to compare their relative effectiveness in supplying this essential nutrient. The results of these analyses are given in Table 11. It is obvious from these results that unless a winter pasture is provided for dairy cows, their carotene intake becomes danger-

Table 11.—Carotene Content of Dairy Feeds.

Feed	Mgm. carotene per 100 gm. dry matter
Pasture	
Abruzzi rye	67.7
Italian rye grass	62.6
White Dutch clover	46.2
Crimson clover	42.9
Carpet grass	37.4
Oats	33.2
Bermuda grass	30.1
Common lespedeza	22.4
Sorghum silage, freshly cut	4.6
Sorghum silage, one year old	1.21
Sericea lespedeza hay (poor quality)	1.18
Alfalfa hay (poor quality)	.84
Grain mixture (dairy herd)	.20
Cottonseed hulls	None

ously low because of the low carotene value of the supplemental feeds.

Oat Pasture as a Protein Supplement for Fattening Hogs. (W. D. Salmon).—When eighty-pound pigs were placed on green oat pasture and given a full-feed of shelled corn and minerals, they made rapid and economical gains. The results are summarized in Table 12.

Table 12.—Fattening Hogs on Green Oat Pasture—Summary of Results.

	Lot 1 Corn—10 Cottonseed meal—1 Minerals[1]	Lot 2 Corn Minerals[1]
Area of oat pasture	1 acre	1 acre
Number of hogs	10	10
Average starting weight	81 lbs.	80 lbs.
Average final weight	202 lbs.	193 lbs.
Average daily gain	1.59 lbs.	1.48 lbs.
Feed per 100 lbs. gain		
Shelled corn	325	352
Cottonseed meal	32	—
Minerals	2	2
Total lbs. feed per 100 lbs. gain	359	354
Return per bushel corn fed during fattening[2]		
With hogs at 7c	$1.00	$1.00
With hogs at 6c	0.82	0.83

[1]The mineral mixture was composed of 3 lbs. basic slag and 1 lb. salt.

[2]In figuring the return per bushel of corn, cottonseed meal was charged at $1.70 per 100 lbs., and oat pasture at $8.00 per acre.

The addition of 1 pound of 41 per cent cottonseed meal for each 10 pounds of corn increased the rate of gain slightly and resulted in a more uniform finish. The gains were not more economical. The results compare favorably with results obtained on white clover pasture at the Tennessee Valley Substation. This is encouraging for sandy land farmers who may not have white clover available. In this experiment the oats had been well-fertilized and made a luxuriant growth. Under such conditions a protein supplement does not seem to be necessary for hogs after they reach a weight of 75 to 80 pounds. When pasture is limited, a protein supplement such as peanut meal, peanut meal and tankage, or cottonseed meal and tankage should always be used.

Basic Slag as a Mineral Supplement for Hogs. (W. D. Salmon).—Basic slag gave satisfactory results again this year in mineral mixtures for hogs. A mixture of 3 pounds basic slag and 1 pound salt was just as good as a mixture of equal parts of lime, charcoal, and salt.

A comparison of two lots of shoats which were being fattened on green oats pasture shows that it is necessary to feed

a mineral mixture to fattening hogs even when they are on pasture. These shoats averaged 55 pounds each when they were started on a full feed of shelled corn supplemented with 1 pound of peanut meal for each 5 pounds of corn. Nine shoats were placed in each of two half-acre lots of green oats on January 31. One lot did not receive a mineral mixture. The other received a mixture of 3 pounds of basic slag and 1 pound of salt.

The fattening period was 100 days. At this time the hogs receiving the mineral averaged 204 pounds each. The hogs not receiving mineral averaged only 149 pounds each and would, therefore, bring about $1.00 per 100 pounds less than the heavier hogs. With hogs at 7 cents per pound the mineral lot would have returned $1.05 per bushel of corn fed during the fattening period; the no-mineral lot would have returned only 73c per bushel. The peanut meal was charged at $1.60 per 100 pounds and the oat pasture at $8.00 per acre in computing this return.

It was interesting to observe that the hogs which did not receive mineral grazed the oats completely into the ground and destroyed the stand. In contrast with this, the hogs receiving the mineral had plenty of grazing when the experiment ended. It would appear that hogs not receiving mineral would require at least twice the acreage of pasture needed by hogs receiving mineral.

Two hogs in the no-mineral lot "went down in their hind parts" before the experiment was finished. This frequently happens when hogs are fattened on peanuts or corn and peanut meal without a mineral supplement.

Another experiment this year has shown that the basic slag mineral mixture can be used for brood sows as well as for fattening hogs. On many farms basic slag and salt will be the most economical mineral mixture for all classes of hogs. It should be kept before the hogs at all times.

Management of Farm Poultry Flocks. (D. F. King and G. J. Cottier).—The object of this project is to study under farm conditions the importance of improved housing, feeding, and breeding of hens and improved methods of raising chicks.

Where no improvement practices were followed the hens produced an average of 58.96 eggs as compared with 77.67 eggs per hen obtained where improved feeding and housing were practiced. On farms without improved housing, but with improved feeding, the egg production per hen was 69.31 eggs. Where improved feeding was not practiced, the average production per hen was 62.34 eggs.

