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# ANNUAL REPORTS

AGRICULTURAL EXPERIMENT STATION  
of the ALABAMA POLYTECHNIC INSTITUTE

January 1, 1955—December 31, 1956

## AGRICULTURAL ECONOMICS

**Use of Management Units in An Economic Research Program.** (J. H. Blackstone.) — As a basis for testing the economic feasibility of applying research results on Alabama farms, several management units have been established on selected Substations of the Agricultural Experiment Station in various parts of the State. All units are self contained with respect to land, labor, basic machinery and equipment, livestock, and other major capital items.

Results of several years' operations of these management units indicate that the application of recommendations from crop and related research are not difficult to make and that the response is normally greatest for the first year of production following adoption. Applying recommendations from livestock and related research is more difficult and response is more difficult to obtain, particularly during the first few years following adoption.

Management units in operation during 1956 varied in size from 30 to 195 acres. With one exception, all units had both cash crop and livestock enterprises. Major livestock enterprises included dairying, beef, swine, sheep, and poultry. Cash receipts in 1956 va-

ried from \$6,500 to \$10,150. In all cases, cash receipts were sufficiently high to cover cash expenses, inventory decreases, depreciation, and family and operator labor costs, and to provide a reasonable return on capital investments. Capital investments in 1956 varied from \$12,000 to \$36,000. Net incomes on these units plus farm-produced products used in households provided family living standards higher than those obtainable from non-farm employment in these particular areas.

### **Financing Dairy Production Adjustments In the Tennessee Valley Area of Alabama.**

(Sidney C. Bell and Ben T. Lanham, Jr.) — The primary objective of this study was to determine capital requirements and credit needs of farmers shifting from cash crops to dairying in the Tennessee Valley Area of Alabama. The sample region studied consisted of survey areas selected at random in Madison, Lawrence, and Lauderdale counties.

Results of budgeting with 1955 prices and costs and based on an analysis of the survey records indicated that the dairy system, with annual milk produc-

tion of 7,000 pounds per cow, was more profitable than the cash-crop system with normal yields. The budgeted dairy system indicated an increase of \$3,192 in net returns. Initial cost of the change-over from cash crops to dairying involved a capital expenditure of \$17,325 that could be recovered within a period of 5.4 years by applying the entire increase of \$3,192 in net returns each year. If farmers used their own capital in making this change, the increase in net return would yield an annual rate of return of 18.4 per cent on their additional investment. Farmers with sufficient security could obtain a 100 per cent loan and repay this loan with 6 per cent interest in 6.8 years, or they could obtain a 50 per cent loan and repay it in 3.1 years.

**Cooperative Cotton Gins in Alabama with an Analysis of Ginning Rates and Marketing Margins for 1955.** (R. S. Glover and Morris White.) — Ginning rates at cooperative cotton gins in Alabama ranged from \$0.65 to \$1.10 per hundredweight of seed cotton in the fall of 1955. Costs and returns data from these gins were not adequate to permit calculation of net profits on individual gin activities. However, revenue from three activities was calculated as a percentage of gross profits. The three activities were ginning and related services, marketing of cottonseed, and marketing of baled or seed cotton. The percentage of gross profits accounted for by each was 73.7, 21.8, and 4.5, respectively. Among individual gins, the range in proportion of gross profits derived from the three activities were from 65 to 94 per cent for ginning and related services, 2 to 29 per cent for marketing cottonseed, and from 0 to 9 per cent for marketing baled or seed cotton.

**Marketing Facilities and Handling of Truck Crops in Alabama.** (Edward E. Kern, Jr.) — Marketing facilities estab-

lished in certain areas of Alabama have not been sufficient for expansion or maintenance of several important commercially-produced truck crops. With the exception of tomatoes and watermelons, over two 8-year periods, 1940-47 and 1948-55, the acreages of six other commercially-produced vegetables in the State have shown declines ranging from 6 per cent for cucumbers to 63 per cent for sweetpotatoes. Over a 17-year period, 1939-55, average variation in prices of Alabama-produced vegetables was 38 per cent, or slightly above that of competing states. Price risks, in terms of variation coefficients, have been wider in Alabama than in competing states for beans, cucumbers, watermelons, potatoes, and strawberries, and less for cabbage and tomatoes.

The term market facility is not synonymous with a dependable market. Inability of management to successfully deal with farmers and the unwillingness of producers to support marketing facilities, primarily as a result of the "pool method" of settling accounts, contributed to the inability of several public-supported facilities to amortize their debts at reasonable rates. If future markets appear feasible in the State, they should be based on the following criteria: Economic need in specific production areas; strong leadership; concentrated volume of specific truck crops at specific points; educational programs aimed at year-round interest in the facilities; compulsory grading and inspection of produce; adequate market information; modest beginning with room for expansion of facilities; and payments in cash to producers.

**Improving Usefulness of Livestock Marketing Information.** (R. O. Russell, Jr. and M. J. Danner.) — Studies of relationships between grades and prices received at Alabama auctions reveal wide variations. These may be because

either buyers or sellers do not know the prevailing prices in other markets. Therefore, this study was begun to determine availability and adequacy of livestock market news.

Fifty per cent of the auction operators and livestock dealers from which schedules were obtained neither received market news reports nor supplied market news information.

The Federal State Market News Service reports 15 weekly auction sales as well as daily terminal market coverage. Terminal market information is released twice daily over leased wire. Auction market, Chicago, and Nashville reports are released twice weekly in mimeographed form to a mailing list of 200,

of which 50 per cent are farmers. These auction reports are also supplied directly to 65 newspapers and 62 radio stations.

Of the 23 daily newspapers serving Alabama, 17 carry some form of livestock market news. Schedules received from 76 of the 117 weekly newspapers in Alabama indicated that only 31 of these papers carry market news.

More than 80 per cent of the farmers interviewed depended on radio as their principal source of livestock market news. Daily newspapers were the next most important source. Most farmers believed that these sources of information were of assistance in estimating the value of their livestock.

## AGRICULTURAL ENGINEERING

**Engineering Phases of Supplemental Irrigation.** (H. Bouwer and F. A. Kummer in cooperation with USDA-ARS.) — A surface irrigation project was installed and evaluated at the Upper Coastal Plain Substation. Results show that high degrees of efficiency and uniformity of water application can be obtained with this type irrigation. A new method for evaluating surface irrigation systems without soil moisture determinations was developed.

A dead-lateral, rectangular, sprinkler-irrigation layout with alleys in tall crops to facilitate pipe moving required 1.5 man-hours per acre per irrigation at the Agricultural Engineering Farm Unit. Labor requirement with laterals equipped with plastic-hose branches was 1.0 man-hour per acre per irrigation. In addition to reducing labor requirements, branched laterals offered several other advantages, such as possibility of increased equipment utilization, reduction in human effort

for moving sprinklers, reduced number of valve tees, and improved trafficability in alleys. A tripod for mounting the sprinklers was developed.

Subirrigation with perforated underground tubing has several attractive features from an engineering standpoint. Results from a field study at Thorsby, however, show that spacing between the pipe lines had to be approximately 10 feet and that efficiency was as low as 5 per cent.

**Mechanization of Cotton Harvesting.** (T. E. Corley, C. M. Stokes, and F. A. Kummer.) — During 1955 and 1956, additional data were obtained regarding the evaluation of machines and methods for mechanical cotton harvesting and of mechanical harvester performance in relation to plant characteristics. The data show that efficiency of the spindle picker was affected more by plant conditions than are influenced by the weather than by any other factor. Low

yields of knotty and hard-lock bolls caused by drought resulted in low (85 per cent) picker efficiency, whereas high yields of sound bolls grown with ample moisture resulted in high (95 per cent) picker efficiency. Of the varieties tested, storm resistance appears to be one of the most important characteristics to consider in choosing a cotton for machine harvesting. Varieties showing storm resistance have less weather loss and still give high machine efficiency. Methods of weed control had no effect on yield and picker harvesting efficiency. However, rotary hoeing and chemical control required 40 per cent and 95 per cent less hoeing, respectively, than the hand hoed check. Results from plant spacing tests show that a stand can safely vary from 20,000 to 60,000 plants per acre without materially affecting yield or spindle picker efficiency.

**Use of Sod Seeder.** (L. Brown, L. A. Smith, and C. M. Stokes.) — Studies made with commercial sod-seeders indicated these machines were unsatisfactory under many conditions.

Applicator feet spaced less than 16 inches apart caused excessive damage to established sod. It is important to apply the same amount of seed and fertilizer per acre regardless of drill spacing.

The competition of established sod with a planted crop is an important factor in establishing sod-seeded crops. Unless means are used in controlling the crops that are growing on the planted area, they will seriously hinder the sod-planted crops during dry periods. Time of planting sod-seeded crops is important, since the old crop on the field tends to compete with the planted crop for moisture and plant nutrients. Sod-seeded crops planted 15 days before frost are normally not affected by competition from the established crops on the area.

**Interplanter for Use in Interplanting in Row Planted Crops and Sod Fields.** (J. O. Helms and C. M. Stokes.) — There are no interplanters suitable to use with tractors for interplanting row crops in Piedmont Area. Therefore, a row interplanter was developed for farm tractors. The machine is capable of applying both seed and fertilizer to the crop that is interplanted between the rows of growing crops. The experimental planter performs satisfactorily as a sod-planter. It is rugged and satisfactory for use under adverse conditions.

**Attic Space Ventilation and Insulation.** (Walter Grub.) — The control of ceiling panel temperatures was studied during hot weather by using various attic space ventilation and ceiling insulation treatments. The ventilation systems consisted of gable end louvers, ridge louver, flue ventilator, attic exhaust fan, and a completely closed attic. Insulation treatments varied from no insulation to 3 inches applied on the top surface of the ceiling. The closed attic produced the highest ceiling panel temperatures, while the attic exhaust fan produced the lowest. Ceiling insulation decreased the differential in temperatures between the various ventilation systems from 17 degrees when no insulation was used to 6 degrees when 3 inches of insulation was applied:

The ridge louver, the flue ventilator, and the gable end louvers caused marked decreases of ceiling temperatures in comparison to the closed attic. However, they were not as effective as the exhaust fan, since they were more dependent upon such factors as wind velocity and direction.

**Feed Grinding and Mixing.** (C. A. Rollo and F. A. Kummer.) — Tests were conducted to determine the most feasible way to obtain a continuous flow of cottonseed meal from a holding bin or hopper when the cottonseed meal is being used as a concentrate in dairy

feed. Test results show that some mechanical means of agitating cottonseed meal must be provided to ensure a continuous flow of meal. An electric vibrator installed on the outside of the bin or hopper was found to give satisfactory results.

**Forage Harvest and Storage.** (C. A. Rollo and F. A. Kummer.) — Three crops were harvested for silage (oats, corn, and sorghum) by a completely mechanized procedure. The equipment consisted of one forage harvester, two self unloading wagons, one forage blower, and four tractors. The sorghum was put in a trench silo and the corn and oats in upright silos. The harvesting rate varied from 7.0 to 15.5 tons per hour, with the sorghum operation producing the highest rate per hour and

the oats the lowest rate. Labor requirements varied from 0.32 to 0.71 man hours per ton, with sorghum requiring the least and oats the highest labor per ton of silage harvested. The combination of equipment and personnel used to harvest silage was efficient from the standpoint of use of men and equipment.

**Peanut Silage.** (C. A. Rollo and F. A. Kummer.) — An experiment was begun to determine if peanut tops would produce satisfactory silage. The criteria used in the laboratory production of silage were the pH value and the protein content. The pH value of 3.87 to 4.62 was within the range of good silage and the protein content of 11.71 per cent to 18.56 per cent compares favorably with that of alfalfa silage.

## AGRONOMY and SOILS

**Soil Testing Studies.** (Clarence M. Wilson, R. D. Rouse, and C. E. Evans.) — During the third and fourth years of operation of the Soil Testing Laboratory, 9,311 and 12,857 samples were analyzed. The total number of samples for 4 years of operation was 34,626.

A summary of all field and pasture samples shows 36.1 per cent having a pH of 5.5 or less, 76.0 per cent with pH 6.0 or less, and only 24.0 per cent above pH 6.0. Of the samples, 73.9 per cent show a need for a fertilizer with an even phosphate-potash ratio, 7.0 per cent for a high phosphate-low potash ratio, and 19.1 per cent for a low phosphate-high potash ratio.

In the past 2 years, sale of fertilizers with even phosphate ratios has increased from 16 per cent to 48 per cent of total fertilizer sales. Those with high phosphate-low potash ratios have shown a proportionate decrease. This indicates

a wide acceptance by farmers of the findings of the Soil Testing Laboratory.

**Urea-Formaldehyde as a Source of Nitrogen.** (C. E. Scarsbrook.) — Three formulations of experimental 12-12-12 grade fertilizer, each containing a portion of the nitrogen as urea-formaldehyde, were compared with ammonium nitrate as sources of nitrogen for cotton and corn. The experiments were conducted with corn at 8 locations and at 5 locations with cotton during a 2-year, 1955-56, period. The formulations used in 1955 contained 38 per cent urea-formaldehyde with an availability index of 20; in 1956 two formulations were used with urea-formaldehyde percentages of 35 and 36 and availability indices of 49 and 57, respectively. Ammonium nitrate supplemented with phosphate and potash produced higher yields of both cotton

and corn than equivalent rates of all formulations of fertilizer containing urea-formaldehyde.

**Legumes Plus Commercial Nitrogen for Corn.** (J. T. Cope, Jr.) — Experiments to determine the effect of commercial nitrogen when applied to corn following a winter legume turned for green manure were begun in 1930 at 5 experiment fields and 3 substations. Corn following winter legumes averaged 43.7 bushels per acre at the 8 locations for 25 years. Application of commercial nitrogen to corn following the legume increased the yield only 1.2 bushels per acre. Amounts of nitrogen applied were 16 pounds for the first 19 years and 32 pounds since that time. Winter legumes, hairy vetch in most cases, have averaged over 16,000 pounds of green weight annually. This is enough vetch to add over 120 pounds of nitrogen to the soil.

**Maintaining Soil Fertility and Crop Production on Soils Cropped with Harvested Peanuts.** (D. G. Sturkie and L. E. Ensminger.) — It is generally recognized that cropping with peanuts rapidly depletes soil fertility and lowers yields.

A study was begun in 1950 to determine the nature of soil depletion. The experiment was conducted in 1/100-acre bins of Norfolk sandy loam. The effect of harvested peanuts on yields and chemical composition of the soil was followed for a 6-year period.

Data show that without treatment, yields declined to a very low level. Applications of phosphorus and potash prevented some of the decline, but lime in addition to phosphorus and potash was much more effective in maintaining yields. Dusting with basic slag or gypsum on limed plots increased yields. Slag was somewhat more effective than gypsum. Turning under corn stalks in addition to lime and fertilizer further increased yields.

Exchangeable calcium dropped to a low level without lime. The data indicate that frequent liming is needed to maintain a desirable calcium level. Phosphorus applications resulted in an accumulation of soluble phosphorus, but potash treatments resulted in only a small increase in exchangeable potash.

**Fertilizer Evaluation and Use. (Cooperative with TVA).** (1) WATER-SOLUBLE PHOSPHORUS IN RELATION TO CROP RESPONSE. (L. E. Ensminger.) — Numerous field tests have been conducted to determine the need for water-soluble phosphorus for cotton and other crops. The importance of water-soluble phosphorus depends on a number of factors, such as soil reaction, placement of fertilizer, rate of application, and the crop itself. Data show that cotton often needs some water-soluble phosphorus for best yields. Results from field tests conducted from 1951 to 1953 show that a complete fertilizer containing 63 per cent of its phosphorus in a water-soluble form produced an average of 100 pounds more seed cotton than a similar fertilizer containing only 25 per cent in water-soluble form.

Early growth of wheat forage was increased as much as 50 per cent by increasing the water-soluble phosphorus. Differences due to water solubility are usually not evident in final grain yields.

Most crops are benefited by some water-soluble phosphorus. However, there is little indication of a need for more than 40 to 50 per cent water-soluble phosphorus in fertilizers.

(2) RESPONSE OF SERICEA TO LIME AND FERTILIZERS. (L. E. Ensminger and J. T. Cope, Jr.) — A test was begun at seven locations between 1947 and 1949 to determine the response of sericea to lime, phosphorus, potassium, sulfur, and minor elements. Hay yields were obtained at all locations for 5 to 9 years. The test was conducted on the

following soil types and locations: Hartsells fine sandy loam, Sand Mountain Substation; Decatur clay loam, Alexandria Field; Appling sandy loam, Piedmont Substation; Boswell very fine sandy loam, Tuskegee Field; Greenville fine sandy loam, Prattville Field; Magnolia sandy loam, Monroeville Field; and Kalmia sandy loam, Brewton Field.

A response to phosphorus was obtained at only two locations. Crops on the Hartsells fine sandy loam responded to phosphorus in the 6th year and on the Boswell very fine sandy loam in the 7th year. All soils were medium to low in phosphorus at the beginning of the test.

Crops on Boswell very fine sandy loam at Tuskegee Field showed the only response to lime, which was not obtained until the 7th year. The pH of the soils at the beginning of the experiment ranged from 5.3 to 5.7.

Soil without a potash treatment was not included in the test. The lowest rate of  $K_2O$  used, 60 pounds per acre annually, was sufficient at all locations for the duration of the test, with the exception of the Boswell very fine sandy loam. Crops for the 8th year on the Boswell soil responded to the second 60-pound increment of  $K_2O$ .

Sericea did not respond at any location to a mixture of boron, manganese, zinc, and copper. Sulfate from gypsum did not increase yields at any location. The lack of response to sulfate may be explained by the fact that all soils studied contained appreciable sulfate in subsurface layers.

(3) RELATIVE EFFICIENCY OF BROADCAST AND ROW-PLACEMENT OF FERTILIZERS FOR COTTON. (J. T. Hood, L. E. Ensminger, and J. T. Cope, Jr.) — An experiment to measure the relative efficiency of fertilizer placement for cotton was begun in 1954. In field tests broadcast placement of fertilizer gave as good yields as row-placed fertilizer where a 60-pound rate of  $P_2O_5$  was used. When the phosphorus level

was reduced to more nearly the critical level, properly row placed fertilizer gave higher yields than broadcast.

When soil moisture was low while the seed were germinating, fertilizer placement was critical. Under these conditions fertilizer placed under or with the seed resulted in poorer stands and lower yields than when fertilizer was placed at the side and below the seed. Fertilizers containing ammonium phosphates produced the poorest stand. Mixing gypsum with ammonium phosphate fertilizers improved stands.

**Factors Affecting the Nature and Behavior of Native and Added Phosphates in Soils:** (1) AVAILABILITY OF PHOSPHORUS IN VARIOUS SOURCES OF ROCK PHOSPHATE. (O. L. Bennett, L. E. Ensminger, and R. W. Pearson.) — Seven sources of raw phosphate were tested under greenhouse conditions. Availability of phosphorus from these sources was measured by yields and phosphorus uptake by Ladino clover and Sudangrass. Sources studied were ground raw rock phosphates from Florida, Tennessee, Idaho, South Carolina, Tunis, Morocco, and Curacao Island.

Foreign sources and South Carolina rock were superior to other tested domestic sources. South Carolina rock was as available as any of the foreign sources tested. Eutaw clay and Cecil clay loam with and without lime were used in testing the sources. Each had a pH of 5.0 before liming. The Cecil is kaolinitic and the Eutaw contains about equal amounts of kaolinitic and montmorillonitic clays.

The rock phosphates were characterized with respect to certain physical and chemical properties. No correlation was found between fluorine content or specific surface and the availability of the phosphorus to plants. There were marked differences between domestic and foreign sources with respect to citrate and sequestrine solubility, with

the South Carolina rock again being an exception. For example, the foreign sources and South Carolina rock showed the most availability as measured by yields and phosphorus uptake and were two or three times more soluble chemically than were the other sources.

(2) CORRELATION OF SOIL TEST PHOSPHORUS WITH YIELDS OF LADINO CLOVER. (L. F. Welch, L. E. Ensminger, and C. M. Wilson)—Ladino clover was grown in 11 × 6-foot concrete-walled field bins that contained Norfolk sandy loam, Eutaw clay, and Cecil clay loam soils. Varying levels of phosphorus had been built up in these soils by past applications of superphosphate. Soil samples, taken from the bins prior to seeding the clover, were extracted for soluble phosphorus by three extracting solutions. The solutions used were 0.05 N HCl + 0.025 N H<sub>2</sub>SO<sub>4</sub>, 0.5 N NaHCO<sub>3</sub>, and 0.03 N NH<sub>4</sub>F + 0.1 N HCl. Six harvests were taken from each bin.

Any of the three soil-testing methods can be used satisfactorily as a basis for making phosphorus recommendations for the soils and crop studied. No one solution proved to be statistically better than the other two. The 0.05 N HCl + 0.025 N H<sub>2</sub>SO<sub>4</sub> is currently being used by the Soil Testing Laboratory at Auburn.

**Behavior of Potassium in Soils:** (1) POTASSIUM STATUS OF HARTSELLS FINE SANDY LOAM. (R. D. Rouse.)—The potassium status of Hartsells fine sandy loam was characterized in the field by cropping for 18 years at rates ranging from 0 to 96 pounds of K<sub>2</sub>O per acre followed by 9 years of cropping without further additions. At the beginning of the residual period, the potassium supplying power of the soil was determined by electro dialysis and by boiling nitric acid. Exchangeable potassium, potassium content of cotton leaves, and cotton yield were deter-

mined annually throughout the residual period.

During the cropping period an annual application of 48 pounds of K<sub>2</sub>O per acre resulted in maximum response of cotton to potassium. On soil that did not receive potassium during this initial period, 48 pounds of K<sub>2</sub>O during the residual period was inadequate as measured by yield and potassium content of cotton leaves until the application had been repeated annually for 5 or 6 years. Potassium did not limit yield on plots not receiving annual application until both the exchangeable and the relatively soluble nonexchangeable were reduced below 125 pounds K<sub>2</sub>O per acre. This indicates that the relatively soluble non-exchangeable potassium and the exchangeable potassium are both of value in sustaining crop production. Therefore, if maximum yields are to be made on this soil, the potassium application should be sufficient to offset crop removal and leaching losses and maintain the exchangeable potassium at 140 to 150 pounds per acre or above.

(2) POTASH SIDEDRESSING FOR COTTON. (R. D. Rouse.)—A 5-year study of the value of potash sidedressing on Kalmia fine sandy loam showed no advantage for drilling 1/3 to 1/2 of the potash at planting and the remainder as a sidedressing at first cultivation over applying all potash at planting. However, it did show that when inadequate potash was applied at planting, efficient use could be made of potash sidedressing. In this study, 5-year average yield of cotton with the several rates of potash per acre was as follows: none, 476 pounds seed cotton; 32 pounds K<sub>2</sub>O, 1,231 pounds; 64 pounds K<sub>2</sub>O, 1,532 pounds; 96 pounds K<sub>2</sub>O, 1,528 pounds; 128 pounds K<sub>2</sub>O, 1,632 pounds.

(3) EFFECT OF SODIUM ON BOLL PRODUCTION AND CATION CONTENT OF COTTON LEAVES. (R. D. Rouse and W.

F. Sowell.) — Results from previous studies on the effect of sodium on yield of cotton were not conclusive. In order to compare a large number of treatments under known environmental conditions, the present study was conducted in a plant growth chamber where light intensity, relative humidity, and temperature were controlled and duplicated from experiment to experiment. Twenty-four ratios of potassium, calcium, magnesium, and sodium were compared under good and poor root aeration at pH 5 and pH 6 using solution culture. Sodium did not affect the uptake of potassium, calcium, or magnesium at any ratio studied as measured by leaf content, nor did sodium affect cotton boll production. Results show that sodium has no direct nutritional effect on the cotton plant. This means that the only value that sodium might have on cotton yield is possible indirect effects on the availability of essential elements in the soil. One of these that has been demonstrated in field experiments is increased yields from the application of a sodium salt at deficient levels of potassium.

(4) SOYBEAN STUDIES IN JACKSON COUNTY. (R. D. Rouse.) — Seventeen fertility and 5 variety tests were conducted in Jackson County to determine lime and fertilizer requirements of soybeans and variety adaptation in that area. During the 3-year period, 1953-55, yields were generally low because of dry weather. However, data obtained indicated a need for lime at 6 locations, phosphate at 10, and potash at 13 locations. The large variation in need for lime, phosphate and potash indicates that a general lime and fertilizer recommendation would not be feasible, but the needs of each field should be determined by soil tests.

The variety test showed that Jackson, representing varieties in maturity group VII, should not be grown for beans in this area. Varieties in ma-

turity group VI, such as Lee and Ogden, should be standard, but the harvest period could be extended by planting a portion of the acreage to earlier maturing beans from group V, such as Dorman.

(5) SOYBEAN CULTURAL PRACTICES. (R. D. Rouse.) — Experiments on row width and seeding rates with Lee and Jackson varieties planted in late May and in late June were conducted during 1953-56 on Kalmia sandy loam. Using 60 pounds of seed per acre, yields from 20- and 30-inch row spacings averaged about 10 per cent higher than from 40-inch rows; yields from 10-inch rows were 60 per cent higher for both varieties. Yields were not affected by seeding rates of 30, 60, 90, or 120 pounds per acre. At a row width of 10 inches, yields were decreased 20 per cent by increasing the seeding rate from 60 to 240 pounds per acre. Yields for the 4 years averaged about 30 per cent less for plantings made in late June as compared to those made in late May, but this varied from no decrease to a 75 per cent decrease in different years.

The data from an experiment comparing drill vs. broadcast applications of 400 pounds of 0-14-14 to Jackson soybeans on Kalmia sandy loam show a 27 per cent decrease in yield from drill application of fertilizer as compared with broadcast application before planting.

**Effect of Electric Steam Plant Effluents on Sulfur Brought Down in Rainwater. (Cooperative TVA.)** (L. E. Ensminger.) — A cooperative project with TVA was begun in 1951 to study effects of steam plant effluents on sulfur in rainwater. Rainwater samples were collected before the steam plant near Tuscumbia was put into operation. Samples were also collected during the time the units were being put into use and for a period of 1 year after all 4 units were in full operation.

For the period before the steam plant began operation, the sulfur brought down in rainwater averaged 4.8 pounds per acre for 23 locations. Data for the first year with all units in operation show an average of about 10 pounds of sulfur per acre brought down. During the first year of operation, it is estimated that 89,000 tons of sulfur were given off in the steam plant effluents. Evidently, the stacks were high enough to cause the effluents to be distributed over a wide area.

**An Evaluation of Coal Washer Refuse as a Soil Conditioning Agent.** (Fred Adams.) — Results from greenhouse and laboratory experiments show that coal washer refuse has no value as a soil amendment or as a medium for plant growth. The cation exchange capacity was found to be only about 7 mg. equivalents, which precludes its use to increase cation exchange capacity of soils. No evidence was found that additions of coal washer refuse reduced the amount of nutrients lost by leaching from a light textured soil. The material was found to reduce plant growth even at moderate rates of application in soil because of its acid-producing property. It proved to be toxic to plants when mixed with sand in ratios that nurserymen use for sand and peat plotting mixtures.

**Effect of Soil pH and Calcium on Uptake of Zinc by Plants.** (John I. Wear.) — Calcium carbonate, calcium sulphate and sodium carbonate were incorporated in a Norfolk sandy loam at various rates to measure the effects of pH and calcium on the uptake of zinc by an indicator plant under greenhouse conditions. An application of 2,000 pounds of  $\text{CaCO}_3$  per acre decreased the zinc content of sorghum from 150 p.p.m. to 50 p.p.m. The pH of the soil was increased from 5.7 to 6.6 and the calcium content of the plant was increased from 0.78 to 1.09 per cent.

Higher rates of  $\text{CaCO}_3$  further decreased the zinc content as the pH of the soil increased. Sodium carbonate decreased zinc uptake depending on change in pH. An application of 2,000 pounds of  $\text{CaSO}_4$  per acre did not decrease the zinc content of the plant. Conclusive evidence was obtained to show that a decrease in zinc content of the plant was a pH effect and not a calcium effect.

**Extractable Boron, Zinc, Manganese, and Copper in Soils of Alabama.** (John I. Wear.) — Boron, zinc, manganese, and copper were determined by accepted procedures to give a measure of availability of 243 samples from various soil regions in the State. Results show that the Coastal Plain and Appalachian soils are lower in boron and zinc than the Limestone Valley and Black Belt soils. The Black Belt soils are the lowest and the Limestone Valley soils are the highest in manganese of any soil area.

Boron, zinc, and copper increase from coarse-textured to fine-textured soils. This relationship does not hold true for manganese in all cases because of the low manganese content of the Black Belt soils, which are predominantly clays.

**Boron and Manganese Requirements for Cotton.** (John I. Wear.) — Ten locations on farmers' fields, substations, and experiment fields were selected to determine if applications of 10 pounds of commercial MC mixture (5 pounds of colemanite and 5 pounds of manganese sulfate) per acre would increase yields of cotton. Results show no significant increase at any location, although there are indications of response at two locations.

**Response of Corn to Minor Elements Under Field Conditions.** (John I. Wear and Doyle Ashley.) — Twenty-six field tests were conducted on representative

coarse-textured soils in Alabama to determine response of corn to minor elements. Main emphasis was placed on response to zinc on limed and unlimed soils. Soil tests were made for pH, Zn, B, Mn, and Cu. At six locations, yield increases were significant for 15 pounds of zinc sulfate per acre under limed conditions. No significant increase in yield was obtained for minor elements other than zinc. No significant responses were obtained for applications of zinc to soil that had not been limed.

**Evaluation of Low Water-Soluble Boron Compounds as Plant Nutrients.** (John I. Wear and C. C. Hortenstine.) — Five low water-soluble boron frits were tested with cotton, soybeans, turnips, alfalfa, and crimson clover on a coarse- and a fine-textured soil under greenhouse and field conditions. Results showed that the frit, FN-215A, was not available enough to provide boron to plants from applications as high as 50 pounds of the material per acre. FN-176C was found to be more available than "A", but not a satisfactory source of boron for crops such as alfalfa. Both greenhouse and field tests showed that FN-176E and F were the most desirable of the frits tested. From tests conducted, FN-176B was the most soluble source and the one most likely to cause toxicity to sensitive plants.

"Rate of Solution" and the "Identical pH" methods for measuring available boron were evaluated and found to have considerable merit for determining available boron in these types of material.

**Time of Planting Crimson Clover.** (J. T. Cope, Jr.) — An experiment on time of planting crimson clover has been conducted at the Brewton Experiment Field annually since 1952. Clover is planted on fallowed land every 15 days, beginning August 20 and ending December 5. One harvest for green weight

yields is made in the spring at the time when clover would normally be turned for green manure ahead of planting corn. Average yields from the different planting dates for the 5-year period 1952-56 have been: August 20, 12,600 pounds; September 5, 19,500 pounds; September 20, 23,400 pounds; October 5, 19,700 pounds; October 20, 18,400 pounds; November 5, 12,400 pounds; November 20, 10,600 pounds; December 5, 4,600 pounds.

**Sugar Cane Varieties and Time of Planting.** (J. T. Cope, Jr.) — Experiments with sugar cane have been conducted at the Brewton Experiment Field continuously since 1931. Two varieties, C.P. 36/111 and C.P. 29/116, have been outstanding in variety tests in recent years. These varieties are resistant to mosaic and red rot. Yields from first and second year stubble have been superior to yields from such old varieties as C.O. 290, Louisiana Purple (old blue cane), Cayanna, and the P.O.J. Sirup yields of the two recommended varieties averaged over 500 gallons per acre for the 3 years, 1954-56.

Fall and spring plantings have produced about the same yields of sirup. Fall planting is recommended because it is usually more convenient.

**Adaptation of Forage Crops to Alabama Conditions:** (1) **SUMMER TEMPORARY GRAZING CROPS.** (W. R. Langford.) — Starr millet has shown certain advantages as a grazing crop over other summer annuals in forage production tests. It has been more productive than the best adapted varieties of Sudangrass and it is leafier and supplies pasturage over a longer season than other varieties of millet. Production of Sudangrass has not been satisfactory in tests in southern Alabama, especially during humid summers.

(2) **PRODUCTIVITY OF WINTER LEGUMES.** (W. R. Langford.) — Results

from forage production tests show that crimson clover and vetch produce earlier pasturage and more total forage than any of the other winter legumes tested. Some of the other legumes tested were: Louisiana S-1 white clover, Kenland and Louisiana red clover, ball clover, mike clover, rose clover, subterranean clover, button clover, and Auburn selections of woollypod and common vetch. The early growth and total forage production of some of these in comparison with that of crimson clover are as follows:

CROP AND NUMBER OF TESTS	RELATIVE YIELD	
	1ST HARVEST	TOTAL
	Pct.	Pct.
Crimson clover	100	100
Hairy vetch, 18	85	88
Ball clover, 18	17	72
Kenland red cl. 12	5	71
Rose clover, 5	14	71
Mike clover, 12	25	57
La. S-1 white cl. 10	8	57
Button clover, 13	19	56
Subterranean cl. 7	17	60

(3) PERFORMANCE OF SUMMER PERENNIAL GRASSES. (W. R. Langford.) — Results from adaptation tests show that Coastal Bermuda and Pensacola Bahiagrass are more productive than other permanent pasture grasses on upland soils in Alabama. Based on experiments to date, the following conclusions concerning the productivity of these two crops can be drawn: (1) They are about equal under conditions of high rates of fertilization and adequate soil moisture, or with low fertility and inadequate moisture; (2) Coastal Bermuda is superior on drouthy soils if well fertilized; and (3) Bahia is best on moist soils of low fertility.

**White Clover Improvement:** (1) EFFECT OF FLOWERING ON THE PERSISTENCE OF WHITE CLOVER. (Pryce B. Gibson.) — The persistence of non-flowering, medium-flowering, and profuse-flowering white clover was studied under normal

daylight and under an extended light period. Persistence was measured in terms of the number of live stolons transecting a line 1 meter long. The extended light period caused plants of the flowering group to reach a peak intensity of flowering earlier than usual and caused plants of the non-flowering white clover to blossom profusely.

The non-flowering clover under the normal daylight period persisted longer than the same clover under the extended light period or the profuse-flowering clover under the normal daylight period. The profuse-flowering clover under the extended light period persisted longer than the non-flowering clover under the same light period. This profuse-flowering clover under the extended light period had apparently passed the peak intensity of flowering and had reverted to vegetative growth prior to the occurrence of the adverse summer conditions.

In general, the response of the medium-flowering clover to an extended light period was intermediate to that of the non-flowering clover and the profuse-flowering clover.

(2) DEVELOPMENT OF A NEW SYNTHETIC WHITE CLOVER VARIETY. (Pryce B. Gibson and E. D. Donnelly.) — A synthetic Ladino type clover variety has been developed from five Alabama clones that were selected on the basis of superior vigor, disease resistance, and persistence. These clones are: 269, 2682, 3757, 3763, and 4249. In preliminary tests, this variety has been superior to most other white clover varieties in both yield and persistence.

**Breeding of Sericea Lespedeza:** (1) EFFECTS OF STEM TYPE ON SOME FEEDING QUALITIES OF SERICEA LESPEDEZA, L. CUNEATA, AS INDICATED IN A DIGESTION TRIAL WITH RABBITS. (E. D. Donnelly and G. E. Hawkins.) — Objectives of the sericea breeding pro-

gram are to improve palatability and nutritive value of sericea. An early study indicated that cattle preferred fine-stemmed plants to coarse. Subsequently, a number of fine-stemmed inbred lines were developed.

A feeding trial using ground fine-stemmed and coarse-stemmed sericea forage for rabbits indicated the following: (A) The nutritive characteristics of the two forage types were different. Both types had some desirable and some undesirable characteristics. (B) Rabbits consumed significantly more fine-stemmed sericea than coarse, and the fine-stemmed contained significantly more total digestible nutrients than did the coarse-stemmed forage. These results indicate that the fine-stemmed diet was more palatable and provided more energy than the coarse-stemmed. (C) Digestibility of the crude protein in the two diets was similar. (D) Digestibility of the crude fiber in the fine-stemmed sericea was considerably greater than that in the coarse-stemmed forage. (E) The fine-stemmed diet was higher in nitrogen-free extract and the digestibility of this constituent was considerably greater in the fine-stemmed diet than in the coarse-stemmed diet. (F) The cellulose contents of the two diets were approximately the same, and there was no difference indicated in the digestibility of this fraction of the forages. And (G) the coarse-stemmed forage contained more ash than the fine-stemmed forage and the digestibility of the ash in the former was considerably higher.

(2) ANALYSIS OF THE ANATOMY OF THREE STEM TYPES OF SERICEA LESPEDEZA, L. CUNEATA. (E. D. Donnelly and J. F. Ferry.) — An anatomical study was made of stems of fine-, medium-, and coarse-stemmed sericea inbred lines and strains grown in the same test. Purpose of the test was to determine differences that might help explain why fine-stemmed sericea plants are less rigid and more palatable than

the coarse-stemmed plants of commercial sericea.

In stems of the first and second cuttings, the number of xylem cells was fewer for the fine-, greater for the medium-, and still greater for the coarse-stemmed material. Also, the xylem of the fine-stemmed strain was less heavily lignified than the two other types. The pith diameter was smallest for the fine-, large for the medium-, and still larger for the coarse-stemmed strain.

The difference in lignification is mainly responsible for the fine-stemmed strain being less rigid and and tough than the other two. This may account for the greater palatability of the fine-stemmed material as shown by feeding tests.