The yearly consumption per hen of cottonseed meal and oyster shell was 16.77 and 1.2 pounds, respectively. Good hatchability under farm conditions was obtained even though cottonseed meal was fed. Mortality was low when compared with mortality among commercial flocks. The lowest mortality was obtained where improved houses were used. Eighty-eight per cent

of the farmers in the group using improved methods of raising chicks brooded chicks successfully with home constructed brooders.

Value of Kudzu and Other Forms of Summer Green Feed for Poultry. (G. J. Cottier and D. F. King).—For four and one-half months during the summer of 1940 kudzu was compared with Bermuda grass, Pearl millet, Kobe lespedeza, and Alyce clover as a grazing crop for laying hens. The earliest grazing was obtained in the kudzu and the Bermuda grass lots, and the largest amount of green feed was produced in the kudzu and the millet lots. The hens grazing lespedeza had the highest egg production, largest egg size, largest body weight, and the lowest mortality. Alyce clover did not make sufficient growth by June 15 to permit its use as a grazing crop.

Table 13.—Response of Poultry to Summer Green Feeds.

Lot No.	Crop grazed	Avg. No. eggs per bird per month	Avg. wt. of eggs (grams)	Avg. body weight (grams)	Mortality per cent	Avg. gain or loss in weight per hen (grams)
1	Kudzu	13.73	51.13	1473	23.31	—82
2	Bermuda grass	11.03	50.46	1456	23.31	—46
3	Pearl millet	13.57	50.35	1503	36.63	+ 9
4	Kobe lespedeza	14.45	51.79	1504	19.98	+67
5	Control—no green feed	8.81	50.02	1378	93.28	—228

A Comparison of Kudzu Meal and Sericea Lespedeza Leaf Meal as Vitamin Supplements to the Chick and Laying Rations. (G. J. Cottier).—Kudzu meal and sericea lespedeza leaf meal were compared as vitamin supplements for both chicks and hens. For chicks these meals were compared with alfalfa leaf meal while in the laying rations they were compared with alfalfa meal.

In the chick rations alfalfa leaf meal was slightly superior to Sericea leaf meal and very superior to the kudzu meal. For hens the sericea lespedeza leaf meal was superior to either kudzu or alfalfa meal.

The Effects of Induced Changes in the Developmental Environment of Certain Genes. (Paul D. Sturkie).—The work thus far on this project has been concerned with the effects of changes in the temperature of incubation on the expression or suppression of certain genetic characters. The temperature treatments tried on embryos to date have been without effect upon the expression of the genetic characters, Naked Neck, Frizzled, Crest, and Comb types.

The character Polydactylism has shown some response to lowered incubation temperatures. The embryos were subjected

to low temperatures at 2½ to 3 days of incubation, the time in development when the limb buds are beginning to form. The character under control conditions is not completely dominant; that is, from a cross of a Homozygous-Polydactylous male to normal females 247 (74 per cent) Polydactylous and 87 (26 per cent) normal chicks were obtained. On the experimental treatment, lowered incubation temperature, 87 or 34 per cent Polydactylous and 71 or 66 per cent normal chicks were obtained. This indicates that the genetic character was suppressed in a high percentage of cases.

BOTANY AND PLANT PATHOLOGY

The Life History of Nut Grass, Cyperus rotundus L. as Related to Possible Methods of Control. (E. V. Smith and E. L. Mayton).—An experiment was conducted during 1938 and 1939 which indicated that nut grass could be nearly eradicated from a cotton field by grazing it with geese.

A second experiment was conducted during 1939 and 1940 on land heavily infested with nut grass. The cotton was not cultivated after chopping and siding. Sixteen geese were grazed on the one-half acre plot during the 1939 growing season and only 4 during 1940. Six trenches, (2 feet wide) were dug across the plot and the tubers were sifted and counted. Not a single live tuber was found. In addition, 55 samples (2 by 2 feet) were dug at random but no live tubers were found.

HORTICULTURE AND FORESTRY

Quantity and Quality Factors as Affected by Stand in Second-Growth Pines. (L. M. Ware and J. E. Bryan, Jr.).—The number of trees on an acre greatly affects the quality and quantity of wood produced. Second-growth stands of pines in the South are conspicuously lacking in number of trees per acre. The recent forest survey of Alabama, conducted under the direction of the Southern Forest Experiment Station, has revealed that the average acre of second-growth pine carries about 43 per cent of the volume it is capable of carrying and that about 53 per cent of the total volume is composed of trees classed as rough and limby. An insufficient number of trees per acre is largely responsible for the low-quality and low-quantity of material in pine stands.

In 1925 two plots were established in a 10-year-old second-growth pine stand. In one plot the trees were thinned to stand approximately 16 feet apart and in the other left approximately 6 feet apart. The first plot represents a poor stand although better than much of the second-growth area of Alabama; the second plot represents a good stand. Data for these two plots are given in Table 14.

Table 14.—Height, Diameter, and Volume of Trees in a Well-Stocked Stand and a Poorly-Stocked Stand of Second-Growth Pines.

Treatment or condition	Trees per acre	Average height (feet)	Average diameter (d.b.h.)	Basal area per acre (sq. ft.)	Volume per acre (cu. ft.)	Cordage per acre
Poor stand (thinned 16′ x 16′)	144	39.8	9.5	76.49	1723.5	22.4
Good stand (left 6′ x 6′ approx.)	1304	37.4	4.9	140.27	3037.3	39.4

In the widely spaced stand, there is about one-half as much total wood volume as in the closely spaced stand; the average tree is larger, but all trees in the widely spaced stand are limby and rough and promise to produce lumber of very low quality. Underneath the widely spaced trees is a dense stand of hardwoods, largely sweetgum, which are ready to take over the stand when the pines are removed.