Based on these data several experimental varieties have been put together using fine-stemmed inbred lines.

**Chemical Weed Control.** (1) WEED CONTROL IN COTTON. (V. S. Searcy.) — Annual weeds have been controlled in cotton by using a combination of pre- and post-emergence chemicals. CIPC and diuron gave best results in tests of pre-emergence chemicals. The rates given below are for 12-inch bands in 40-inch rows. CIPC for sandy soil, 1 to 1½ pounds per acre and for heavy soils, 2 to 2½ pounds; diuron, ¼ pound per acre for sandy soil and ½ pound for heavy soil. Post-emergence herbicidal oil was applied as needed at the rate of 5 gallons per acre per application.

(2) CONTROL OF WILD GARLIC (*Allium vineale*). (V. S. Searcy.) — Chemical weed killers, MH, ATA, 2,4-D, 2,2,3-TPA, dalapon, and a mixture of creosote-diesel fuel at various rates have been tested in experiments for the past 4 years. The experiments are located on Bermudagrass, white clover-Dallisgrass, and fescue sods. With few exceptions all chemicals at all rates and

in all experiments significantly reduced the wild garlic population when compared with the untreated check. No plot was completely free of wild garlic regardless of treatment or duration. To date, 2,4-D at 2 pounds per acre and MH at 3 to 4 pounds (active material) per acre are the best chemicals to use when considering their effect on wild garlic.

(3) **THE CONTROL OF JOHNSON AND BERMUDAGRASS.** (V. S. Searcy).—Chemical weed killers, TCA, dalapon, ATA, MH, and 2,2,3-TPA at various rates have been tested. It was found that TCA at 100 or more pounds per acre and dalapon at 10 or more pounds per acre were the most effective chemicals tested for killing Johnson and Bermudagrass. Better kill of Bermudagrass was obtained from all chemicals by turning the sod 1 to 2 weeks after application.

Two applications of dalapon at 10 pounds per acre were much better than single applications as high as 40 pounds per acre for killing Coastal Bermudagrass that was not plowed. All chemicals were applied when the grasses were in a good growing condition. The Johnsongrass was 10 to 12 inches high.

(4) **CONTROL OF DOCK** (*Rumex crispus* and *R. pulcher*) IN A CALEY PEA-VETCH-JOHNSONGRASS MEADOW. (V. S. Searcy).—An experiment on the control of dock with 2,4-D was begun in 1954. Low volatile ester and amine forms of 2,4-D were used at the rates of  $\frac{1}{2}$ , 1, and  $1\frac{1}{2}$  pounds per acre annually. Although excellent control of dock was obtained by all 2,4-D treatments, no treatment gave complete control and Caley peas and vetch were killed almost 100 per cent by all 2,4-D treatments.

## ANIMAL DISEASE RESEARCH

**Transmissible Gastroenteritis in Swine.** (W. G. Dacres).—Sows once infected with the virus and recovered were not susceptible to reinfection. Those animals infected within the first week of life died. Infection of older animals produced anorexia, diarrhea, and fever for 4 or 5 days followed by recovery. Sows infected within a few days prior to farrowing did not protect their pigs; however, second litter pigs were immune. Chick embryo passage did not prove to be a successful means of growing the virus.

**Treating Repeat-Breeding Cows with Intra-uterine Infusions of Chloromycetin.** (George K. Kiesel).—Thirty-four cows showing repeated signs of heat at normal intervals and having been bred three or more times, received intra-uterine infusions of 1 gm. of chloromycetin, intra-muscular type. Twenty-three inoculations were made from 4

to 24 hours after breeding. The remainder were treated 1 month to 2 days before breeding. Eight cows conceived at the time of treatment, eight at the next heat period, and 5 at the second or at some subsequent heat period; 13 cows did not conceive. It was concluded that the routine intra-uterine infusion of 1 gm. of intra-muscular type chloromycetin in repeat breeder cows is not effective in reducing infertility unless frank infection is present.

**Infectious Agents Associated with Reproductive Disorders in Cattle, Excluding Brucellosis, Leptospirosis, Trichomoniasis, and Vibriosis.** (George K. Kiesel and William G. Dacres).—Six hundred and twenty-five cervical cultures were taken from difficult-breeders to determine to what extent infection is related to repeat breeding in cattle. Of these, 188 showed the presence of bacteria as follows: Streptococci 65, Staphylococci 27,

Vibrio sp. 25, Coliform bacteria 8, B. subtilis 8, Gaffhya 2, Sarcina 1, Diplococci 2, Gram positive rods 13, and pleuro-pneumonia-like organisms 4.

A streptococcus pyogenes, a hemolytic coagulase positive staphylococcus, and a hemolytic diplococcus were each inoculated at the external os of the cervix of three clean heifers (total of 9 head) 3 weeks to 2 days before breeding. Three other clean heifers were used as controls. The heifers were bred artificially at subsequent heat periods after a culture of the cervix was made. None of the bacteria had any effect on the breeding efficiency of the heifers. Inoculated heifers required an average of two services, whereas the controls had an average of one and one-half. Four and one-half months after initial inoculation, all heifers were again inoculated at the external os of the cervix with the same bacteria. Sterile saline was used on the controls. Pregnancy was not disturbed. It is intended to inoculate these bacteria directly into the uterus after calving to note any effects, inasmuch as a lowered resistance or a traumatized organ may be a prerequisite to infection.

**The Role of Trichomonads in the Etiology of Atrophic Rhinitis of Swine.** (C. S. Roberts.) — A total of 71 swine were inoculated intranasally with material obtained from infected swine and birds. An additional 23 swine served as control animals for inoculated groups or received exposure by direct contact with infected animals.

Atrophic rhinitis is transmissible to suckling pigs by nasal instillation of nasal washings from infected swine. The resistance of the pig to infection by this method apparently increases with age. Pigs over 6 weeks of age were not infected. The disease has not been transmitted with bacteria-free filtrates of nasal washings or suspensions of *Trichomonas sp.* in artificial culture media. Although the disease did not

produce distortion of facial bones of all affected shoats or other symptoms of the disease, there were lower weight gains among affected animals in a single litter than in their normal, healthy litter mates.

**Relationship of Green Oat Toxicity of Cattle to the Application of Nitrate Fertilizer to the Soil.** (C. S. Roberts and L. W. Turner.) — Green oat poisoning, a highly fatal disease of cattle and sheep, occurs in Alabama during the winter months in animals grazing cereal grain plants, particularly oats and wheat. Attempts were made to produce the disease in both cattle and sheep by allowing them to graze fields of oats top or sidedressed with levels of ammonium nitrate ranging from 0 to 705 pounds per acre. The fields were located in Lee, Dallas, and Autauga counties. None of the animals died from grazing oats that received nitrogen after planting, whereas 2 of the 11 cows died from grazing oats that did not receive ammonium nitrate. The average blood serum calcium, magnesium, and phosphorus values of all the cows on each of the groups were essentially the same irrespective of the rate of nitrogen application. The disease more closely resembles grass tetany than any other condition.

**Relationship of Leptospirosis to Bovine Reproductive Disorders. ISOLATION OF LEPTOSPIRA FROM INFECTED ANIMALS.** (C. S. Roberts and L. W. Turner.) — Thirty-one isolation attempts were made using material collected from suspected cattle or bovine fetuses to inoculate guinea pigs, hamsters, chinchillas, and artificial media.

*Leptospira pomona* was isolated from 3 cattle representing 2 herds in the same geographical area of the State. This is the first reported isolation of leptospira from cattle in Alabama. Principal symptoms of infection in these two herds were abortions occurring late

in the course of pregnancy and a non-inflammatory type of mastitis in one, and death of young calves in the other. Limited trials with the chinchilla (*Chinchilla laniger*) as a laboratory animal

indicate that this rodent is more susceptible to *L. pomona* infection than the hamster or guinea pig. Leptospiras were demonstrated in tissue sections of the kidneys from two fetuses.

## ANIMAL HUSBANDRY

**Changes in Chemical and Physical Properties of Pasture Herbage That Influence Their Utilization and Nutritive Value for Grazing Animals.** (W. B. Anthony, J. G. Starling, and C. A. Brogden.) — Seasonal changes have been determined for crude protein, cellulose, calcium, phosphorus, and magnesium in warm season forage crops. Without the addition of nitrogen, protein contents of Coastal and common Bermudagrass and Pensacola Bahiagrass seldom exceed 10 per cent in early spring and decline to 6 and 7 per cent during most of the grazing season. Application of nitrogen raises the crude protein contents of these forages, but the amounts present fall below 10 per cent near the end of the grazing season.

Cellulose contents of these grasses do not show much seasonal change. The amount of cellulose is near 30 per cent in early spring and may increase to about 35 per cent in late summer. Cellulose is present in the leaves of these plants to the same extent as in stems. Protein is more concentrated in the leaves. Calcium contents of these forage crops have been found to be fairly high (0.60 per cent on the average) for the first clipping in the spring. Subsequent clippings always have much less calcium. Calcium values usually range from 0.22 to 0.30 per cent on a dry matter basis. Phosphorus content changes noticeably with the season, but it is generally low. Many samples of these grasses have a phosphorus content less than 0.16 per cent on a dry matter basis. Magnesium content of

the grasses is usually found to be 0.15 to 0.20 per cent.

On the average, yearling steers grazing these grasses consume  $8.27 \pm 1.05$  pounds of digestible dry matter per head daily for the season. This amount of feed is not sufficient for maintenance and a high rate of daily gain. Low digestible dry matter intake appears to be the greatest single factor restricting daily performance of young cattle grazing these grasses. At the Wiregrass Substation, Coastal and common Bermudagrass and Pensacola Bahiagrass produced about 168 days of grazing. Total weight gain per yearling steer for the entire grazing season averaged 208, 157, and 189 pounds for Coastal, common, and Bahia, respectively. The average slaughter grade of the cattle at the end of the grazing season was Utility.

**Production and Utilization of Forage Crops for Growing and Finishing Cattle for Slaughter:** (1) **SILAGE PRODUCTION ON HUMPHREYS SILT LOAM.** (W. B. Anthony, J. K. Boseck and P. F. Parks.) — A two-cropping system is practiced wherein sorghum is produced for silage followed by oats for grazing and silage. Irrigation has been used at time of planting and once or twice later in the growing season. In 1955, Tracy sorghum yielded 19.81 tons of silage per acre. Oats that followed on this land did not grow sufficiently during the fall for grazing but yielded 6.99 tons of silage per acre the following spring. Sorghum that followed the oat crop produced 12.57 tons of silage per acre.

Oats were planted immediately after harvest of the sorghum. The oats supplied grazing for 74 days and were harvested for silage. The yield per acre was 5.03 tons. Another adjacent field has been utilized for production of corn for silage followed by oats for grazing. Oats sown in the fall of 1955 produced 221.9 animal grazing days per acre (beef calves) and the live weight gain per acre was 330 pounds. Corn produced for silage following the oat grazing yielded 8.17 tons per acre. Oats that followed on this land provided 216 animal grazing days per acre. Corn harvested the following summer from this area yielded 5.7 tons of silage per acre.

(2) WINTERING STOCKER CALVES ON SILAGE. (W. B. Anthony, J. K. Boseck, and P. F. Parks.) — Weaned beef calves full-fed silage plus 2 pounds of ground ear corn and 1.5 pounds of cottonseed meal per head daily gained 1.46 pounds each per day, with an average feed requirement per hundredweight of gain of 1,403 pounds of silage, 137 pounds of corn, and 100 pounds of cottonseed meal. Comparable animals fed corn silage and supplement gained 1.93 pounds per head daily and required 1,328 pounds of silage, 104 pounds of corn, and 86 pounds of cottonseed meal per hundredweight of gain. During the same time the calves were fed silage, other comparable animals were on oat grazing plus supplemental feed when the oat forage was not available. The daily gain on oat grazing averaged 1.18 pounds.

**Evaluation of Forage Crops for Beef Cattle Production in the Piedmont Area of Alabama.** (W. B. Anthony, E. L. Mayton, W. R. Langford, and P. F. Parks.) — In 1955 a replicated grazing test was begun at the Piedmont Substation to determine beef production potentials for several grazing crops. Results for 1 year have been obtained on alfalfa-orchardgrass, Dallisgrass-orchardgrass-

white clover, crimson clover-Coastal Bermudagrass, and lespedeza sericea. Intake of nutrients by yearling steers was determined by use of a combination of chromic oxide and plant chromogens. Digestible forage dry matter consumed per animal per pound of live weight gained was 8.23, 8.76, 9.31, and 24.81 pounds, respectively, for alfalfa-orchardgrass-clover, Dallis-orchardgrass-clover, crimson-Coastal Bermudagrass, and sericea. Daily intake of nutrients by steers was surprisingly similar for all of the swards. Digestible protein in sericea was extremely low and may account in large measure for the poor relative efficiency in utilization of this crop by the young cattle.

**Supplemental Feeding of Steers on Summer Pastures.** (W. B. Anthony, J. G. Starling, C. A. Brogden, and P. F. Parks.) — Intake studies with steers on summer grasses revealed that low feed intake is the greatest single factor limiting their daily performance. Preliminary studies were made to find out if it is possible to economically improve steer performance on summer grasses by supplemental feeding. In 1955, cottonseed meal and cottonseed meal with stilbestrol were used to supplement yearling steers grazing common Bermudagrass. Intake of forage was measured by use of a combination of chromic oxide and plant chromogens. Protein supplement with or without stilbestrol did not improve daily gain or increase intake of forage. In 1956 a comparable test was conducted except that the supplemental feeds consisted of 7.5 pounds of ground snapped corn daily per head in one instance and cane molasses (free choice) in another. The average daily molasses consumption was 4 pounds per head. Both types of energy supplement increased daily gain (control, 1.11 pounds daily; cane molasses supplemented, 1.52; and corn supplemented, 1.71), but lowered the intake of forage dry matter.

In this test the increased value of the steers receiving the supplements was more than sufficient to offset cost of the supplements.

**Parakeratosis or Zinc Deficiency Disease in Hogs.** (Howard F. Tucker and W. D. Salmon.) — Parakeratosis studies have been conducted several years to determine its causes. This swine syndrome was found to be of nutritional origin and was characterized by dermatitis, enteritis, cirrhosis of the liver, jaundice, and inanition. Growth rate may be severely affected. The routine addition of antibiotics, all known vitamins, lysine, methionine, tryptophan, and fats were not prophylactic. The disease developed in pigs on diets that were relatively high in phosphorus, calcium, or both. Additions of various zinc salts prevented occurrence of the disease and resulted in rapid recovery by the pigs. The disease condition is a mineral imbalance phenomenon resulting from excessive levels of calcium and phosphorus in the ration which, in some way, precipitates a deficiency of zinc. Additions of 100 p.p.m. zinc to mixed rations have been adequate.

**Some Comparisons of Pasture and Confinement Systems of Growing-Finishing Hogs.** (Howard F. Tucker.) — Consolidation of data has resulted in the following generalizations: (1) Rates of gain of hogs grazing various forage crops were not greatly different from those fed complete rations (16 per cent protein) in concrete floored pens. (2) Feed costs not including cost of pasture were slightly lower for the pasture system. (3) Mixed rations (16 per cent protein) resulted in faster gains than those from groups fed corn and supplement. (4) Feed efficiencies and cost of gain between the two methods of feeding were similar. Cost of feed preparation was not included.

Alfalfa, white clover, oats, and crimson clover have proved satisfactory for cool season grazing. Alfalfa, millet, sudan, and white clovers where possible have performed well during the warmer season. It has been difficult to maintain a continuous supply of quality grazing.

**Various Levels of Zinc, Calcium, and Phosphorus in Hog Rations.** (Howard F. Tucker.) — The experiment was designed to study the interrelation of zinc, calcium, and phosphorus in hog rations and the occurrence of parakeratosis. Tricalcium phosphate was added at 0.375, 0.75, 1.125, and 1.5 per cent levels to a control ration containing N.R.C. levels of calcium and phosphorus. Zinc was added at the rate of 100 p.p.m. to each of the same formulas.

In a second trial, zinc was added at rates of 25, 50, and 100 p.p.m. to a control ration that contained N.R.C. levels of calcium and phosphorus plus tricalcium phosphate additions of 0.375 per cent and 1.5 per cent.

In comparing growth rates and incidence of parakeratosis in hogs receiving various levels of dietary calcium and phosphorus,  $\text{Ca}_3(\text{PO}_4)_2$ , with and without various additional levels of zinc, it was found that: (1) severe reductions in growth rate and development of parakeratosis occurred on levels of 0.15 per cent Ca and 0.075 per cent P above N.R.C. requirement; (2) reduction in growth rate and onset and severity of the disease increased as the level of Ca and P in the ration increased; (3) the levels of zinc required to prevent deficiency symptoms are not absolute but are relative to the Ca and P content of the ration, increasing as the levels of Ca and P increase; (4) the addition of 50 p.p.m. zinc was as effective as 100 p.p.m. zinc in a ration that contained 1.25 per cent Ca and 0.71 per cent P, whereas, 25 p.p.m. zinc supplementation was not adequate.

## BOTANY and PLANT PATHOLOGY

**Nematodes in Relationship to Crop Production in the South:** (1) PLANT PARASITIC NEMATODES CONSIDERED TO BE OF IMPORTANCE IN ALABAMA. (E. J. Cairns.) — About 700 soil and plant samples have been examined for the presence of nematodes. On the basis of these, the following list of nematode genera of particular interest as crop pests has been compiled: *Meloidogyne* spp. (root-knot nematodes), *Tylenchorynchus* spp. (stylet nematodes), *Pratylenchus* spp. (meadow nematodes), *Rotylenchus* spp. and *Helicotylenchus* spp. (spiral nematodes), *Ditylenchus* (stem and bulb nematodes), *Aphelenchoides* spp. (leaf and bud nematodes), *Xiphinema* spp. (dagger nematodes), and *Trichodorus* spp. (stubby root nematodes).

(2) TESTING FOR RESISTANCE TO ROOT-KNOT NEMATODES IN CORN. (E. J. Cairns and F. S. McCain.) — Four of the commonly found root-knot nematode species, *Meloidogyne incognita*, *M. incognita acrita*, *M. arenaria*, and *M. javanica*, were tested against Golden Cross Bantam and four inbred lines having desirable commercial characteristics. The results indicated that the plant breeder has genetic resources for resistance in terms of reduced root-gall formation for at least two of the root-knot nematode species tested. However, no special resistance was found to penetration and maturation of any species.

(3) PATHOGENICITY OF A SPECIAL NEMATODE IN RELATION TO CORN. (E. B. Sledge and E. J. Cairns.) — The frequent findings of *Helicotylenchus nannus*, Steiner, 1945, in corn plantings in southern Alabama required investigation of this nematode's relationship to the crop. The following varie-

ties were selected for testing because of their widespread planting in the region: Dixie 11, Dixie 18, Dixie 33, North Carolina 27, Coker 811, and Golden Cross Bantam. It was established that this nematode thrives on corn as an external root-feeding parasite. Although the nematode was able to exist and multiply on all corn tested, Coker 811 was found to be the best choice for planting in areas where this nematode is abundant, particularly when corn is to be followed by some other crop susceptible to the nematode. The number of nematodes declined markedly in soil not containing seed plants and in cultures containing three commonly found soil fungi. This suggests that fallowing may be an effective control measure.

(4) PATHOGENICITY OF A SPIRAL NEMATODE TO SOYBEANS. (E. J. Cairns and N. A. Minton.) — Ogden variety of soybeans was grown in sterile soil and inoculated with 500 spiral nematodes, *Helicotylenchus nannus*, per plant at time of planting. A significant reduction in dry root weight was measured at maturity but without significant reduction in seed yield. Nematode population increased an average of at least 10.6 times by harvest. Field observations indicated that soybean plant injury and reduction of yield are to be associated with large numbers of this nematode. In field soil it is considered likely that feeding wounds produced on roots by the nematodes serve as portals of entry for other soil microorganisms.

(5) TEST OF VARIOUS CROP AND WEED PLANTS FOR SUITABILITY AS HOSTS FOR A SPIRAL NEMATODE. (E. J. Cairns and N. A. Minton.) — Various field plants, occurring in areas where

the spiral nematode, *Helicotylenchus nannus*, is found, were tested. Cotton, Ladino clover, Bermudagrass, and Dallisgrass were found to be very suitable hosts for multiplication of the spiral nematode. Nutgrass, oats (Victorgrain 48-93), Johnsongrass, and fescuegrass (Kentucky 31) were considered intermediate in suitability. Sudangrass (Sweet Sudan), sand spur, orchardgrass, and grain sorghum (Early Hegaria) were least suitable, but with some increase occurring in the nematode populations. It is possible that continued testing will establish that this nematode has a wide range of host plants. It was evident that some common weeds can serve as carryover hosts for this nematode in the absence of crop plants.

(6) PATHOGENCITY OF THE STUNT NEMATODE ON OATS. (E. J. Cairns.) — The stunt nematode, *Trichodorus primitivus*, was found through experimentation to be capable of increasing its number by at least 8 times in 90 days association with the roots of Victorgrain oats. Root and foliar weights were reduced. It was found also that this nematode was unable to persist in soil in the absence of seed plants, which suggests fallowing as a control measure.

(7) SURVEY FOR NEMATODES IN SOUTHEASTERN PINE SEEDLING NURSERIES. (B. E. Hopper.) — Thirty-six nurseries were included in the survey. Three were found in which pine seedling injury could be attributed directly to nematodes. Ten nurseries had seedlings with root-rot conditions in which nematodes could have been components of a disease complex. Large populations of a recently discovered species of a new genus of plant-parasitic nematodes, *Meloidodera floridensis*, were found to be injurious to slash pine seedlings. Various species of *Tylenchorhynchus*, including *T. claytoni* and an undescribed species, were found to be in-

jurious to slash pine seedlings. The frequent occurrence of reportedly fungal-feeding nematodes in association with seedling root-rots and their possible significance as parasites of mycorrhizal fungi is considered of special interest.

(8) SURVEY OF ROOT-KNOT NEMATODES IN ALABAMA. (N. A. Minton and E. J. Cairns.) — This survey, to be completed in 1958, revealed to date five species of root-knot nematodes in the State: *Meloidogyne incognita*, *M. incognita acrita*, *M. hapla*, *M. arenaria*, and *M. javanica*. The nematodes were found in almost every major soil type in the State, ranging from heavy clays to light sandy soils. The finding of different root-knot nematode species is significant. It means that exact determination of the species present in a particular field will be necessary in order to get full advantage of rotation and varietal recommendations since the host ranges of root-knot nematodes differ in some respects.

(9) HOST RANGE TESTING FOR FIVE SPECIES OF ROOT-KNOT NEMATODES. (N. A. Minton and E. J. Cairns.) — Testing to determine host ranges of the five common species of root-knot nematodes is being continued until virtually all plants of economic importance in the State have been examined. Not only are differences in host range being found between the various root-knot nematode species, but some differences in host suitability are being found between varieties of the same crops.

(10) DEVELOPMENT OF ROOT-KNOT NEMATODES IN SUSCEPTIBLE AND RESISTANT COTTON. (N. A. Minton.) — Four of the commonly occurring root-knot nematode species, *Meloidogyne incognita*, *M. incognita acrita*, *M. arenaria* and *M. javanica*, were used with cotton selections and varieties ranging from susceptible to resistant. Invasion

of the roots occurred in resistant as well as susceptible cottons. Nematode development was slower in resistant plants than in susceptible ones. Differences were noted also in rate of development between the nematode species. For example, *M. incognita* was able to develop into mature, egg-laying females in all cotton tested. *M. javanica* did not reach maturity in any cotton. It was concluded that the nature of resistance to root-knot nematodes is not inability of the nematodes to infest cotton roots but is the inability of the nematodes to complete maturation.

(11) EFFECTS OF THREE SOIL FUMIGANTS ON NEMATODE POPULATION ASSOCIATED WITH COTTON. (E. J. Cairns and A. L. Smith.) — Shell D-D was applied in the row at 7, 10, and 14 gallons per acre and Dowfume W-85 in the row at 2, 3, and 4 gallons per acre. Planting was 9 days later. Soil samples were taken at 4, 10, and 33 weeks after treatment for checking the nematode populations.

The two fumigants were about equally effective in suppressing populations of species of *Hoplolaimus*, *Pratylenchus*, *Trichodorus*, *Tylenchus*, *Aphelenchoides*, and *Dorylaimus*. Lack of marked differences in the populations in respect to rates of application indicate that the dosages were equally effective, at least to the extent of the rhizosphere sampled along the line of treatment. In another experiment in which the same chemicals were applied at time of planting, somewhat similar results were found.

The stylet-bearing nematode populations were suppressed for at least 10 weeks after treatment, with only slight increases being noted at the final sampling date. Non-parasitic nematode populations were reduced initially, but parasitic types were not reduced. Results of another field experiment using Shell Nemagon, a new soil fumigant, showed this chemical able to reduce

and retard stylet-bearing nematode populations for at least 10 weeks. Initial action of the chemical was slow, reductions in the nematode populations being more noticeable at 10 weeks than at 4 weeks after treatment. Nemagon had little effect on the non-parasitic nematode populations.

(12) EVALUATING USE OF RADIOACTIVE ISOTOPES FOR PATHOLOGY STUDIES OF ECTO-PARASITIC NEMATODES. (E. J. Cairns and D. E. Davis.) — To utilize isotopic tracer techniques with the external root-feeding nematodes, much higher levels of radioactivity are required than for comparable work with internal root-feeding nematodes. Various methods for producing the necessary high levels of radioactivity in roots of test plants have been tried. A method of continuous pressure injection with solutions of P<sup>32</sup> has been found best. Preliminary results indicate that the tracer technique is possible for demonstrating if a particular nematode species will feed on the roots of certain plants. The dilution factor for activity in the plants and the very small uptake by individual nematodes are limiting factors in extension of this technique to all types of susceptible plants.

**Studies of Forage Crop Diseases.** (1) DISEASES OF FORAGE CROPS UNDER SPRINKLER IRRIGATION. (E. A. Curl and H. A. Weaver.) — During July and August, 1954, and in each month of 1955, intensities of diseases occurring on sprinkler-irrigated forage crops were estimated. These crops were: Kenland red clover, intermediate white clover, Oregon Ladino clover, Atlantic alfalfa, African alfalfa, commercial orchardgrass, Kentucky 31 fescue, and reed canarygrass. At least 18 fungal pathogens and 2 virus diseases were identified on the 8 crops. Considering all crops together, more diseases were present in May, June, and July, part of the 5-month period during which most water was applied, than in other

months. *Pseudoplea* leaf spot was the most persistent and most damaging disease of the white clovers. *Stemphylium* leaf spot was most damaging on the alfalfa, and rust was the most damaging disease of the grasses. On most of the crops disease intensity was slightly greater in plots that received the most water. The diseases that showed the greatest increase in intensity under high-level irrigation over a 1-year period were *Pseudoplea* leaf spot on intermediate white clover, yellow patch (virus) and *Curvularia* leaf spot *Curvularia trifolii* on Ladino clover, and *Pseudopeziza* leaf spot *Pseudopeziza medicaginis* on African alfalfa. The intensities of powdery mildew *Erysiphe polygoni* on red clover and of rust *Puccinia rubigo-vera tritici* on orchardgrass were greater in the low-level irrigated plots.

(2) ANTAGONISTIC RELATIONSHIP OF SOIL MICROFLORA TO SCLEROTIUM ROLFSII. (E. A. Curl.)—Tests with known media for isolating microorganisms from soil showed that peptone-dextrose-rose bengal-streptomycin agar for fungi, glycerol agar for actinomycetes, and Thornton's manitol-asparagin agar for bacteria were best for isolating these groups from Alabama soils. A screening program was begun to find microorganisms antagonistic to *Sclerotium rolfsii*. Soil samples were taken from plots of white clover, red clover, alfalfa, and fescue that had been receiving high and low levels of irrigation. The average number of fungi per gram of soil did not vary significantly between the two levels of irrigation. None of 506 fungal isolates tested exhibited true inhibition of *S. rolfsii* in culture. More actinomycetes were obtained from high-level than low-level irrigated plots, the greatest number being taken from fescue and alfalfa soils. Only 1 of 652 actinomycete isolates showed antagonism. A much greater number of bacteria were obtained from high-level irrigated

crops, particularly from white clover soil. Twenty per cent of the bacterial isolates from high-level and 22 per cent from low-level irrigation were antagonistic to *S. rolfsii*. However, only a few of the bacterial isolates exhibited enough inhibition in the laboratory to warrant further testing in the greenhouse. These isolates did not give significant control of the pathogen on soybean in either sterile or natural soil. Without concern for quantitative determinations of microorganisms, other soil samples from a number of sources were processed for antagonists. A species of *Trichoderma* was found to be extremely antagonistic to *S. rolfsii*. This fungus is being studied further for its ability to control root diseases.

**Causes of Variability in the Activity of Herbicides:** (1) TEMPERATURE AND RAINFALL STUDIES ON DNBP AND CIPC. (D. E. Davis and H. H. Funderburk, Jr.)—Greenhouse experiments were conducted to determine effects of temperature and rainfall on the phytotoxicity of pre-emergence applications of the alkanolamine salts of dinitro-o-secondary butyl phenol (DNBP) and isopropyl N(3-chlorophenyl) carbamate (CIPC). DNBP consistently gave better weed control than CIPC when no surface moisture was applied. When surface moisture was applied, CIPC gave better control of crabgrass, *Digitaria* spp., and less control of Florida pusley, *Richardia scarabra*, than DNBP. At high soil temperatures DNBP was more toxic to cotton than CIPC.

(2) EFFECTS OF THE ANATOMY AND/OR PHYSIOLOGY OF PLANTS ON THEIR SUSCEPTIBILITY TO KILLING BY DNBP. (D. E. Davis and H. H. Funderburk, Jr.)—Effects of the anatomy and/or physiology of plants on their susceptibility to killing by DNBP were investigated with the following crops: Cotton, oats, soybeans, grain sorghum, English peas, corn, snap beans, and peanuts. These plants had (1) elon-

gating and non-elongating hypocotyls, (2) broad and linear leaves, (3) coleoptiles and no coleoptiles, (4) waxy and non-waxy leaves, and (5) various seed sizes. Significant differences (at the 5 per cent level) of crop susceptibility to killing by a pre-emergence application of DNBP follow: Cotton = oats = soybeans > grain sorghum > English peas = corn = snap beans > peanuts. Differences in susceptibility were not correlated apparently with any factor except seed size. In general, larger-seeded species were more resistant than the smaller ones. The crops had approximately the same relative differences in susceptibility to vapor of DNBP as to a pre-emergence application of the chemical, but the effects were quite different on the above-ground plant organs.

**Factors Affecting the Development and Control of Gummy Stem Blight of Cucurbits.** (U. L. Diener.) — Silver nitrate (1-10,000) and Clorox (1.3 to 5 per cent Cl) excelled as surface disinfectants of watermelon seed. Field plantings of watermelon seed, which had been extracted and inoculated in 1955 with cultures of the fungus, *Mycosphaerella melonis*, failed to develop the gummy stem blight disease. These results concurred with greenhouse data, which indicated that the organism was avirulent. However, the organism could not be killed in 25 to 30 per cent of the inoculated seed with a 5-minute soak of full strength Clorox, indicating deep penetration of the seed or seed coat by the fungus. Methods were developed for inoculating watermelon fruit, stems, and vines, making aseptic extractions and seed inoculations, germinating seed and growing seedlings aseptically for several weeks, preparing large quantities of inoculum, and conducting greenhouse inoculations of plants. Cultures of the fungus collected in 1956 were found to be pathogenic on both cantaloupe and watermelon in

greenhouse inoculations. A long-range study on maintenance of pathogenicity of *M. melonis* in culture was begun. Fungicide and fermentation treatments were made on sublots of seed inoculated with pathogenic cultures in 1956. Other sublots were fixed for histological studies. Data on over-wintering of the organism in soil were inconclusive.

**Relationship of Microflora to Deterioration of Stored Seed.** (U. L. Diener.) — The predominant fungi isolated from stored peanut seed were found to be in the *Aspergillus glaucus* group, *A. flavus-oryzae* group (*A. tamarii*), *A. terreus* group, *Penicillium* (2 species), and *Cladosporium*. Other fungi identified were *Rhizopus* sp., *Mucor* sp., *Cunninghamella* sp., *Diplodia* sp., *A. niger* group, *Penicillium* sp., and *Fusarium* sp. A method was developed for making quantitative determinations of mold populations. Peanut samples of 20 to 50 gm. were ground in a food chopper and 10 gm. were then homogenized in a Bodine centrifugal wet mill. Dilution plate series were prepared using a 7.5 per cent salt-2 per cent malt-2 per cent agar medium. Three or 4 dilutions with 3 plates per dilution were used in the procedure. Mold colonies were counted after 4 days incubation at 25°C. with the aid of a stereoscopic microscope (10×). It was found that on the average 2 or 3 dates or repeats would be required to obtain statistical differences within 40 per cent of the mean.

**Cause and Control of Collar Rot of Peanuts.** (J. A. Lyle.) — Experiments were conducted to determine the cause of collar rot disease complex of peanuts. Fungi isolated from diseased plants were: *Sclerotium rolfsii*, *S. bataticola*, and species of *Diplodia* (tentatively identified as *D. theobromae*, *Fusarium*, and *Rhizoctonia*). Inoculations of peanut seedlings with these fungi with and without nematodes, primarily northern

root knot nematode, *Meloidogyne hapla*, failed to reproduce the disease under greenhouse and laboratory conditions. Associative effects of these fungi were studied in the laboratory.

Field tests were established for the control of collar rot in 2- and 4-year crop rotation plus soil nematocide experiments. In the former test, the following results were obtained in the soil nematocide treatments: (1) significant yield increases of peanuts, oats, and grain sorghum, (2) increased growth measurements of peanuts, and (3) decreased nematode populations. In the latter experiment, the following results were obtained from soil nematocide treatments: (1) significant yield increases of Dixie and early runner peanuts, and grain sorghum, (2) increased growth measurements of peanuts, and (3) decreased nematode populations. In the 4-year rotation experiment, no significant differences were obtained between treatments in plant stands, collar rot and root-knot indices of peanuts, and yield of oats, soybeans, and wheat.

#### Plant Disease Survey and Exploration:

(1) **SMALL GRAIN DISEASES.** (J. A. Lyle.) — An evaluation was made of the incidence of diseases that attack small grain varieties at 16 locations within the State. Rust and smut collections were obtained for race identification at each location. Systematic clipping (simulated grazing) of all varieties resulted in decreased disease incidence. Lodging in all varieties was also less prevalent in the clipped plots.

(2) **OAT AND RESCUEGRASS SEED DISEASE CONTROL.** (J. A. Lyle.) — Experiments were conducted with chemical seed protectants to evaluate their effectiveness in control of seed- and soil-borne diseases of oats, *Helminthosporium victoriae* in particular, and of rescuegrass, *Ustilago bullata* especially. Significant increases were obtained in emergence, green forage, and grain

yields from use of seed protectants on oats. Agrox, Ceresan M, and Panogen were the most effective treatments used in disease control. Significant stand increases and smut decreases were obtained with use of Agrox and Ceresan M on rescuegrass seed.

(3) **SOIL-BORNE PEANUT DISEASE CONTROL.** (J. A. Lyle.) — Experiments were conducted to determine the effectiveness of soil treatments for control of soil-borne diseases of peanuts. Three nematocides, Dowfume W-85, Fumazone, and Telone, were effective in controlling nematodes and the collar rot disease. Effectiveness in disease control was determined by (1) reduction in pathogenic nematodes and collar rot infested plants, and (2) increased yields.

(4) **PEANUT SEED DISEASE CONTROL.** (J. A. Lyle.) — Tests were conducted to evaluate the effectiveness of chemical seed protectants in the control of seed- and soil-borne diseases of peanuts. Arasan, 2 per cent Ceresan, Delsan A-D, Metasan E, and Metasan M were most effective in disease control as measured by (1) greenhouse and field emergence increases, and (2) laboratory germination and isolation tests.

(5) **VEGETABLE DISEASE CONTROL.** (U. L. Diener.) — Terraclor fungicide was effective in reducing losses of pepper from southern blight caused by *Sclerotium rolfsii*, when applied as a setting water treatment at two locations in Alabama in 1956. Terraclor was used at the rate of 4 pounds (wettable powder containing 75 per cent pentachloronitrobenzene) per 100 gallons of setting water. About  $\frac{1}{4}$  to  $\frac{1}{2}$  quart of solution was applied to the base of each plant. Losses at the Chilton Area Horticulture Substation, Clanton, and the North Alabama Horticulture Substation, Cullman, were reduced from 69.4 and 14.4 per cent to 34.1

and 7.0 per cent, respectively, in 65-plant plots replicated 5 times.

Sweetpotato mosaic was found for the first time in Alabama in August, 1956. This virus disease is potentially a serious menace to sweetpotato production. The disease was observed in Cullman County in an uncertified field of sweetpotatoes and its corresponding seedbed. The grower had purchased diseased roots of the variety, Georgia Red, at a Birmingham market for table use and later decided to use them for seed.

**Processing and Storing of Seed, Grain, and Hay.** (H. S. Ward, Jr.) — The hygroscopic equilibrium curve was established for white clover seed by the method of saturated salt solutions. The curve was of the sigmoid type as was shown previously with seed of blue lupine, crimson clover, lespedeza sericea, watermelon, and fescue. Safe storage moisture content was 8.7 per cent, based on the curve and germination behavior. The percentage of hard seed was increased with decreasing seed moisture.