In the closely spaced stand there is about twice as much wood as in the widely spaced stand. The stems are well spaced, and offer a choice of trees of good form and vigor for the ultimate crop trees. Natural pruning of the lower branches has already assured trees free of knots. In 1940 approximately 508 fence posts per acre were removed, leaving the stand in better condition than before. Beneath the pines on this area there are no conspicuous hardwoods.

The one area is representative of a typical acre of second-growth pine in the South; the other is representative of an ideal acre. These two plots standing side by side in effect represent a contrast of what the forest area of the State is and what the forest area might be with a good stand.

Selectivity Studies on Slash Pine and Loblolly Pine Underplanted in an Existing Hardwood Stand. (W. R. Boggess and J. E. Bryan).—The importance of selectivity in determining the proper spacing in plantations of slash pine and loblolly pine has been previously reported. It was shown in this study that an original planting of 1000 to 1200 seedlings per acre was necessary to insure a sufficient number of well-spaced disease-free trees of good form and high vigor, which can be carried through to ultimate "crop trees."

In planting pines on non-restocking areas all trees have an equal chance of survival and growth. In underplanting pines on areas already restocking with hardwoods, each pine must compete with the plants already established on the land. The number of trees originally planted, from which a choice may later be made for high-quality crop trees, is of much importance. It has been assumed that it was necessary to have only the number of trees planted which would be needed for crop trees

since existing hardwoods would provide proper silvicultural conditions for their development. The need of a large number of trees from which high quality crop trees could be chosen has been largely overlooked.

Plots of slash pine and loblolly pine planted in 1933 in a thick stand of oak and hickory, which were approximately six feet in height, were examined in 1940. Liberation cuttings were made on some of these plots in 1937. At present the more vigorous trees of slash and loblolly have attained a height equal to, or exceeding, the hardwoods. From all appearances the pines will dominate the stand in the future.

Individual trees were classified according to dominance, shape of bole, and the presence or absence of defect and disease. Two plots of slash pine and three of loblolly, planted in an adjacent open field in 1933, were examined as a check against the hardwood underplanting. Table 15 presents the data for both the underplanted hardwoods and old field plots. All values are expressed on a per acre basis.

Table 15.—Classification of Eight-Year-Old Pine Underplanted in Established Stands of Young Hardwoods and in Open Field Planting.

Species	No. trees planted	Type of planting	No. high quality trees	No. poor quality but usable trees	No. suppressed, diseased or defective trees	No. trees dead or missing
Slash	908	Underplanting	110	200	498	100
Slash	908	Old field	175	371	292	60
Loblolly	908	Underplanting	100	230	468	110
Loblolly	908	Old field	140	362	328	78

The need of a sufficient number of trees for selection of high-quality crop trees can be readily seen by the data in the above table. The number of high-quality trees and the number of low-quality but usable trees is much reduced in the underplanting; mortality and defects have also been greater. While it is necessary to have a relatively large number of trees in the original planting, the picture is far from discouraging. Approximately 300 to 350 trees per acre have a chance of making usable products, and the site is now supporting valuable species instead of inferior hardwoods.

Another fact brought out by this study is that conversion of scrub hardwood areas is quite feasible, although information must be obtained on the amount of release needed and the time when release will be most effective.

Comparative Cold Resistance of Several Cabbage, Collard, and English Pea Varieties in the Field During the Winter of 1939-40. (Francis E. Johnstone, Jr.).—The exceptionally cold winter of 1939-40 afforded an unusual opportunity to compare

Table 16.—Classification of Cold-Injured Plants

Variety	Total number plants	Percent of the total injured in each class						
		No injury	Five or fewer leaves injured	Five to ten leaves injured	Stem injury plus leaf injury	Plant completely ruined	Col. 3 Col. 4 Col. 5 (combined)	Comparative rank
All Head Sel. FM 87093	40	20.0	37.5	37.5	0	5.0	42.5	4
All Head Sel. FM 87105	50	12.0	26.0	22.0	8.0	32.0	62.0	9
All Head Early FM 75682	57	14.0	35.1	35.1	3.5	12.3	50.9	6
All Head Select	48	27.1	47.9	22.9	0	2.1	25.0	3
Ferry's Round Dutch	53	11.3	43.4	15.1	11.3	18.9	45.3	5
Midseason Market	42	4.8	38.1	35.7	4.8	16.7	57.1	7
Marion Market	49	8.2	30.6	16.3	4.1	40.1	61.2	8
Chieftain Savoy	32	65.6	21.9	6.3	3.1	3.1	12.5	1
Charleston Wakefield	45	15.6	60.0	22.2	2.2	0	24.4	2
Copenhagen Market[1]	4	0	50.0	25.0	0	25.0	50.0	—
Cornell Early Savoy[1]	3	67.0	0	33.0	0	0	33.0	—

[1]Only one plot of each planted due to scarcity of plants.

the cold resistance of winter vegetables at Auburn. Cabbages and collards had been transplanted to the field in October and a large percentage of the cabbages and cabbage collards was headed by the time the heavy freezes began in January. English pea varieties were planted approximately every three weeks from October 11 to February 23 so that comparisons were possible for different stages of growth.