Corn grain of 13.4, 8.8, 5.3, and 2.4 per cent moisture contents were stored for 1 year at 76°, 86°, 95°, 99°, 104°, and 122°F. To prevent a decrease in viability, moisture content of the grain must be at 2.4 per cent at 122°F., at 5.3 per cent at 104°F., and at 8.8 per cent from 99° to 76°F. Grain at 13.4 per cent moisture content had a complete loss in viability at all temperatures.

The rates of decrease in viability and increase in free fatty acids in peanuts during storage was shown to be related to initial quality. An initial combination of kernel moistures above 10 per cent and damage of 3 per cent caused low viability and high free fatty acids in peanuts stored for 1 year. Damage of more than 1 per cent was caused by a curing environment of more than 1 rain in combination with maximum temperatures above 90°F.

In contrast to the hydrolytic (fatty acids) and biological changes (viability) that were shown to occur in stored peanuts, autoxidation of the lipid fraction was not demonstrated by the Kreis test. Neither initial high kernel moisture contents nor high damage caused changes in Kreis test values.

Taste test evaluation of roasted peanut samples from various lots of artificially dried peanuts showed that desirable flavor and aroma were lost by rapid drying from initial kernel moistures of 20 per cent or higher at temperatures above 100°F. The total sugars and carbonyl contents did not differ as a result of the various artificial drying treatments. Therefore, the sugar and carbonyl fractions of the peanut kernel could not be related to the loss of desirable flavor and aroma in artificially dried peanuts.

**The Market Value of Peanuts as Affected by Changes in Chemical and Physical Properties During Storage.** (H. S. Ward, Jr.) — The use of 2,3,5-triphenyl-tetrazolium chloride (TTC) as a quick test of peanut quality was studied. The degree of staining of embryonic tissue by TTC was assumed to be related to viability, since viability might be correlated with flavor and other properties that characterize peanuts of high market value. Results showed that the TTC standard test was not correlated with viability as determined in a germinator and by field emergence. Failure to obtain a correlation was related to variations in pH and moisture content of the embryonic tissue. A split-embryonic axis technique showed no specific relation between degree of TTC staining of one half and growth of the other half of the embryo.

Chemical analysis of peanut kernels with concealed damage showed that damaged kernels were higher in free fatty acids, total organic acids, and thiobarbituric acid values, while tocopherol content was decreased. High free fatty acids were associated with

off-color of the oil. Lots of peanuts that graded 2 per cent damage or higher had lower market value because

of off-color oil and undesirable flavor and aroma associated with chemical changes in the damaged kernels.

## DAIRY HUSBANDRY

**Johnsongrass and Coastal Bermudagrass Hays for Dairy Cows.** (George E. Hawkins.)—The study reported here was conducted to determine the relative consumption of Johnsongrass and Coastal Bermudagrass hays and to measure the value of nutrients from these hays in milk production.

Fifteen milking cows were fed a ration of chopped alfalfa hay and a concentrate for 2 weeks. At the end of this standardization period, the cows were divided into three similar groups. The three test rations were: (A) alfalfa hay and concentrate, (B) Johnsongrass hay and concentrate, and (C) Coastal Bermudagrass hay and concentrate. Hay allowances remained the same as during the standardization period. When hay allowances were not consumed in full, the concentrate allowance was increased to keep the TDN (total digestible nutrient) intake constant. The TDN and digestible protein contents of the experimental forages, in percentages, were: alfalfa hay, 52.2 and 11.2; Johnsongrass hay, 58.9 and 8.6; and Coastal Bermudagrass hay, 50.0 and 9.0, respectively.

The average daily production of 4 per cent FCM (fat corrected milk) by roughage groups was: (A) 23.0, (B) 20.8, and (C) 21.6. Average daily hay intakes in pounds per cow by ration groups for the standardization and the experimental periods were: (A) 20.9 and 20.7, (B) 21.6 and 19.1, and (C) 20.0 and 18.9. Weight changes within diet groups varied. The lowest producing cow on ration A gained 67 pounds during the 28-day experimental period, whereas the average change in body weight for the other 4 cows on this ra-

tion was 49 pounds. Average weight gains of cows on Johnsongrass and Coastal Bermudagrass hays were 23 and 28 pounds, respectively. The relationship between weight gains and milk production was essentially linear. That is, the amount of gain in body weight was greatest for cows that showed the greatest drop in milk production.

Results of this study show that the consumption of Johnsongrass and Coastal Bermudagrass hays was less than that of alfalfa hay. Also, nutrients from alfalfa hay were superior to those from the grass hays as measured by milk production.

**Reed Canarygrass as a Source of Roughage for Dairy Cows.** (George E. Hawkins.)—A series of tests were conducted to determine the nutritive and digestive qualities of reed canarygrass grown in Alabama. Results of studies in Northern States indicate that this forage is not well liked by cattle.

Reed canarygrass grown near Tallassee, Alabama, during the winter of 1955 was tested by two digestion trials and a feeding experiment begun March 14, 1955. The green forage, which was between 4 and 12 inches high, was cut between 6 and 7 a.m. every second day and refrigerated at 30°F. until fed. The TDN content of the forage averaged 72.2 per cent and digestible protein, 21.9 per cent on a moisture-free basis. Average chemical composition of the green forage, moisture free basis, in percentage, was: ether extract (crude fat), 3.0; crude fiber, 21.7; crude protein, 24.3; and ash, 11.8.

The 12 Jersey cows used in the feed-

ing experiment had received 20 pounds of peanut hay daily as the only roughage during the 2 weeks preceeding this test. Concentrates were added to balance the rations. During the 2-week feeding experiment, cows receiving roughage nutrients as 4- to 12-inch-high reed canarygrass produced an average of 21.1 pounds of 4 per cent FCM, whereas those on peanut hay produced an average of 21.3 pounds of 4 per cent FCM. Most cows refused some of the reed canarygrass during the first 2 or 3 days only. One cow, however, continued to refuse approximately 50 per cent of the amount fed. Extra concentrates were fed when reed canarygrass was refused.

**Evaluation of Certain Cool Season and Certain Warm Season Perennial Grasses as Feeds for Dairy Cattle.** (G. H. Rollins and W. R. Langford.)—Grazing trials with lactating cows are in progress at the North Auburn Dairy Research Unit. The objectives are to evaluate certain forage species in pure stands with and without irrigation from the standpoint of milk production, and their relative yield of total digestible nutrients per acre.

Coastal Bermudagrass, Dallisgrass, and Pensacola Bahiagrass, termed warm season grasses, were planted in 1½-acre paddocks on prepared seedbed in the spring of 1955. The split-plot randomized block design with three replications was used. Reed canarygrass, tall fescue, and orchardgrass, termed cool season grasses, were similarly established by planting in the fall of 1955. Annual applications of 1,000 pounds of 0-12-20 and 200 pounds of nitrogen were constant for all paddocks.

One year's results revealed no significant differences between lactation responses of cows pasturing Coastal Bermudagrass, Dallisgrass, and Bahiagrass. No significant differences resulted from the irrigation treatment; however, rain-

fall distribution eliminated any prolonged effect of dry weather. The total digestible nutrient yields per acre were not significantly different. Stands of these forage species appeared to be excellent at termination of the first year's grazing.

Sufficient data for analyses were not obtained for the cool season grasses. A high percentage of the orchardgrass stands died during the summer and fall following establishment. Sparse stands of reed canarygrass resulted on several paddocks.

Observations noted are: Cows confined to reed canarygrass pastures consumed all foreign plants within the paddock and as far outside the fence as they could reach before grazing reed canarygrass. Milk production of these cows showed an extremely abnormal decline during early part of the experiment, but declined less rapidly as the cows were forced to consume reed canarygrass. After heavy frost, the cows consumed this forage more readily and increased slightly in milk production. First year fescue was consumed by lactating cows without any noted ill effects.

**Galactopoietic Substances in Forage Crops and Other Feeds. II. Soybean and Cottonseed Meals.** (George E. Hawkins.)—Some reports indicate that cows grazing grasses containing estrogenic activity show moderate increases in milk production and in percentage of non-fatty solids, thus suggesting a relationship between lactation response and estrogenic activity. This study was originated to compare the effects on lactation of soybean meal, which reportedly has a high estsogenic potency; with cottonseed meal, another protein supplement; and with a conventional dairy concentrate.

The study involved 25 cows that were divided into 5 similar groups. The ration variables and the percentage of TDN intake supplied by each were: (A) alfalfa hay, 72, and concentrate,

28; (B) alfalfa hay, 71, and cottonseed meal, 29; (C) alfalfa hay, 74, and soybean meal, 26; (D) Johnsongrass hay, 68 and cottonseed meal, 32; and (E) Johnsongrass hay, 64, and soybean meal, 36. There was no increase in uteri weight of mice when fed alcoholic extracts from the concentrate mixture, soybean meal, alfalfa hay, or Johnsongrass hay. Cottonseed meal alone supplied estrogenic activity equal to 0.0042  $\mu\text{g}$ . of diethylstilbestrol per gm. of feed. It is surprising, therefore, that the concentrate mixture that included 40 per cent cottonseed meal did not show estrogenic activity. Persistency of milk yield in per cent by dietary groups was: (A) 103, (B) 92, (C) 92, (D) 87, and (E) 84. Relationship between milk production response to cottonseed and soybean meals was similar on both hays. However, production was less when these protein supplements were the only concentrate than when a concentrate mixture was fed. Nutrients from cottonseed meal, the feed that showed the greatest estrogenic activity by the mice uteri assay, was similar to nutrients from soybean meal and somewhat inferior to nutrients from a concentrate mixture for milk production.

**Sericea Supplemented with Urea for Growing Calves.** (George E. Hawkins and K. M. Autrey) — Results of a previous study showed cottonseed meal to be a good supplement to sericea hay for growing calves. Urea, a non-energy yielding compound, has been used successfully to replace part of the protein in rations for ruminants. The study reported here was made to evaluate urea as protein replacement for growing calves fed sericea hay.

Twelve healthy male calves, 28 days of age, were assigned to three experimental rations as follows: (AH) alfalfa hay and concentrate, (SH) sericea hay and concentrate, and (SHU) sericea hay supplemented with 11.7 gms.

of urea per pound and concentrate. Feeding and managing the calves was similar to that followed during the study in which cottonseed meal was used as the supplement, except that the concentrate allowance was 3 pounds instead of 2 pounds daily.

During the period from 29 to 185 days of age, the average daily weight gains, in pounds, by ration groups were: (AH) 1.14, (SH) 0.93, and (SHU) 0.94. The concentrate supplied a relatively high percentage of the nutrient intake of the calves prior to 185 days of age. During the subsequent period, beginning with 186 and extending to 300 days of age, the average daily gains of calves on all diets dropped. Only 1 pound of corn was fed daily during this period. The daily rate of gains in pounds by dietary groups were: (AH) 0.94, (SH) 0.53, and (SHU) 0.49. During the first and second periods, respectively, the TDN requirements per pound of gain in body weight, in pounds, by ration groups were: (AH) 2.8 and 5.2, (SH) 3.2 and 7.7, and (SHU) 3.2 and 9.0.

Urea had no value as a protein substitute for sericea hay when fed to calves. Diet SH supplied from 59 to 93 per cent of the recommended allowance of digestible protein and the "digestible protein equivalent" supplied by diet SHU was 97 to 123 per cent of the recommended allowance. Considering the shortage of digestible protein in diet SH, a growth response was expected on the urea supplemented sericea. The absence of a growth response to urea supplementation suggests that the urea was not converted to amino acids by rumen microorganisms.

**Urea Supplementation of Sericea for Milking Dairy Cows.** (George E. Hawkins and K. M. Autrey.) — Fifteen dairy cows fed the same ration for 2 weeks were selected for the experiment and assigned at random to the test rations. They had passed their peak in milk

production. The roughages fed were (AH) alfalfa hay, (SH) sericea hay, and (SHU) sericea hay plus urea. In addition, the cows were fed enough of a 16 per cent protein concentrate mixture to balance the ration for TDN intake. These rations are similar to those fed to calves in a growth study.

During the experimental period, the average daily 4 per cent FCM yields in pounds by roughage groups were: (AH) 27.9, (SH) 22.7, and (SHU) 22.5. Thus, urea had no beneficial effect on milk production of cows fed sericea. Sericea was not a highly productive roughage when it supplied between 40 and 60 per cent of the TDN intake. Statistical studies indicate that energy from sericea was not equal to that from other feeds for milk production.

Digestibility studies made at the beginning and end of the feeding experiment revealed that the digestible protein content varied between 4.34 and 6.96 per cent. Hay with 4.34 per cent digestible protein was fed during the early part of the feeding experiment. Hay with the low digestible protein content supplied insufficient digestible protein to maintain milk at the pre-experimental level of production.

**Johnsongrass, Millet, and Sudangrass Pastures.** (W. B. Kelley, L. A. Smith, and George E. Hawkins.)—This study was conducted 28 days to characterize the nutritive qualities of immature Johnsongrass, Starr millet, and sweet sudangrass pastures for milking cows. Three similar groups of 6 cows each were assigned to the three pastures supplying 4.25 acres of each forage. In addition to the pasture, the cows received 1 pound of concentrate for each 5 pounds of 4 per cent FCM. Digestibility of the forage was not measured. However, crude protein, ether extract, crude fiber, nitrogen-free extract, cellulose, and ash contents were determined and the results indi-

cated that all forages were high in quality. During the experiment, the average weekly 4 per cent FCM yields of the cows in pounds per pasture group were: Johnsongrass, 153.4; millet, 153.9; and Sudangrass, 160.8. Average daily milk yields for cows turned on Sudangrass increased during the first week, whereas those of cows on other pastures showed a decline. Cows on Sudangrass gained weight, whereas those on Johnsongrass and millet lost weight. These weight changes indicate that the nutrient intake of cows grazing Johnsongrass and millet was inadequate. There was a sufficient amount of millet available, but the Johnsongrass pasture was short.

**Freshly Clipped Johnsongrass, Starr Millet, and Sweet Sudangrass for Milking Cows.** (George E. Hawkins.)—A study was made to determine the nutritive qualities of Johnsongrass, Starr millet, and sweet Sudangrass for dairy cows in production. All three grasses are members of the same grass family.

Three similar groups of 5 cows were assigned to the experimental forages, which were in the pre-bloom to early bloom stage of maturity at the beginning and in the milk to dough stage at the end of the experiment. Average TDN and digestible protein contents of the forages in per cent, dry matter basis, were: Johnsongrass, 73 and 13.2; millet, 63 and 10.4; and Sudangrass, 58 and 11.4.

Daily milk production of cows in pounds by forage groups were: Johnsongrass, 26.0; millet, 24.0; and Sudangrass, 26.3. Average daily changes in body weight, in pounds, were: Johnsongrass, 2.7; millet, -0.1; and Sudangrass, 1.4. Differences in milk production and in changes in body weight between roughage groups were related to the amount of forage eaten. Utilization of nutrients consumed was similar for all roughage groups.

**Comparison of Freshly Cut Alfalfa, Oats, Crimson Clover, and Subterranean Clover for Dairy Cows.** (George E. Hawkins.)

— This experiment, to determine relationship between estrogenic potency of the forage and milk production, involved 15 dairy cows. The experimental rations follow: (A) alfalfa hay, (B) green alfalfa plus alfalfa hay, (C) green oat forage plus alfalfa hay, (D) green crimson clover plus alfalfa hay, and (E) green subterranean clover plus alfalfa hay. Cows in groups B, C, D, and E received 50 per cent as much hay as they ate before the experiment plus 50 pounds of green forage. In addition, each cow in all groups was fed 4 pounds of ground shelled corn daily.

The TDN and digestible protein contents of the experimental roughage in per cent on dry matter basis were: alfalfa hay, 60 and 10.0; green alfalfa, 67 and 20.5; green oats, 71 and 9.0; green crimson clover, 72 and 14.0; and green subterranean clover, 59 and 13.3.

Estrogenic potency of the forages was measured by the mouse uterus assay by adding alcoholic extracts of the forages to a basal diet with low estrogenic potency. Weights of uteri, in mg., from mice fed the experimental forages were: alfalfa hay, 6.1; green alfalfa, 11.5; green oats, 3.6; green crimson clover, 8.9; and green subterranean clover, 13.1. Uteri weights from mice fed the basal diet and the basal diet supplemented with 0.04  $\mu\text{g}$ . of diethylstilbestrol per gm. of diet were 3.5 and 22.1 mg. respectively.

Persistency of milk production, in per cent, on the five rations was: (A) 100, (B) 116, (C) 121, (D) 105, and (E) 103. There was no consistent relationship between the estrogenic potency of the forages and the persistency of milk yield.

**Tracy Sorghum Silage and Johnsongrass Hay for Dairy Cows.** (W. B. Kelley, L. A. Smith, and George E. Hawkins.) —

An experiment with 24 milking cows was done to evaluate Johnsongrass hay and Tracy sorghum as roughages for dairy cows. The rations tested were: (A) alfalfa hay, (B) Johnsongrass hay and Tracy sorghum silage, and (C) Johnsongrass hay. Concentrates were fed at the rate of 1 pound to each 3 pounds of milk produced.

The TDN and digestible protein contents of the forages in per cent on dry matter basis were: alfalfa, 58 and 14.9; Johnsongrass, 65 and 7.4; and Tracy sorghum, 46 and 0, respectively. The intakes of hay or hay equivalent in pounds per 100 pounds of body weight by roughage groups were: (A) 2.55, (B) 2.10, and (C) 2.34.

Average daily milk production in pounds by forage groups were: (A) 27.6, (B) 25.8, and (C) 26.8. Ration B apparently supplied an inadequate amount of digestible protein.

**Effect of Feeding Low Levels of Diethylstilbestrol on Established Lactation in Dairy Cows.** (George E. Hawkins and K. M. Autrey.) — Milk production often increases when cows are changed from barn feeding to grazing. It has been suggested that the lactation-stimulating qualities of young pastures may be related to their estrogen content. Diethylstilbestrol, a synthetic compound, has estrogenic activity. This study was designed to determine the response of milking cows to low levels of diethylstilbestrol in the ration.

Fifteen dairy cows were standardized on alfalfa hay and concentrate with low estrogenic potency. At the beginning of the 28-day experiment, the cows were divided into three similar groups. Each group received the same feeds as during the standardization period. The amounts of diethylstilbestrol added per pound of feed for the three groups were: (A) none, (B) 0.068  $\mu\text{g}$ ., and (C) 3.40  $\mu\text{g}$ .. These levels provided estrogenic activity

within the range of that normally found in green forages.

There were no differences among the groups in level of milk produced nor in percentage of non-fat solids in milk. Body weight changes and use of available TDN by the cows were similar for all groups. These results indicate that increases in milk production when cows are changed from dry feed to pasture are not related to the estrogenic activity of the feeds.