Cabbages

The classification of the cabbage varieties as to cold injury is given in Table 16. The data in this table were obtained by examination and classification of each head when it was harvested. The ranking is based on the combined totals of the three worst classes of injury. Heads falling in any of the latter classes were considered unmarketable although stem injury was not always apparent until the head was cut open.

Chieftain Savoy probably owes its outstanding resistance to cold in the headed stage to the protective effect of the "savoyed" leaves, as it has not proved especially hardy when subjected to freezing before the plants begin to head.

Strain differences are exemplified by the wide difference in the comparative rank of the strains of All Head Select.

Collards

All the collards were definitely more cold resistant than the cabbages, and the cabbage collards were more resistant than the non-heading collards.

The cold resistance rating, order of going to seed, and the per cent seeded on March 7 are given in Table 17.

Table 17.—Comparative Cold Resistance Rating, Order of Seeding, and Per Cent Seeding on March 7 of Collard Varieties.

Variety	Cold resistance rating	Order of seeding	Per cent seeded on March 7
Georgia Cabbage Collard	1	4	100
Improved Heading Collard	2	5	0
Asgrow Cabbage Collard	2	2	100
Louisiana Sweet	3	3	100
Green Glazed	4	1	100

Since seeding is dependent on prolonged low temperatures, resistance to seeding constitutes a part of the composite character termed "winter hardiness". Morris Improved Heading Collard was outstanding in this respect. On March 7, it did not have a single seeder, whereas every plant in the other varieties had seed stalks.

English Peas

During early January, medium severe freezes injured the earlier plantings of World's Record, Alaska, Little Marvel, and Thomas Laxton, in order from worst to least injured. Nine other varieties were slightly and about equally injured. Willets Wonder (both Asgrow and Alabama strains) were not visibly injured. The very low temperatures of late January (lowest was 7° F.) completely killed all plants above ground at that time, except the first planting of Willets Wonder and a few plants of Stratagem Improved in the same planting.

A later freeze on the night of April 12 injured the last plantings slightly. On the basis of injury, varieties were classified as follows:

No injury	*Slight leaf injury*	*Medium leaf injury*
Willets Wonder	Thomas Laxton	[1]World's Record
Stratagem Improved	Laxton's Progress	Alaska
Dwarf Alderman	Alderman	
Creole	Whirlwind	
Hundredfold	Laxtonian	
Blue Bantam	Little Marvel	

[1]Most severely injured.

As in previous years, and contrary to the prevailing belief among gardeners in Alabama, Thomas Laxton, and Alaska were among the least hardy varieties.

Comparison of Outstanding Lines of Pole Snap Beans Developed by the Alabama Station and Several Commercial Varieties. (Francis E. Johnstone, Jr.).—Studies on yield and root-knot resistance with three leading lines of pole snap beans developed by the Alabama Station and several commonly grown commercial varieties have been carried on for three years on two different sites at Auburn. The results have been summarized and are presented in Tables 18 and 19.

The results show clearly that Alabama 25 and Alabama 1 are higher yielding beans than Kentucky Wonder at Auburn, and that Alabama 18 is at least as good, on the average, as the latter. In addition, Alabama 1 and Alabama 18 are very resistant to root knot.

Alabama 18 is especially valuable as a breeding parent as it has green pods and root-knot resistance combined in the same plant. Apparently the genes for resistance and for green pods are linked because crosses between Alabama 1 and Kentucky Wonder, which have been made at Auburn, have yielded a very low percentage of green-podded resistant plants. Many more such plants should be obtained in crosses with Alabama 18, giving a much wider range of selection for other desirable characters.

Table 18.—Average Yields in Bushels per Acre of Six Lines of Pole Snap Beans.

Variety	1938			1939			1940			Three-year average[1]
	Better soil	Poorer soil	Average	Better soil	Poorer soil	Average	Better soil	Poorer soil	Average	
Kentucky Wonder	247	153	200	226	116	171	299	261	280	217
Genuine Cornfield	314	271	292	138	——	——	330	258	294	261[2]
Ideal Market	296	199	247	——	——	——	——	——	——	——
Alabama 1	380	405	392	203	102	153	348	299	324	290
Alabama 18	375	381	378	136	67	102	249	260	255	245
Alabama 25	390	287	388	190	63	126	511	439	475	329
Least difference for significance at the 5 per cent level.			44			44	105	40	51[3]	
Least difference for significance at the 1 per cent level.			59			60	145	55	69[3]	

[1]Only summarized data for 1938 available; therefore, it was not possible to analyze the three years together by the anaylsis of variance method.

[2]Average of "better soil" only.

[3]Interaction of varieties X fields removed.

Table 19.—Comparative Root-Knot Resistance of Some Pole Snap Beans.

Variety	Location	Total number plants examined	Classification as to degree of infestation				Total number infested	Per cent of total infested
			Free	Light	Med.	Heavy		
Kentucky Wonder	Student garden	79	0	15	28	36	79	100
Alabama 1	Student garden	337	163	168	6	0	174	52
Kentucky Wonder	Hillculture farm	151	67	52	15	17	84	56
Alabama 1	Hillculture farm	283	283	0	0	0	0	0
Alabama 18	Hillculture farm	121	120	1	0	0	1	1
Alabama 25	Hillculture farm	140	70	45	15	10	70	50

Alabama 25 is valuable as breeding material because of its high yielding ability. However, it is not resistant to root-knot.

The Influence of Several Plant Hormones on the Rooting of Some Ornamental Plants. (E. W. McElwee).—Various concentrations of 4 plant hormones or growth-promoting substances, indolacetic acid, indolbutyric acid, indolpropionic acid, and phenylacetic acid were used in treatments of different lengths to determine the most effective material, concentration, and length of treatment for stimulating rooting of some southern ornamental plants. Eighteen species of woody plants were used in this study; 4 species, Chamaecyparis pisifera filifera, Cotoneaster francheti, Michelia fuscata, and Ilex vomitoria failed to respond to any treatment.

Cuttings treated with indolbutyric acid consistently showed a higher percentage of rooting and developed larger root systems than cuttings treated with the other plant hormones. The data presented in Table 20 show that for 60 per cent of the species the indolbutyric treatment gave an average increase of 40 per cent in the total number of rooted cuttings. This treatment increased the speed of rooting and for 80 per cent of the species, ordinarily difficult to root, caused the maximum increase in percentage of rooting.

Another material, cane sugar or sucrose, proved to be almost as effective as indolbutyric acid in stimulating rooting of the species used in this study. The data in Table 20 show that cuttings of 45 per cent of the species treated for 24 hours in a .05 molar solution of cane sugar (0.6 oz. to a quart of water) gave an average increase of 45 per cent in the total number rooted. Sugar did not materially increase the speed of rooting, but for 80 per cent of the species not ordinarily difficult to root it caused the greatest increase in percentage of rooting.

Another study was conducted to determine the relative value of Vitamin B_1 and an extensively advertised commercial plant hormone which is used in dust form for stimulating rooting. The species and treatments used in this study are listed in Table 21.

The Vitamin B_1 treatment consisted of watering the propagating media weekly with a .013 p.p.m., solution of Vitamin B_1. The hormone powder treatment consisted of dipping the base of the cuttings in the powder. The indolbutyric acid treatment consisted of soaking the cuttings for 24 hours in a solution of 5 mgm., of acid to 100 c.c. of water.

The data in Table 21 show that Vitamin B_1 alone had little or no stimulating effect on rooting. In some cases it appeared to have a detrimental effect on rooting. Data not reported showed that the hormone powder increased the speed of rooting. The treatment of Azalea and Camellia cuttings with Vitamin B_1 and hormone powder in combination increased rooting above that of the check and also that of the hormone powder treatment

Table 20.—The Influence of Certain Plant Hormones on the Rooting of Some Ornamental Plants.

Species	Check and material giving best results	Number cuttings	Concn. mgm. per 100 c.c.)	Length of treatment (hours)	Plants rooted in 51 to 111 days (per cent)
1. Species ordinarily not difficult to root.					
Abelia grandiflora	Check	15	—	—	13
	Sugar (Sucrose)	15	1700	24	53
Berberis sargentiana	Check	5	—	—	60[1]
	Sugar	5	1700	24	100[1]
Viburnum carlesi	Check	7	—	—	14
	Sugar	7	1700	24	57
Viburnum dentatum	Check	13	—	—	84
	Indolacetic	13	5	6	91[1]
	Indolbutyric	13	5	12	91[1]
Viburnum tinus	Check	20	—	—	15
	Sugar	20	1700	24	80
2. Species ordinarily slightly difficult to root.					
Kolkwitza amabilis	Check	18	—	—	17
	Indolbutyric	18	5	12	100
Ligustrum quihoui	Check	10	—	—	20
	Sugar	10	1700	24	70
Lonicera maacki	Check	14	—	—	21
	Indolbutyric	14	5	24	35
Viburnum tomentosum	Check	7	—	—	0
	Indolbutyric	7	5	24	43
3. Species ordinarily difficult to root.					
Juniperus horiz	Check	6	—	—	0
	Sucrose	6	1700	24	33[1]
plumosa	Indolbutyric	6	5	24	33[1]
Photinia glabra	Check	10	—	—	0
	Indolbutyric	10	5	24	80
	Indolbutyric	10	5	48	80
Photinia serrulata	Check	10	—	—	40
	Indolbutyric	10	5	24	90
Pyracantha gibbsi yunnanensis	Check	10	—	—	0[1]
	Indolacetic	10	5	24	80
Symphoricarpos chenaulti	Check	8	—	—	0[1]
	Indolacetic	8	5	24	25
	Indolbutyric	8	5	24	25

[1]Records completed in 51 days.

Table 21.—The Rooting Response of Some Ornamental Plants to Treatment with Vitamin B_1 and Other Plant Hormones

Species of plant	Number cuttings	Per cent rooting in 173 days				
		Treatment				
		Check	Hormone powder	Indolbutyric acid	B_1	B_1 and Hormone powder
Azalea hinodegiri	50	82	86	74	90	100
Euonymus patens	10	88	67	20	63	88
Gardenia florida veitchi	20	80	35	45	75	85
Camellia japonica	15	40	60	93	0	93
Photinia glabra	20	5	75	30	5	30

used. This combination treatment increased by 40 per cent the rooting of the two species, Camellia japonica and Photinia glabra, which are difficult to root.