**Rabbit as a Pilot Animal in Sericea Improvement.** (George E. Hawkins.) — A consistent relationship between digestibility of crude protein in lawn clippings by rabbits and steers has been reported. Consequently the rabbit appeared to be the logical pilot animal in a sericea breeding program having the objective of improving digestibility of the nutrients in sericea. To determine whether the rabbit may be used as the pilot animal for this work, a study was made to compare steers and rabbits in ability to digest the nutrients of sericea and of alfalfa.

There was no consistency in apparent digestion coefficients of steers and rabbits when alfalfa, and first and second cuttings of sericea were considered. However, rabbits digested about half as much crude protein and a third as much crude fiber and cellulose in sericea as did the steers. When digestibility of dry matter was used as a co-variable, the relationship between steer

and rabbit digestion coefficients for crude protein were similar for all the hays studied. It appears that the rabbit may be used as a pilot animal in assessing the relative digestibility of crude protein of sericea.

**Nutritive Characteristics of Several Inbred Lines of Sericea as Measured by Rabbits.** (George E. Hawkins and E. D. Donnelly.) — Nutritive qualities of forage from 31 inbred lines of sericea that had been studied in the field for stem type and leafiness were evaluated by digestion trials with rabbits. Mean intakes of dry matter of diets containing 45 per cent of these lines varied from 33.4 to 51.6 gm. per rabbit per day, which differences were significant.

Digestibility of dry matter in the diets ranged from 39.2 to 58.5 per cent. Percentage digestibility of protein in the sericea lines showed a wide range. The number of lines within given ranges were: (a) 1 over 60, (b) 5 between 51 and 60, (c) 14 between 41 and 50, (d) 6 between 31 and 40, (e) 3 between 21 and 30, and (f) 2 less than 20. Relationship between digestibility of dry matter by cattle and rabbits was inconsistent; however, the relationship between digestibility of protein by these animal species was consistent. Thus, these data suggest that it is possible to develop a new strain in which the digestible protein content would be higher than in present commercial strains.

## FORESTRY

**Intensive Woodlot Management in the Alabama Piedmont.** (G. I. Garin.) — Higher stumpage prices paid woodlot owners during the last decade have increased the value of farm woodlots. By application of management practices, the growing stock can be manipulated to increase returns from a wood-

lot. Pine stumpage brings a better price since it is in greater demand than hardwood stumpage. Therefore, woodlots should be managed with the view of growing as much pine as feasible.

An experiment forest located in Coosa County is typical of woodlot conditions in the Piedmont region of

Alabama. The topography is steep and pines are found on the tops of the hills, while hardwoods are predominant in the narrow bottoms near small streams. Between these extremes, a mixed pine-hardwood stand is found on the slopes. A study was made comparing diameter-limit cut with a cut leaving the best trees as growing stock. One-half of the study area was cut to a 9-inch diameter limit and the other half was marked before it was logged. Shortleaf pine was heavily infected with littleleaf disease. This species was marked for a heavy cut. Eighty per cent of the pine stand was removed on marked areas. Hardwoods in the 9-inch diameter class and larger were cut only if they were merchantable. The cut left considerably more hardwood than was anticipated.

After 5 years an inventory was made of trees in the 9-inch diameter class and larger. Results show that in the pine type, cut to a diameter limit, ingrowth of pine was considerable. The pine component of the stand was reduced from 73 per cent before cutting to 54 per cent 5 years later. Where pines were marked for cutting, they constituted 70 per cent of the stand before it was cut and 60 per cent 5 years later. Cutting to a diameter limit is less desirable for maintaining the pine component than leaving healthy pine trees in a marked stand. If the area marked had not been affected by littleleaf disease, the results would have favored this method even more in comparison to cutting to a diameter limit.

Cutting to a diameter limit and cutting marked trees in a mixed stand produced the same results. In both cases, the pine component was reduced by about 8 per cent, 5 years after cutting. It was initially reduced from 40 per cent to 32 per cent on an average.

Method of cutting in the hardwood type produced the same results. The pine component was, however, reduced by 17 per cent. The proportion of pine

in the hardwood type, which was only 23 per cent before it was cut, was reduced to 6 per cent. In the hardwood type, management practices would have to be oriented toward growing the better hardwoods. This portion of the woodlot can be best utilized by striving to grow a stand of hardwoods composed of species well adapted to the site. Good hardwood species grown to optimum merchantable size will produce good returns if they are of good quality.

**All-Aged Management by the Selection System.** (H. E. Christen.) — During the 5-year period, 1952-56, the sawtimber growth on a 2.1-acre tract of the Auburn management area totaled 2,868 board feet, International ¼-inch scale. Each acre produced 1,366 board feet during the period or a growth of 273 board feet annually. This growth was added to a residual stand that averaged 4,574 board feet per acre during the period. On the basis of this residual stand, rate of growth was 6 per cent.

Mortality for the period on this intensively managed area accounted for loss of 45 trees or 21.4 trees per acre. Most of the trees that died were in the merchantable size classes, thus indicating that generally mortality can be kept very low on intensively managed areas.

Although periodic annual growth on the area appears to be adequate, growth per cent earned on the growing stock is high and mortality is low, there is a very noticeable lack of reproduction in the openings made by the harvest cuts. Future plans call for trying direct seeding in the openings in an effort to obtain adequate reproduction.

**Corner-Joints in Wood.** (D. B. Richards.) — Glued corner-joints with longitudinal axis of all members lying in one plane have been studied. Two bending tests have been developed, one

that loads the inner corner of such a joint in tension and another that loads the inner corner in compression. Appropriate mathematical analysis allows a modulus of rupture to be calculated for such joints.

Of the joints tested, two showed considerable promise: (1) a multiple mortise and tenon joint that had in each member multiple parallel faced tongues about  $\frac{3}{8}$ -inch thick separated by similar grooves, the tongues of one member being glued into the matching grooves of the other; (2) a wedge-tongue joint that had in each member multiple wedge-shaped tongues separated by wedge shaped grooves, the tips of the tongues being cut at a miter angle to each member and the tongues of one member being glued into the matching grooves of the other member.

The multiple mortise and tenon joint is difficult to assemble in pieces wider than 3 inches. The wedge-tongue joint must be cut with a special cutterhead and requires careful clamping techniques during assembly and cure. With members between  $2\frac{1}{2}$  and  $3\frac{1}{2}$  inches wide, these joints yield modulus of rupture values that average between 5,500 and 9,000 pounds per square inch in southern pine lumber. These values indicate that about 50 per cent of the bending strength of the wood is being developed at the joint.

**Physical and Chemical Characteristics of Loblolly Pine Seedlings Associated With Drought Resistance.** (A. R. Gilmore.) — The objective of this study was to determine whether transpiration or accumulation of various nutrient elements in different parts of a loblolly pine seedling could be correlated with the ability of the seedling to survive under extremely dry conditions.

The transpiration study showed that the more drought-resistant seedlings had a more efficient transpirational apparatus than the less drought-resistant seedlings. It appeared that the more

drought-resistant seedlings could absorb water almost as fast as they lost water even when the soil was at a low moisture content.

The amounts of nitrogen, potassium, phosphorus, thiamine (Vitamin B<sub>1</sub>), reducing sugars, or sucrose in the plant were not found to be correlated with drought resistance. The total carbohydrate content and the calcium content of the roots appeared to be associated with drought resistance. Roots of the more drought-resistant seedlings contained higher concentrations of both total carbohydrate and calcium.

These results suggest the possibility of developing laboratory tests to determine inherent drought resistance of seedlings.

**Evaluation of Site Quality for Longleaf Pine Using Aerial Photographic Evidence.**

(E. W. Johnson.) — The quality of the site, using the site index for longleaf pine, was determined on 59 sample plots in the pine hills area of the lower coastal plain of southern Alabama and northwestern Florida. A series of independent variables, chosen because of their possible relationship with site index and the fact that they could be evaluated on aerial photographs, were related to site index by both graphical and mathematical curve-fitting techniques. Of these variables only average tree height, per cent slope, and number of trees per acre were found to have value for prediction purposes. The multiple correlation coefficient was 0.598, indicating that the prediction equation was not very effective. The substitution of photogrammetrically determined values would probably reduce this value even more.

Attempts to use topographic classes as guides to site quality also yielded negative results.

One major conclusion resulted from this study. In this area it is very difficult, if not impossible, to evaluate the site index for longleaf pine from aerial photographic evidence.

**Effects of Certain Prescribed Fire Treatments and Hardwood Removal by Poisoning on Soil and Seedbed Properties in the Loblolly-Shortleaf Pine Type.** (Earl J. Hodgkins.) — The study involved testing two burning treatments and a hardwood poisoning treatment for effects on soil, forest floor, and vegetation properties at the Fayette Experiment Forest. Burning treatments consisted of August burning in 1951 and in 1954, and January burning in 1952 and in 1955. The hardwood poisoning treatment consisted of killing with ammonium sulfamate an average of 6.23 square feet of basal area per acre in hardwoods over 3 inches in diameter breast high.

The 1951-52 burnings, having 10 years of fuel accumulation, were hotter and caused greater changes than the 1954-55 repeat burnings. The August burnings reduced the forest floor more than the January burnings, and the second August burnings left a dangerously thin residual floor on some plots. However, normal autumn leaf fall apparently soon gave adequate protection to the mineral topsoil against damage from raindrop impact. Generally the loss of nitrogen, potassium, calcium, and phosphorus from the forest floor was in direct proportion to loss of the forest floor itself.

Burning raised the pH of the top 3 inches of mineral soil and added more potassium and calcium to it than the forest floor had lost. The gains were

presumed to have come from live vegetation killed by the fires. Available phosphate was increased, but only the repeat burnings appeared to have contributed the additions. Because the soils were extremely low in available phosphate, it was deduced that roots had absorbed additions made available by the 1951-52 burnings during the interval between the burnings and the measurements in 1953-54. Burning caused no change in total soil nitrogen, in soil organic matter, in soil infiltration rates, and in total porosity, macroporosity, and microporosity of the top 3 inches of mineral soil.

Legumes, composites, and euphorbs increased in density of cover in the first growing season after burning, but resumed normal growth thereafter. By middle of the third growing season, shrubs and vines increased, with January burning showing more increase than August burning. Hardwood cover 6 feet high and less was reduced by burning, but it was back to normal in the third growing season. Only August burning significantly reduced the cover of all vegetation more than 6 feet high. Grass cover may have been reduced the first season after burning, but subsequently it varied inversely with the total cover of trees, shrubs, and vines.

The only effect of hardwood poisoning seemed to be an increase of soil nitrogen and organic matter on ridges.

## HORTICULTURE

**Studies of Fertilizers, Organic Materials, and Culture for Vegetable Crops:** (1) EFFECT OF SOIL TYPE AND OF RATES OF FERTILIZER, MANURES, AND LIME ON YIELD OF CARROTS. (L. M. Ware and W. A. Johnson.) — Yields over a 4-year period show no great difference between response of carrots to fertilizer

or organic treatments on light and heavy soils. On Chesterfield loamy sand soil with 2,000 pounds of a complete fertilizer (6-8-8), yields were increased from 15,302 to 22,119 to 28,906 pounds per acre as rate of manure was increased from 0 to 12 to 24 tons per acre. On a Cecil clay soil, correspond-

ing yields were 15,509, 21,640, and 27,207 pounds per acre.

On the Chesterfield soil with 2,000 pounds of fertilizer and 24 tons of manure, yields were 28,906, 32,985, and 32,175 pounds from use of 0, 1, and 2 tons of limestone per acre, respectively. Corresponding yields on the Cecil soil were 27,207, 28,747, and 30,336 pounds per acre.

No increase in yield resulted from increasing the fertilizer rate from 2,000 to 3,000 pounds per acre.

(2) EFFECTS OF SOIL TYPE AND RATES OF FERTILIZER, MANURE, AND LIME ON YIELD OF SPINACH. (L. M. Ware and W. A. Johnson.) — With 2,000 pounds of fertilizer (6-8-4) per acre, yields of spinach over a 4-year period were increased from 2,923 to 6,139 to 10,243 pounds per acre on a Chesterfield loamy sand as the rate of manure was increased from 0 to 12 to 24 tons per acre. On a Cecil clay soil, corresponding increases were from 1,747 to 5,808 to 8,232 pounds per acre.

On the Chesterfield soil with 2,000 pounds of fertilizer and 12 tons of manure, 1 ton of limestone increased yield from 6,139 to 7,661 pounds; on the Cecil clay soil, 1 ton of lime increased yields from 5,808 to 9,033 pounds per acre. With 2,000 pounds of fertilizer and 24 tons of manure applied to the Chesterfield soil, yields were 10,243 pounds without lime and 10,987 with 2 tons of lime; corresponding yields on the Cecil clay soil were 8,232 without lime and 11,074 pounds per acre with lime.

Yields were not increased from applications of fertilizer above 2,000 pounds per acre.

(3) EFFECT OF SOIL TYPE AND RATES OF FERTILIZER, MANURE, AND LIME ON YIELD OF BEETS. (L. M. Ware and W. A. Johnson.) — Beets gave a decidedly higher yield on a Cecil clay soil than

on a Chesterfield loamy sand from corresponding treatments.

With 2,000 pounds of fertilizer (6-8-4) per acre, yields over a 4-year period on the Chesterfield soil were increased from 4,569 to 9,355 to 16,954 pounds per acre and on the Cecil soil from 13,420 to 19,195 to 25,042 pounds as the rate of manure increased from 0 to 12 to 24 tons per acre.

One ton of limestone increased the yield on the Chesterfield soil from 9,355 to 10,939 pounds, but on the Cecil soil from 19,195 to 24,802 pounds per acre where 12 tons of manure per acre had been added. With 24 tons of manure, 1 ton of limestone increased yields on the Chesterfield from 16,954 to 18,356 pounds per acre and on the Cecil soil from 25,042 to 31,013 pounds per acre.

On the Chesterfield soil, after 2,000 pounds of fertilizer and 12 tons of manure had been added, an additional 12 tons of manure increased yields 7,599 pounds, while an addition of 1 ton of limestone instead of the 12 tons of manure increased yields 1,584 pounds. On the Cecil soil, the corresponding yield increase from the 12 tons of manure was 5,847 and from the limestone 5,607 pounds per acre.

(4) VALUE OF ORGANIC MATERIALS FOR ONIONS AT DIFFERENT FERTILIZER RATES. (L. M. Ware and W. A. Johnson.) — Yields of green onions in 1956 without manure were increased from 9,766 to 12,378 pounds per acre as the rate of fertilizer (6-8-8), was increased from 1,000 to 2,000 pounds per acre. After 2,000 pounds of fertilizer per acre was added, yields were increased none by 1,000 pounds of extra fertilizer, but increased 5,632 pounds by 4 tons per acre of dry sericea, 10,841 pounds by 20 tons of sawdust, 15,014 pounds by 24 tons of manure, and 20,275 pounds by 24 tons manure plus 20 tons of sawdust.

Organic material had been added

2 years prior to the onion crop and two intervening crops had been grown without further addition.

(5) EFFECT OF IRRIGATION AND ORGANIC MATERIALS ON RESPONSE OF POTATOES TO FERTILIZER RATES IN YEARS OF HIGH AND LOW RAINFALL. (L. M. Ware and W. A. Johnson).—In 1955, a year of favorable rainfall, increasing the rate of fertilizer (6-10-7) from 800 to 1,600 and from 1,600 to 2,400 pounds per acre resulted in yield increases of No. 1 potatoes of 34 and 67 bushels per acre with no organic matter and no irrigation added. Corresponding increases were 87 and 40 bushels where organic but no irrigation was added, 17 and 79 bushels where irrigation but no organic was added, and 154 and 87 bushels where both irrigation and organic materials were added.

In 1956, with low rainfall during the larger part of the growing season, the same increases in fertilizer rates resulted in yield increases of No. 1 potatoes of 8 and —5 bushels without organic materials and irrigation added; of —7 and 10 bushels with organic material but no irrigation added; of 102 and 28 bushels with irrigation but no organic material added; and of 90 and 80 bushels with both organic materials and irrigation added.

Spacing was 12 inches and size of seed piece was 1½ ounces in all comparisons. Yields in 1955 were from new growth after plants were killed by a freeze.

(6) EFFECT OF SIZE OF SEED PIECE ON YIELD OF POTATOES AFTER KILLING OF TOPS BY COLD AS INFLUENCED BY FERTILIZER RATE, ORGANIC MATERIAL, AND IRRIGATION. (L. M. Ware and W. A. Johnson).—Tops of potatoes were killed in 1955 after they were about two-thirds grown. With no irrigation and no organic materials, yields of No. 1 potatoes were increased 30, 29, and 112 bushels per acre from seed pieces

of ¾ to 1½ ounces when supplied with 800, 1,600, and 2,400 pounds of fertilizer (6-10-7), per acre, respectively. With 2,400 pounds of fertilizer, the larger seed pieces gave increased yield of 153 bushels with organic materials added; 89 bushels with irrigation added; and 146 bushels with both irrigation and organic materials added. With 2,400 pounds of fertilizer and 1½-ounce pieces, yields were 202 bushels with organic materials added; 187 bushels with irrigation added; and 396 bushels with both added.

(7) YIELD OF TOMATOES AS AFFECTED BY FERTILIZER RATE, ORGANIC MATERIALS, AND IRRIGATION. (L. M. Ware and W. A. Johnson).—The 2-year average yield of marketable tomatoes on soil receiving no treatment was 1,361 pounds per acre. One-thousand pounds of fertilizer (8-10-7) per acre increased yields to 24,571; addition of 12 tons of manure increased yields to 42,852, while further addition of irrigation increased yields to 49,257 pounds per acre.

Addition of 1,000 pounds of fertilizer, 12 tons of manure, and vetch gave a yield of 40,651 pounds per acre. Addition of irrigation increased yields to 55,458 pounds; increasing the fertilizer rate to 1,500 pounds per acre increased yields to 56,198 pounds; and increasing the fertilizer rate to 2,000 pounds increased yields to 59,586 pounds per acre.

Total yields in 1956 from 2,000 pounds of fertilizer and 12 tons of manure per acre in addition to irrigation and vetch was 83,803 pounds per acre.

(8) YIELD OF PIMENTO PEPPERS AS AFFECTED BY FERTILIZER RATE, ORGANIC MATERIALS, AND IRRIGATION. (L. M. Ware and W. A. Johnson).—The 3-year average yield of marketable pimento peppers from 600 pounds per acre of a base application of complete

fertilizer (4-10-7) was 5,782 pounds per acre without irrigation and 10,578 pounds with irrigation. Increasing the fertilizer rate to 1,200 pounds increased yields to 5,938 pounds without irrigation and to 12,966 pounds with irrigation.