A Continuous Supply of Sweet Potatoes for Use on the Farm. (C. L. Isbell).—Experiments were conducted during the years 1934 through 1939 to determine a practicable combination of time of planting, time of harvesting, and methods of common storage that could be used with sweet potatoes on the average farm with reasonable assurance that a supply would be available for home use throughout the year.

Three lots of early set plants were harvested. The first lot was harvested either by grabbling or digging small amounts of the largest potatoes twice weekly for approximately 15 weeks, harvest beginning about August 1. The second lot was harvested in late fall before frost killed the vines when the soil was dry and the weather warm. The third lot was harvested after frost had killed the vines and when the temperature was generally cool.

Some of the potatoes of the second harvest were stored in banks immediately after harvest. Others of the second harvest were allowed to dry or cure for about 10 days before they were stored in banks. Potatoes of the third harvest were stored in banks soon after harvest.

There were three large and three small banks, each consisting of 25 or 12½ bushels, respectively, stored at each storage period. A large and a small bank in each group was provided with either ventilation and shelter, ventilation but no shelter, or with neither ventilation nor shelter. Provision was made to record the temperatures on the outside and inside of one of the large banks that was sheltered and ventilated. Some of the potatoes were taken out of the banks in late winter or early spring and stored in a barn loft until August 1.

Harvesting by grabbling small quantities twice weekly from early set plants reduced the total yield less than 3 per cent and supplied potatoes for use during August, September, October, and part of November.

When the potatoes were harvested before frost and stored immediately, approximately 54 per cent remained sound without ventilation or shelter; 63 per cent remained sound with ventilation; and 64 per cent remained sound with both ventilation and shelter. When the potatoes were harvested before frost and dried for 10 days before storing, 42 per cent remained sound in banks without ventilation or shelter; 47 per cent remained sound in ventilated banks; and 51 per cent remained sound in banks with both ventilation and shelter. When the potatoes were harvested after frost, slightly less than 7 per cent remained sound without ventilation or shelter; 7 per cent remained sound with ventilation; and 10 per cent remained sound with both ventilation and shelter provided.

In the various banks the small and medium size potatoes kept better than the large ones. When there was a relatively long cold spell and the temperature on the outside of the bank reached a maximum of 20°F., during the day and was as low as 10°F., during the night, the temperature of the inside of the bank was just about 32°F., or low enough to cause serious spoilage of the sweet potatoes such as resulted generally throughout Alabama during the winter of 1939-1940.

The rest period of banked sweet potatoes was over by late winter or early spring, about the time farmers bed potatoes for the production of plants. Unless removed from the bank at this time or earlier, the potatoes began to sweat, sprout, and crack and soon spoiled. However, if they were removed from the bank and stored in small lots in a dry barn and covered on cold nights to prevent chilling, some of them remained sound and usable until August 1.

Possibilities of Devil's Shoestring (Tephrosia virginiana) as a **Hillculture Crop.** (O. A. Atkins).—In 1939 a series of experimental plots were set up at Auburn, Alabama, to determine the possibilities of the Devil's Shoestring as an erosion control crop and poor land plant, and to determine its possibilities as a commercial source of rotenone in the United States. Sister plants to those included in the experiment, which were transplanted as one-year-old plants, were found to average about 2 per cent rotenone according to G. A. Russel of the Bureau of Plant Industry who supplied the plants. Since the experiment was established detailed data have been obtained as to height of plant, length, number of runners, etc., for all plants, plots, and treatments.

In the fall of 1940, after having grown two years at Auburn, one half the plants were harvested and the fresh weight as well as the dry weight of the roots determined. Devil's Shoestring has given little response to any fertilizer treatment. Yields of roots (dry weight basis) between 1080 and 2220 pounds per acre were obtained when calculated on the basis of 6000 plants

per acre. If a value of 7 cents per pound is given for the dry roots, this is a gross return of 75 to 155 dollars per acre.

The roots of the Devil's Shoestring are long and slender and are of little value in holding the soil. During the summer months, however, the rather dense tops of the plants act quite satisfactorily in retarding erosion. Since the plant is a perennial and loses its leaves in the fall, it offers very little protection to the soil during the winter months; therefore, some practice of using a winter ground cover with the herb must be worked out if good soil conservation is to be obtained where this plant is grown.

SPECIAL INVESTIGATIONS

Studies on Crotalaria and Sericea. (J. F. Duggar).—Crotalaria, drilled in single rows at same time as corn at the rate of one pound per acre in the middles between 6-foot corn rows, gave a 6-year average annual yield of 78 pounds of shelled crotalaria seed per acre; from a seeding rate of 2½ pounds, the yield was 151 pounds; and from a seeding rate of 5 pounds, the yield was 276 pounds.

Untreated crotalaria seed, confined in bags of very thin muslin, were spread on the surface of prepared sandy soil for varied periods in the month of May 1940. A few months later these seed were placed in an incubator for 28 days. They germinated at rates of 5, 90, 89, 94, 76, and 57 per cent for exposure periods of 0, 5, 12, 17, 25, and 29 days, respectively, to natural conditions on the soil surface.

From scarified sericea seed sowed in mid-August 1937, at rates of 10, 20, 30, 40, and 50 pounds per acre, the average annual yields of hay for a 3-year period were respectively 3566, 4130, 4757, 4195, and 4850. From a seeding made May 12, 1938, also at rates of 10, 20, 30, 40, and 50 pounds per acre, the average annual yields of hay for the first three years were 5962, 6298, 6307, 6289, and 6833 pounds per acre, respectively.

Following the plowing under of stubble from a three-year-old stand of sericea, corn fertilized with basic slag and muriate of potash afforded the first year an increase of 18.6 bushels per acre, and in its second year an increase of 11.6 bushels of corn. These are gains of 95 per cent in the first corn crop and 38 per cent in the second.

From plowing under of sericea stubble aged two years, with shoots about 6 to 8 inches tall, the increase of Sudan grass hay with non-nitrogenous fertilizers the following year was 2609 pounds per acre or 176 per cent.

The average yield of corn for five years on the plots where corn annually followed turned-under crotalaria plants that had emerged after laying-by corn was 11.6 bushels greater than from the plots continuously in corn without any legume or any commercial nitrogen.

ZOOLOGY-ENTOMOLOGY

The Relative Efficiency of Rotenone-Containing Insecticides in the Control of Vegetable Insects. (F. S. Arant).—Laboratory and field experiments with rotenone insecticides were continued in 1940. In the laboratory, a satisfactory method of evaluating the rotenoid content of insecticides was developed. It consisted of adapting the Goodhue colorimetric method for use with a photo-electric colorimeter, the establishment of exact temperature relationships, and the elimination of sulphur as an interfering element in mixtures containing this material as a diluent.

Commercial samples of rotenone-sulphur dusts, which were giving unsatisfactory control of vegetable insects in the State, were found to be in poor mechanical condition. The mixtures were lumpy and uneven and contained commercial sulphur flour rather than a dusting grade of sulphur.

Roots of devil's shoestring (*Tephrosia virginiana*) grown on sandy loam soil at Auburn, in cooperation with the Soil Conservation Service and the U. S. Bureau of Plant Industry, retained their rotenone content during the second year of growth. Chemical tests indicated 0.6 to 2.8 per cent rotenoid content as determined by the modified Goodhue method. Yields of ½ ton to more than 1 ton of dry roots per acre were also recorded.

In field experiments with late cantaloupes and cucumbers (Gherkins), the pickleworm, *Diaphania nitidalis* (Stoll), was effectively controlled by derris-talc dusts containing 1 per cent rotenone and 10 per cent flour. In the experiment with cantaloupes each treatment was replicated 5 times on fortieth-acre plots; control from different rates of application varied from 83 to 94 per cent. Cantaloupes receiving 9 applications of dust, each at the average rate of 14.1 pounds per acre, matured edible melons of good quality at the rate of 3200 per acre as compared with 96 melons per acre on the undusted plots. Most of the melons ripened between August 23 and September 5. In the experiment with Gherkin cucumbers, seven applications of dust, applied during a rainy period, resulted in a control of 93.6 per cent.

Field experiments were conducted with 1 per cent rotenone dusts for control of the Harlequin bug, *Murgantia histrionica* (Hahn) on collards. Two applications of derris-talc and of *Treated derris*-talc mixtures, each containing about 10 per cent flour, resulted in approximately 96 per cent control. The insects subsequently killed the plants which were not dusted. Four additional applications of dust, all affected by rainfall, were required to protect the dusted plants from bugs migrating from the dying undusted ones.

Since investigators elsewhere had recommended the inclusion of sulphur, hydrated lime, and nicotine in rotenone dusts for the control of the aphid, *Brevicoryne brassicae* (L), and other insects on cabbage, experiments to determine the effectiveness of such a

mixture in Alabama were conducted. This dust, composed of derris, sulphur, hydrated lime, and nicotine sulphate, 25-37.5-37.5-5 by weight, was considerably more effective against the aphid in a field experiment than derris and talc of the same rotenone content, but little or no more effective than derris, talc, and nicotine sulphate, 25-75-5. Laboratory tests with the same mixture, diluted with talc to 0.2 per cent rotenone and 0.4 per cent nicotine content, showed the derris mixture containing sulphur, lime, and nicotine was less effective 20 to 26 days after mixing than derris and talc alone against adults of the Colorado potato beetle, *Leptinotarsa decimlineata* (Say) and the Harlequin bug, *Murgantia histrionica* (Hahn). *Treated derris* was more effective against these insects than an untreated brand.

Studies on the Occurrence, Epidemiology and Inter-Host Relationships of Nematode Parasites of the Chicken (Gallus gallus) in Alabama. (R. O. Christenson).—Autopsy records of the poultry of the Alabama Agricultural Experiment Station show that the degree of parasitism has not diminished during 1940, except in the case of *Ascaridia galli. Heterakis bonasae* has been found in Alabama bobwhite quail. *Heterakis gallinae* was found concurrently with blackhead in the wild turkey. A chukar partridge was found infected with *Ascaridia galli,* and the bobwhite quail from the State Quail Farm at Prattville, Alabama, had a high incidence of *Eimeria dispersa* and *Trichomonas sp.,* both of these parasites being Protozoa. *Raillietina sp.,* a cestode, has been found in the chukar partridge.

Studies have been concluded on the morphology of the eggs of chicken nematodes, namely: (1) *Capillaria columbae,* (2) *Cheilospirura hamulosa,* (3) *Ascaridia galli,* and (4) *Heterakis gallinae.* The eggs of the latter two species will remain viable *in vitro,* for well over a year under optimal conditions. The longevity of the former two species will extend over six months. These studies show that potential infections will endure for long periods in the soil which must be taken into account in any pen rotation program if it is to be entirely successful.