Application of 1,200 pounds of fertilizer plus a side application of 64 pounds of nitrogen gave a yield of 9,324 pounds per acre without irrigation and 16,759 pounds with irrigation. Increasing the base application of complete fertilizer to 1,800 or to 2,400 pounds and increasing the side application of nitrogen to 96 pounds did not increase yield of marketable pimentos.

Yields of marketable pimento peppers from application of 1,200 pounds of complete fertilizer, plus side application of 96 pounds of nitrogen, plus 18 tons per acre of manure were 7,870 pounds without irrigation and 19,967 pounds with irrigation.

(9) EFFECT OF IRRIGATION ON NITRATE LEVELS IN SOILS RECEIVING DIFFERENT FERTILIZER RATES AND ORGANIC MATERIALS. (L. M. Ware and W. A. Johnson.) — Irrigation has frequently been found to lower nitrate content of soil. This could either be caused by increased uptake of nitrates from irrigated crops or to leaching of nitrate by irrigation. The 2-year average nitrate ( $\text{NO}_3$ ) content in the soil during the tomato-growing season under nonirrigated and irrigated conditions for otherwise identical treatments were as follows: (a) with 1,000 pounds of fertilizer (8-10-7) — without irrigation, 45 p.p.m., with irrigation, 31 p.p.m.; (b) with 1,000 pounds of fertilizer plus 12 tons manure — without irrigation, 88 p.p.m., with irrigation, 58 p.p.m.; (c) with 1,000 pounds of fertilizer plus 12 tons manure plus vetch — without irrigation, 131 p.p.m., with irrigation, 84 p.p.m.

During the latter part of the growing season of fall-grown green onions on November 3, 1955 the amounts of

nitrates found in the soil were as follows: (a) with 1,000 pounds of fertilizer (8-10-7) — without irrigation, 96 p.p.m., with irrigation, 36 p.p.m.; (b) with 1,000 pounds of fertilizer plus manure — without irrigation, 132 p.p.m., with irrigation, 28 p.p.m.; (c) with 1,000 pounds of fertilizer plus spring-turned vetch — without irrigation, 117 p.p.m., with irrigation, 19 p.p.m.

(10) IMMEDIATE AND RESIDUAL EFFECTS OF DIFFERENT ORGANIC MATERIALS OF YIELD OF FALL TURNIPS ON LIGHT AND HEAVY SOILS. (L. M. Ware and W. A. Johnson.) — Earlier studies showed little effect on yield from applications of organic materials for the first year, but indicated an increased effect in later years. In studies with different kinds of organic materials, fall-grown turnips following summer-turned crotalaria on a loamy sod showed a loss in yield the first year of 2,496 pounds per acre, but gave an increase of 15,916 pounds the second year and 11,232 pounds the third year. On a heavy clay soil, the crotalaria gave an increase in yield of 5,703 pounds per acre the first year, 12,481 pounds the second year, and 25,824 pounds the third year.

Vetch grown and turned with an intervening summer crop resulted in a loss of 3,322 pounds per acre in fall turnip yield the first year, but gave a gain of 23,788 pounds the second year and of 18,144 the third year on the light soil. On the heavy soil this treatment increased yield 5,991 pounds the first year, 19,546 the second year, and 21,120 pounds the third year.

(11) EFFECT OF LONG CONTINUED APPLICATIONS OF ORGANIC MATERIALS ON ORGANIC MATTER CONTENT OF THE SOIL. (W. A. Johnson and L. M. Ware.) — On a Chesterfield sandy loam soil low in organic matter, the organic content has been measurably increased by annual additions of organic materials

over a long period of time. In plots receiving only residues from horticultural crops from 1940 through 1955, the organic matter content of the first 6 inches of soil was increased from 0.72 per cent to 1.04 per cent in the 15-year period. For the same period of time the organic matter content of the soil increased from 0.74 to 1.36 per cent where a crop of vetch was turned, from 0.77 to 1.53 per cent where rye was turned, from 0.81 to 2.86 per cent where 12 tons of manure was added, and from 0.81 to 2.92 per cent where 12 tons of manure was added and a crop of vetch was turned.

(12) **EFFECT OF RATES OF FERTILIZER AND EXTRA NITROGEN AS SIDE APPLICATIONS ON POTASH CONTENT OF POTATOES.** (W. A. Johnson and L. M. Ware). — When potatoes were supplied 1,000, 1,500, and 2,000 pounds per acre of 6-8-8 grade fertilizer at planting time, the potash content was 0.49, 0.46, and 0.46 per cent for the tuber and 0.34, 0.32, and 0.42 per cent for the plant, respectively. When 1,000 pounds per acre of 6-8-8 grade fertilizer was applied at planting plus 1,000 pounds per acre applied as a side application 1 month later the percentages of potash were 0.49 for the tubers and 0.36 for the plants. However, when 1,000 pounds of 6-8-8 was applied at planting time and 60 pounds of N per acre applied 1 month later, the percentage of potash was 0.32 for the tubers and 0.15 for the plants. The foliage on plants receiving the last treatment showed severe potash deficiency symptoms; yield was also very low.

**Chemical Weed Control in Strawberries.** (R. L. Livingston, C. C. Carlton, Jack L. Turner, and T. B. Hagler.) — In weed control studies with Klonmore strawberries at the Chilton Area Horticulture Substation, a mixture containing 2 pounds each of, Sesone (Crag Herbicide-1) and Chloro-IPC per acre

was more effective in reducing weed population than either chemical applied alone. Reductions in weed counts following spring, summer, and fall applications were 81, 58, and 93 per cent, respectively. Summer applications of all chemicals were less effective in controlling weeds. Best control was obtained when chemicals were applied following cultivation and irrigation.

**Rates of Zinc and Calcium for Pecans.** (T. B. Hagler, W. A. Johnson, and John I. Wear.) — Stuart pecans grown in greenhouses were supplied with combinations of low, medium, and high rates of zinc and calcium. Rates of zinc and calcium were 0.1, 1, and 10 p.p.m. and 1, 4, and 16 m.e. per liter of dilute solution, respectively. Best plant growth occurred at high calcium and high zinc levels. Increasing zinc from 0.1 to 10 p.p.m. increased growth of plants from 115 to 137 inches. Rates of calcium had no effect on growth except at the high zinc level where growth increased from 112 to 155 inches when calcium concentration in solution was increased from 1 to 16 m.e. per liter.

Calcium content of leaves increased from 25 to 49 m.e. per 100 gm. dry weight when calcium was increased from 1 to 16 m.e. per liter of dilute solution. Increasing zinc in solution had no effect on the calcium content of leaves.

The zinc content of leaves increased from 87 to 355 p.p.m. when zinc was increased from 0.1 to 10 p.p.m. in solution. Zinc contents for low, medium, and high levels of calcium were 182, 226, and 184 p.p.m., respectively.

Increasing levels of calcium or zinc did not increase the pH of the nutrient solutions.

**Rates and Sources of Nitrogen for Strawberries.** (T. B. Hagler.) — The yield of strawberries, when 96 pounds of N was applied per acre, varied from 1,776 quarts per acre with nitrate of soda to

3,280, 2,704, 2,800, and 3,120 quarts per acre with ammonium nitrate, urea (Nugreen), Uramite, and cottonseed meal, respectively. With foliar applications of urea at the same rate of N per acre, the yield was 4,192 quarts per acre. When the rate was increased to 128 pounds of N per acre, yields in quarts per acre from the various sources of nitrogen were: Nitrate of soda, 2,704; ammonium nitrate, 2,816; urea to soil, 2,080; urea spray, 4,128; Uramite, 2,768; and cottonseed meal, 3,728. Increasing the rates of Uramite and urea sprays from 128 to 160 pounds N per acre resulted in increased yield from 2,768 to 4,060 quarts per acre for Uramite and from 4,128 to 4,304 quarts per acre for foliar sprays containing urea. Increasing rates of N to 160 pounds per acre from other sources did not increase berry yield.

#### **Development and Refinement of Processes for Making Selected Products from Horticultural Crops:**

(1) **FREEZE PRESSING BLACKBERRIES.** (Hubert Harris.) — A study was made of freeze pressing blackberries. The purpose was to develop a method of extracting concentrated juice for use in making jelly by the freeze concentration process. A highly satisfactory method was developed that involves use of standard rack-and-cloth juice press. With original soluble solids in the berries ranging from 7.5 to 10 per cent, it was not difficult to regulate pressing conditions to yield a juice with approximately 12 per cent soluble solids, the amount needed for jelly making. Compared to conventional single strength pressing, the freeze pressing resulted in better juice flow, better clarification of juice, and less sticking of press cake to cloths. However, to obtain these results it was necessary to partially defrost the berries, grind or crush them, and adjust the temperature within the range of 29.5 to 30° F. before pressing. The ice in the juice aided greatly in regulating

the temperature within this narrow range.

The basic studies were made with a 50-pound capacity laboratory press. The method was then tested in a commercial press of 400-pound capacity. Results in the commercial press were practically the same as those obtained with the laboratory press.

(2) **IMPROVED METHOD OF PEELING SWEETPOTATOES.** (Hubert Harris and J. M. Barber.) — Losses from peeling and trimming sweetpotatoes in commercial plants may range from less than 15 per cent to more than 50 per cent. Improper regulations of the depth of peel may cause these losses to be unduly heavy.

Studies were made to determine the most suitable depth to peel different grades of sweetpotatoes from the standpoint of labor required, trimming loss, and quality of finished product. Improved peeling techniques were used to obtain better control of depth of peel and to reduce the amount of discoloration from peeling.

In peeling with high pressure steam, better color in canned sweetpotatoes was obtained by peeling to the phloem tissue. However, the quality of sweetpotato puree was not lowered by removing only the cork tissue and leaving the pericyclic layer intact. This peel required extra trimming; but, by peeling deep enough to remove part of the pericycle layer and following with a good brush-wash treatment, the trimming time was about the same as with deeper peels.

By pre-washing the potatoes, flashing the pressure to 90 p.s.i. saturated steam, holding for 45 to 60 seconds, exhausting rapidly, and cooling immediately, the potatoes were peeled satisfactorily and uniformly to the phloem tissue. Trimmed recoveries in replicated tests on different grades of the Early-port variety were 84 per cent for 1¼ to 2 inches, 87 per cent for 2 to 2¼ inches, 89 per cent for 2¼ to 3¼ inches,

92 per cent for 3¼ to 5 inches, and 89 per cent for field run. Percentage of recoveries on these grades with 30 seconds peeling time were 91, 92.5, 96, 97.5, and 96 per cent, respectively.

(3) **QUALITY STUDY OF SWEETPOTATO VARIETIES.** (Hubert Harris.) — In 1955 and 1956, a number of promising varieties and selections of sweetpotatoes were tested for total solids and for baking qualities. House-cured No. 1 potatoes were used. Representative samples were obtained by taking a few potatoes from each of several crates. Total solids were determined by the vacuum oven method. Samples were baked in a gas-heated oven and rated by a panel of judges.

Of 17 varieties tested in 1955, total solids ranged from 21.4 per cent for the Copper Skin Goldrush to more than 32 per cent for Red Porto Rico, Porto Rico, and Earlyport. Red Porto Rico and B-45-70 scored highest on general appearance for baking. On color of the baked products, the Allgold, Goldrush, Earlyport, B-45-70, and HM-40 varieties ranked second. Porto Rico, Red Porto Rico, Earlyport, and B-45-70 varieties received high flavor scores. The Earlyport rated highest on the basis of all qualities.

Twenty varieties were tested in 1956. Total solids ranged from 21 per cent for Oklahoma 51 to 31 per cent for Porto Rico and G-52-15-1. In general baking qualities, G-52-15-1, Earlyport, Allgold, Oklahoma 55, and P-81 were outstanding among the other varieties. Goldrush scored very high in color, but it was slightly lower than the other varieties in flavor, considerably lower in total solids, and considerably higher in shrinkage from baking.

(4) **QUALITY OF IRISH POTATO CHIPS FROM DIFFERENT VARIETIES AND STORAGE TREATMENTS.** (Hubert Harris and R. L. Spigner.) — Eight varieties of Irish potatoes stored by four different methods were tested for chip quality.

Varieties were Pontiac, Triumph, Red Lasoda, Lasoda, Kennebec, Sebago Cobbler, and Katahdin. Each variety was tested for chips when dug and after 51 days in storage at room temperature, 55-59°F and 40-45°F.

The yield of chips was not consistently high for any single variety for all storage treatments. Storage at 55-59°F or 40-45°F increased chips yields of all varieties as compared to no storage or room temperature storage.

Chip samples from all varieties were satisfactory in color and flavor in the case of the no storage and room temperature storage. Chips of the Kennebec and Katahdin varieties rated highest, while those of Triumph rated lowest. In general, room temperature storage resulted in a small improvement in color over the no-storage treatment.

Storage at 55-59°F and at 40-45°F resulted in marked decreases in color and flavor ratings of the chip samples of all varieties. These decreases were greater in the case of the lower storage temperature.

**Effect of Irrigation at Different Minimum Levels of Soil Moisture and of Imposed Droughts on Yield of Selected Vegetable Crops:** (1) **GREEN ONIONS.** (S. T. Jones and W. A. Johnson.) — Irrigating at 0.3, 0.6, and 1.2 atmospheres tension produced total yields of 23,473, 16,997, and 6,720 pounds of green onions per acre, respectively. The corresponding marketable yields were 20,435, and 13,705, and 2,812 pounds per acre. Tensions of 0.3, 0.6, and 1.2 atmospheres correspond to 80, 60, and 40 per cent available moisture, respectively. Onions subjected to drought periods of 2, 4, and 6 weeks duration produced averages of 76, 53, and 39 per cent of the total yield and 73, 47, and 27 per cent of the marketable yield of the highest yielding treatment. Droughts imposed early in the season were not as severe in effects as droughts imposed later.

(2) POTATOES. (S. T. Jones and W. A. Johnson.) — Potatoes were irrigated at maximum tensions of 0.3, 0.6, 1.2, 2.4, and 4.8 atmospheres, which represent minimum available moisture levels of 80, 60, 40, 20, and 10 per cent, respectively. Total yields of potatoes from these treatments in the order previously named were 317, 240, 162, 130, and 99 bushels per acre. Yields of No. 1 grade potatoes were 218, 143, 73, 59, and 32 bushels per acre. With drought periods of 2, 4, and 6 weeks duration, production averaged 81, 55, and 34 per cent of the total yield and 72, 39, and 16 per cent of the No. 1 yield of the highest yielding treatment. Early droughts were not as detrimental as those later in the season.

(3) CABBAGE. (S. T. Jones and W. A. Johnson.) — Cabbage irrigated at 0.3, 0.6, 1.2, and 2.4 atmospheres tension or 80, 60, 40, and 20 per cent available moisture produced 14.0, 11.3, 4.9, and 3.2 tons of cabbage per acre, respectively. Droughts of 4 or 5 weeks duration resulted in yields of 59 per cent of the highest yielding treatment. No effect of time of occurrence of the drought was noticed.

**Study of Environmental Factors as They Influence Growth and Development of Lanceleaf Greenbrier, Southern Magnolia.**

(1) MAGNOLIA SEED TREATMENTS. (Henry P. Orr and Troy Keeble.) — Cleaned seed planted soon after cleaning had a higher germination percentage than uncleaned seed. There was no great change in germination count after stratification at 40°F. for 4 months in a sand-peat mixture or in vermiculite.

(2) SURVEY OF SEVERAL INDIGENOUS STANDS OF MAGNOLIA GRANDIFLORA. (Henry P. Orr.) — Trees were found growing in well-drained, moist areas with soil pH's ranging from 3.7 to 7.6. Soils from all locations were low in available nitrates, phosphates, potash, calcium, and in soluble salts. The per-

centage of organic matter found in the soils of natural stands varied from 0.13 to 60.5 per cent. The greatest number of seedlings was found in the soil area with 60.5 per cent organic matter; however, seedlings were numerous in soils with organic content as low as 0.13 per cent. The tree of best foliage quality observed was growing in a soil with a pH of 6.4 and an organic content of 1.35 per cent; however, nearby was a tree of poor foliage quality growing in a soil of pH 6.5 and organic content of 1.29 per cent. Seemingly factors other than pH, macro-nutritional elements, and organic content are affecting the growth of *Magnolia grandiflora* seedlings and trees in any chosen area.

**Developing and Adjusting Precision Methods of Growing Pot Plants and Cut Flowers for Southern Conditions:**

(1) OBSERVATION OF FLOWERING OF ORCHID SPECIES AND VARIETIES AT AUBURN, ALABAMA. (Henry P. Orr.) — The following orchid plants are being observed for flowering in the ornamental horticulture greenhouses at Auburn: 3 *Cattleya* species (36 plants), 4 *Cattleya* varieties (5 plants), 14 *Brassocattleya* varieties (79 plants), 13 *Laeliocattleya* varieties (30 plants), and 3 *Brassolaeliocattleya* varieties (6 plants). The flowering range of a particular species or variety may vary considerably from year to year; the month of heaviest flowering usually has remained the same each year. The number and size of flowers have varied greatly from year to year.

(2) USE OF SUPPLEMENTARY ILLUMINATION TO IMPROVE THE QUALITY OF POINSETTIAS FOR CHRISTMAS SALES. (Tokuji Furuta and Larry Brown.) — Quality of poinsettia plants sold at Christmas was improved by using supplementary illumination beginning September 15. Natural bud initiation occurred from September 20 to October 1 at Auburn. For highest quality plants

at Christmas, lights were used from September 15 to October 10 when the plants were grown at 60°F. and from September 15 to October 15 when grown at 65°F.

Daily use of lights from sundown to 10 p.m. or from midnight to 1 a.m. was satisfactory. A minimum light intensity of 2 foot-candles was necessary when lights were used from sundown to 10 p.m. and a minimum intensity of 4 foot-candles was necessary for the midnight lighting to prevent premature budding.

Varieties tested were: Improved Albert Ecke, Albert Ecke, Barbara Ecke, Indianapolis Red, Ecke's Pink, and Ecke's White. All varieties responded similarly.

(3) STUDIES ON THE FLOWERING OF STEPHANOTIS. (Tokuji Furuta.) — Year-round flowering of stephanotis was accomplished by using supplementary illumination during the period of September to May. Lights were used all night, but it appears that 16 hours photoperiod is satisfactory.

Use of sodium nitrate resulted in delayed and reduced flowering when compared to ammonium sulfate as a source of nitrogen. Delay in flowering was correlated with increasing sodium concentration in the leaf and decreasing Ca/Na and K/Na relationship.

The amount of potassium in the leaf varied as follows: (a) Increasing rate of potassium application — 4.21 to 5.94

per cent; (b) increasing rate of ammonium sulfate application — low potassium application 4.21 to 5.12 per cent, high potassium application 4.21 to 5.53 to 5.20 per cent; (c) increasing rate of sodium nitrate application — low potassium application 4.21 to 4.95 to 4.70 per cent, high potassium application 4.21 to 5.36 per cent.