The soil temperatures since September 19, 1940, have not reached magnitudes sufficient to kill parasite eggs. During dry periods the soil does become sufficiently desiccated to kill the eggs in unsodded, unshaded plots.

Eggs of *Ascaridia galli* and *Heterakis gallinae* will tolerate strong nicotine compounds for short periods. They will develop to active embryos in solutions which will later kill them. Nicotine alkaloid retards the development of embryonic nematodes. Adult *Ascaridia galli* will tolerate strong solutions of nicotine alkaloid but lose motility and become quiescent when even traces of the compounds are present. The retarding effect on the larvae, and the stupefying effects on the adults, probably account for the degree of effectiveness possessed by nicotine anthelmintics.

The Fumigation of Camellias and Azaleas with Methyl Bromide. (L. L. English).—Tests were conducted in a gas-tight chamber equipped with thermostatic controls. With the temperature held constant at 80°F., the margin of safety between perfect kills of Coccids (*Lepidosaphes camelliae* Hoke and *Fiorinia theae* Green) and plant injury decreased as the dosage was increased. The margin of safety with dosages of 4 and 6 pounds per 1000 cubic feet was too small for practical use. With the dosage held constant at 2 pounds per 1000 cubic feet, the margin of safety between perfect kills and the maximum exposure without injury to Camellias was 1 hour at temperatures of 80, 85, and 90°F. At 75 and 95°F., the margin of safety was ½ hour. With the one variety of Azalea used throughout, the margin of safety was 1 hour at 80°F., and ½ hour at 75, 85, and 90°F; at 95°F., the margin of safety was zero.

Out of 58 varieties of Azalea cuttings tested, 34 survived a dosage of 2 pounds per 1000 cubic feet for 1½ hours at a temperature of 80°F., with negligible loss. Serious loss was sustained by 6 varieties, the most susceptible being Coral Bell and Salmon Beauty. Twenty-four out of 46 varieties of Camellia cuttings survived a dosage of 2 pounds for 2 hours at 80°F., with negligible loss. Serious loss was sustained by 8 varieties.

Fifty-three varieties of Camellias from 8 to 20 inches in size were fumigated as dug from cold frames. The injury amounted to no more than slight burn to tender foliage on a few varieties. The dosages and exposures were 2 pounds for 2 hours, 1 pound for 3 hours, and ½ pound for 5 hours, all at 80°F.

As a practical measure a dosage of 2 pounds per 1000 cubic feet with an exposure of 2 hours at 80°F., was recommended.

Farm Fish Ponds. (H. S. Swingle and E. V. Smith).—Male orange-ear bream (*Eupomotis microlophus*) and female bluegills (*Lepomis macrochirus*) were crossed successfully. The resulting hybrids are being tested for sterility.

The maximum weight of bass fingerlings produced in a fertilized pond was 124 pounds per acre. The maximum weight of goldfish produced in a fertilized pond was 996 pounds per acre.

Soybean meal was found superior to peanut meal and cottonseed meal as a fertilizer for ponds containing bluegill bream. The addition of superphosphate increased the effectiveness of the soybean meal.

Bass fry, hatched in May, were raised to a size of approximately one pound by December. Where ponds were stocked with the correct number of bass fry, over 80 per cent of these fish lived to reach a legal size.

In one year of fishing, 339 pounds of bass, bream, and crappie were removed from a 1.3 acre fertilized pond. The effect of such heavy fishing on this pond is being studied.

Studies were made of the bottom organisms in a fertilized and an unfertilized pond; the dry weight of organisms per square foot

in the former was 3.48 times that in the latter. The fish production in the fertilized pond was 2.6 times greater than that in the unfertilized pond. The maximum concentration of food organisms occurred in the fall just before the ponds were drained to check on the fish production.

Experiments dealing with the control of several aquatic weeds were conducted in several ponds in the State. Naias (*Najas guadalupensis*) is one of the worst weeds in Alabama ponds. It was controlled in three large ponds in 1939 by the use of inorganic fertilizer. It reappeared in only one of the three ponds in 1940 and was controlled again. Two new ponds were in a Naias control experiment in 1940, and the Naias was greatly reduced in both. The fertilizer induced a heavy growth of filamentous algae or phytoplankton which apparently "shaded out" the Naias. A curly leaf species of Potamogeton also was controlled by fertilization.

Spatter dock (*Nuphar advena*) was controlled by cutting the leaves with a scythe five times during the summer. The infestation of water shield (*Brasenia schreberi*) was greatly reduced by removing the leaves twice.

A pond was stocked with bream alone for eight years and then brood bass were added; the latter were not able to spawn successfully. Beginning in 1939, the pond was fertilized and fished heavily. The bass then were able to spawn and the bream grew almost as much in one year as they had previously grown in five.

A thirty-year-old pond located in poor sandy land in east-central Alabama was drained to determine its productivity. This 29-acre pond was supporting an average of 48 pounds of fish per acre. A nine-year-old pond located in central Alabama was also drained. This 5-acre pond was found to be supporting 100 pounds of fish per acre. In each pond the weight of carnivorous fish made up about one-third the total weight of fish.