The concentration of sodium in the leaf varied as follows: (a) Increasing rate of potassium application only — 0.29 to 0.66 to 0.41 per cent; (b) increasing rate of ammonium sulfate application — low potassium application 0.29 to 0.21 to 0.70 per cent, high potassium application 0.29 to 0.21 to 0.45 per cent; (c) increasing rate of sodium nitrate application — low potassium application 0.29 to 1.44 per cent, high potassium application 0.29 to 0.95 to 0.83 per cent.

(3) STUDIES ON GROWTH OF HYDRANGEA ROOTS. (Tokuji Furuta.) — Most rapid root growth occurred when the root ball was crushed or broken before dormant plants were potted. Methods compared were: Bare rooting, crushing ball, soaking ball in water, and no treatment.

Use of growth-promoting substances did not influence root growth in the concentrations used.

Little correlation was found between root growth 1 month after potting and the quality of the final product.

## POULTRY HUSBANDRY

**Protein and Amino-Acid Requirements of Laying and Breeding Hens:** (1) PROTEIN REQUIREMENT OF LAYING HENS AS AFFECTED BY TEMPERATURE, AGE, BREED, SYSTEM OF MANAGEMENT, AND RATE OF LAY. (G. R. Ingram and J. E. Milton.) — Because of a wide variation in recommendations for the level of protein needed by laying hens, a study

was made of some factors that might affect the level required.

Tests of about 8 months duration have been conducted for 2 consecutive years using duplicate groups of 50 birds each in most of the tests. In certain tests, smaller groups were used. Rations were calculated to contain 14, 16, and 18 (analyses showed 14.9, 16.8, and 19,

respectively) per cent protein, but with the same productive energy level. A 12 (analyzed 12.9) per cent protein ration also was included in some tests the second year.

In two series of tests with pullets in individual laying cages, the room containing the birds was heated to approximately 90°F. each day and allowed to cool to around 70°F. each night. Under these conditions, an increase in production was obtained with an increase in protein level up to 18 per cent, the highest level used.

Comparisons were made between 1-year-old hens and pullets in individual laying cages. Slightly higher production was obtained from old birds with 16 and 18 per cent protein rations than with lower levels. Pullets produced as well on 14 per cent protein as on higher levels. The 12 per cent ration proved inadequate.

In one test with heavy crossbred pullets, better production was obtained with the higher levels of protein. With White Plymouth Rock pullets, production was as good on the 14 per cent ration as on higher levels.

In comparisons between pullets in floor flocks and pullets in cages, no indication of higher protein requirements for caged birds was obtained.

With one or two exceptions feed conversion was somewhat in favor of the 16 and 18 per cent protein rations. Egg size increased with increasing protein levels.

(2) TRYPTOPHAN, LYSINE, AND METHIONINE REQUIREMENTS OF LAYING HENS. (G. R. Ingram and P. L. Little.) — Studies have been made to more accurately determine the tryptophan, lysine, and methionine requirements of the laying hen.

Using a corn-corn gluten meal-gelatin ration, the L-tryptophan requirement of hens has been shown to be approximately 0.142 per cent of the ration.

With a ration similar to the one used in the tryptophan studies, the require-

ment for L-lysine was shown to be approximately 0.488 per cent of the ration.

Using a wheat-peanut meal ration, additions of methionine above 0.225 per cent of the ration failed to increase egg production. The hen required 0.25 per cent methionine to maintain egg size and 0.32 per cent to maintain body weight.

**Effect of Light on Growth of Broiler Chickens.** (Claude H. Moore.) — Broiler-type birds have been grown from 1 day to 8 weeks of age with exposures of 6, 12, 18, and 24 hours of total light per day. The first three treatments were applied in different intervals ranging from 1 to 8 periods per day. Other groups were grown with different combinations of these treatments being used with change in age. One foot-candle of incandescent light was used for all treatments.

In 3 tests, 20 males and 20 females were used in each of 16 treatments, each treatment having 3 replications. Four subsequent tests have been completed using eight light treatments. Twenty males and 20 females were used per group with 2 groups per treatment in each of these tests. Weights were taken individually at 2-week intervals in all tests. A sample of males and females was sacrificed from each pen at each weighing for gonad weights. Feed consumption was tabulated in all tests.

These data reveal that broiler chicks up to 3 or 4 weeks of age grow faster with continuous light or that approaching continuous lighting. Less light is needed as they near 8 weeks. Better growth also was obtained when light was applied in 4 or 6 periods per day instead of 1 period. Data from groups where light was varied with age have not revealed a satisfactory method of reducing light with increased age while maintaining increased growth rate. Feed efficiency has been slightly better

for those birds receiving less light throughout the growth period.

**Helminth Studies:** (1) **HOST PREFERENCE.** (S. A. Edgar, J. A. Frazier, and C. Flanagan.) — Ninety-seven per cent of 42 chickens inoculated with embryonated *Ascaridia galli* eggs were infected and averaged 18.3 worms per bird as compared with only 48 per cent of 42 turkeys with an average of 3.9 worms. Of 42 chickens inoculated with *A. dissimilis* eggs, only 4.8 per cent harbored 1 male worm each as compared with a 95 per cent infection with an average of 27.8 worms per bird among 42 turkeys. *A. galli* developed to maturity in the chicken and a few worms developed to maturity in the turkey. *A. dissimilis* developed to maturity in the turkey, but none developed to maturity in the chicken. Growth of *A. galli* and *A. dissimilis* were retarded in turkeys and chickens, respectively. Aside from a slight difference in arrangement of anal papillae on males of the two species of worms, no other morphologic differences were noted. Evidence indicated that *A. galli* and *A. dissimilis* are separate and valid species.

(2) **AFFECT OF *Ascaridia* INFECTIONS ON GROWTH.** (S. A. Edgar, J. A. Frazier, and C. Flanagan.) — In three experiments, growth of chickens infected with *A. galli* and turkeys infected with *A. dissimilis* was retarded beginning 2 to 3 weeks after inoculation. The maximum effect usually was reached by 4 to 5 weeks after inoculation. From then on the growth of infected birds paralleled that of non-infected controls.

(3) **THERAPY STUDIES.** (S. A. Edgar, J. A. Frazier, and C. Flanagan.) — Results of experiments indicate that piperazine and several of its salts were effective in causing 95 per cent or greater elimination of *A. dissimilis* from the turkey and *A. galli* from the chicken.

Worm elimination following drug administration via the feed was as great as when given in the drinking water provided the level given in the feed was twice that in the water. Two to 4 hour water or feed starvation prior to drug administration resulted in greater elimination than when birds were not starved. One hundred mg. of pure piperazine per adult chicken and 200 mg. per adult broadbreasted bronze turkey resulted in 95 to 100 per cent elimination of mature worms and 50 per cent or greater elimination of larvae.

(4) **LOCATION OF *A. galli* AND *A. dissimilis* IN THE DIGESTIVE TRACTS OF CHICKENS AND TURKEYS.** (S. A. Edgar, C. Flanagan and J. A. Frazier.) Several experiments revealed that more than 70 per cent of *A. galli* and *A. dissimilis* were in the region of the yolk sac diverticulum between the 9th and 21st day of infections. As the age of infection increases, some worms move anteriorly and live permanently in the anterior third of the small intestine. By 60 to 70 days, 80 to 90 per cent of an infection was eliminated naturally.

That there is a tissue phase for *A. galli* has been verified, but never more than 10 per cent of the total larvae load was in the wall of the gut during 7- to 20-day-old infections.

**Breeding and Immunizing Chickens for Resistance to Coccidiosis:** (1) **IMMUNIZING PHASE.** (S. A. Edgar, C. Flanagan, and J. Hwang) — *A. Vaccine.* A practical method of immunizing chickens against cecal and four species of intestinal coccidiosis has been developed. The procedure and inoculum for immunization are essentially the same as that reported in 1954 except for the addition of *Eimeria maxima* to a layer type vaccine. Two types of vaccine are being marketed for chickens. One for broilers contains 3 species of coccidia and one for layers contains 5 species.

Birds inoculated at 3 days of age resisted challenge to all species in respective inocula at 28 days of age. Additional experiments have revealed that inoculated chickens usually develop solid immunity to 3 or 5 types of coccidiosis by 4 weeks of age even when fed continuously prophylactic levels of certain coccidiostatic drugs. Drugs and levels in the feed found to be compatible with immunization include 0.0125 per cent nitrophenide, 0.0125 per cent sulfaquinoxaline, 0.00325 per cent 2-sulfanilamido-6-chloropyrazine, 0.0055 per cent nitrofurazone, Bifuran at the rate of  $\frac{1}{2}$  pound per ton of feed and Trithiadol or Polystat at 2 pounds per ton. Inoculated chicks fed 0.0125 per cent Nicarbazin were usually still highly susceptible to 3 or more types of coccidiosis at 12 or 16 weeks of age. By the addition of a suspending agent, coccidiosis vaccine can be administered in drinking water as well as in feed.

There was no mortality from coccidiosis among experimental birds inoculated with 3 to 5 species of coccidia at 3 days of age via the water or feed and fed continuously one of the mentioned drugs from 1 day of age through 4 or 8 weeks. In general an economic saving of 0.1 to 0.3 cents per bird can be realized by this method of coccidiosis control when compared with continuous feeding of one of the commercial coccidiostatic drugs as generally practiced in the broiler industry.

**B. Immunity to *E. brunetti*.** Several experiments revealed that chickens developed immunity against *E. brunetti* infection safely and as promptly as they do to other types of coccidiosis. Turkeys develop prompt immunity to *E. adenoides* and *E. meleagritidis*.

(3) RELATED ASPECTS. (S. A. Edgar, C. Flanagan, and C. Thomas.) — **A. Chemotherapy Studies.** Experiments comparing the efficacy of several coccidiostatic drugs for control of one or more types of coccidiosis revealed that 2-sulfanilamido-6-chloropyrazine exhib-

ited 2 to 4 times the activity against *E. tenella* and *E. necatrix* infections as did sulfaquinoxaline. Furazolidone at the rate of 75 gm. per ton of feed was highly effective against *E. necatrix* infections. Trithiadol was effective against *E. tenella*, *E. necatrix*, and *E. maxima* infections in chickens. None of the three drugs was as effective against two types of turkey coccidiosis as was sulfaquinoxaline.

**B. Age Resistance.** Non-exposed turkeys were still highly susceptible to *E. adenoides* infection at 3 months of age. Non-lethal infections retarded growth an average of more than 1 pound per bird.

**Transmission of Diseases of Chickens by Mosquitos.** (S. A. Edgar and C. Thomas.) — In a series of experiments, all attempts to transmit lymphomatosis (visceral and neural types), fowl typhoid, and pullorum disease by mosquito were unsuccessful.

**Effect of Fowl Pox on Growing Chickens and Duration of Immunity.** (S. A. Edgar and Dwight S. Bond.) — A commercial, fowl-pox vaccine used on chickens from 1 day to 8 weeks old caused a slight, but not significant, depression of growth. In contrast, a less attenuated strain of virus caused a significant depression of growth in birds vaccinated at 2 weeks or older. Immunity to the less attenuated strain of virus was of longer duration than that to the commercial vaccine. Chickens challenged at 1, 2, 3, 4, 6, 8, 12, and 16 days after vaccination with commercial vaccine had partial protection against lesion formation by 4 days and full protection by 6 days. A large lesion formed from multiple stabs of a  $\frac{1}{2}$ -inch square area caused greater weight loss without increased immunity than a single stab in the wing web with a double needle. Growth of S. C. White Leghorns was retarded more than that of White Plym-

outh Rocks or New Hampshires. There was no difference in susceptibility between sexes.

In the absence of re-exposure, chickens vaccinated at 2 weeks of age had longer lasting immunity than those vaccinated day-old. Not all birds vacci-

nated as late as 12 or 16 weeks of age were fully protected 90 and 120 days later. Chicks can be vaccinated safely at 1 day of age. Management practices and environmental conditions have a bearing on immunity of flocks under commercial conditions.

## ZOOLOGY-ENTOMOLOGY

**Control of Cotton Insects.** (F. S. Arant, R. L. Robertson, G. F. Burkhalter, and R. H. Mount.) — Laboratory and field experiments were conducted to determine susceptibility and resistance of cotton aphid, *Aphis gossypii* Glover, and boll weevil, *Anthonomus grandis* Boh., to certain chlorinated hydrocarbon insecticides. All BHC dusts containing 3 per cent gamma isomer were effective in controlling cotton aphid in one field in Autauga County and ineffective in another field. There was no difference in dusts formulated from BHC with high (40 per cent) and low (15.1 per cent) gamma isomer content and from lindane. All gamma isomer formulations of BHC and lindane were highly effective as sprays against a local strain of aphids in the laboratory at Auburn. It was found that first-instar nymphs were significantly more susceptible than intermediate nymphs or adults. The cotton aphid appeared to be resistant to BHC in one of the areas where studies were made.

Toxaphene, endrin, and Guthion were applied topically to 2-day-old boll weevils reared from squares collected from Fairhope, Courtland, Lowndesboro, Frisco City, and Auburn. Dosages of toxaphene required to kill weevils from the 5 localities were calculated as follows: For LD-20 — Fairhope 0.6 µg. per gm. of insect, Courtland 9.0, Frisco City 75.0, Lowndesboro 85.0, Auburn 95.0; for the LD-50 — Fairhope 65.0, Courtland 85.0, Frisco City 100.0, Lowndesboro 350.0, Auburn 250.0; for

LD-80 — Fairhope 450.0, Courtland 450.0, Frisco City 450.0, Lowndesboro 800.0, Auburn 700.0 µg. per gm. of insect. There was no evidence of acute resistance of boll weevil to toxaphene.

Thimet and Di-syston applied to cotton seed or in the drill controlled thrips and fleahoppers for several weeks after application. However, the seed treatments caused a reduction in the stand of cotton and in a few instances a reduction in yield.

Several insecticides gave excellent control of boll weevil and resulted in increased yields of approximately ½ bale per acre above that on the check plots. Toxaphene, endrin, and Guthion applied at twice the normal rate at 8-day intervals were about as effective as the same materials applied at the normal rate at 4-day intervals. Malathion at the rate of 1.5 pounds per acre gave satisfactory control of boll weevil. Two applications of heptachlor granules plus 4 dustings with heptachlor-DDT mixture were about as effective as 13 applications of a standard insecticide for boll weevil control.

**Control of Animal Ectoparasites with Systemic Insecticides.** (T. R. Adkins, Jr., and F. S. Arant.) — Replicated experiments were conducted to determine dosage response of Dipterex to fifth-instar nymphs of the bed bug, *Cimex lectularius* L., and nymphs of the Gulf Coast tick, *Amblyomma maculatum*

Koch, which fed on rabbits dosed orally with the chemical.

Mortalities of bed bugs after feeding were: On rabbits receiving 10 mg./kg. of body weight, 36.3 per cent mortality; 20 mg./kg., 74.5 per cent; 30 mg./kg., 83.9 per cent; and 40 mg./kg., 97.8 per cent. None died on rabbits that were not dosed.

Mortalities of ticks were: On rabbits receiving 25 mg./kg. of body weight, 25.2 per cent mortality; 50 mg./kg., 88.3 per cent; 75 mg./kg., 95.5 per cent; and 100 mg./kg. 100 per cent. There were no deaths of ticks on rabbits that were not dosed. Dipterex given to rabbits 1 to 2 hours before the bugs fed killed 50 per cent of the bed bugs at a dosage level of 14.0 mg./kg. The LD-50 to the ticks through the rabbit was calculated to be 36.0 mg./kg. body weight of rabbit.

#### Control of Insect Pests of Vegetable and Truck Crops:

(1) CONTROL OF APHIDS ON TURNIPS. (W. G. Eden.) — Experiments were conducted at Ashford in 1955 on control of a root aphid (commonly known as the poplar stem gall aphid, *Pemphigus populitransversus* Riley) and the turnip leaf aphid, *Rhopalosiphum pseudobrassicae* on turnips. Weekly applications of 2 per cent parathion dust or 0.5 pound of parathion per 100 gallons of emulsion spray were highly effective in control of the leaf aphid. Two sprays at a 2-week interval of 0.25 pound demeton per acre were also highly effective on the leaf aphid. The parathion and demeton treatments were also effective in reducing the number of root aphids. The yields of turnip tops were increased 4 times and the root yields about 3 times as a result of using the insecticides. The demeton sprays were applied on January 26 and February 9. On March 10 the roots contained 0.7 p.p.m. of demeton and the tops contained 7.2 p.p.m. On March 31 there was no demeton in the roots and only 2.7 p.p.m. in the tops.

(2) CONTROL OF SOIL INSECTS OF IRISH POTATOES. (W. G. Eden.) — Research was conducted in Baldwin County in 1955 and 1956 on control of the Gulf wireworm, *Conoderus amplipennis* (Gyll.), and the imported fire ant, *Solenopsis saevissima richteri* Forel, in Irish potatoes. Broadcast spray treatments of 2 pounds of aldrin, dieldrin, or heptachlor or 4 pounds of chlordane per acre were all highly effective in controlling wireworms and fire ants. The treatments were also effective the second year.

(3) CONTROL OF CORN BORER ON PIMENTO PEPPER. (W. G. Eden.) — Experiments on control of the European corn borer, *Pyrausta nubilalis* (Hbn.), on pimento pepper were conducted at Cullman and Crossville in 1955 and 1956. Weekly applications of 20 per cent toxaphene or 10 per cent DDT dust significantly reduced the percentages of pods infested with corn borers. Equivalent amounts of sprays of toxaphene and DDT, as well as 0.375 pounds of endrin per acre, were also effective. Cooperative research with FDA showed that no DDT residue was found in the canned pimento even when applied at twice the recommended rate.

(4) CONTROL OF COWPEA CURCULIO OF PEAS. (G. H. Blake, Jr., and W. G. Eden.) — In an experiment at Ashford several insecticides were tested for control of the cowpea curculio, *Chalcoedermus aeneus* Boh., on crowder peas. Larval emergence from peas was significantly reduced by dust applications of 2 per cent endrin, 2½ per cent heptachlor, 5 per cent Thiodan, 20 per cent toxaphene, 2½ per cent Guthion, and 4 per cent malathion. Reductions in infestations from plots treated with endrin, heptachlor, Thiodan, and toxaphene were highly significant.

(5) CONTROL OF MEXICAN BEAN BEETLE. (G. H. Blake, Jr., and W. G.

Eden.) — An experiment on control of the Mexican bean beetle, *Epilachna varivestis* Muls., on pole beans was conducted at the North Alabama Horticulture Substation, Cullman. Bean beetle counts throughout the season revealed that 4 per cent malathion, 5 per cent Thiodan, and 20 per cent toxaphene were more effective for bean beetle control than 1 per cent rotenone. Rotenone, however, caused significant reductions in beetle numbers as compared to the non-treated plots.

(6) CONTROL OF MELONWORMS AND PICKLEWORMS ON CANTALOUPE. (G. H. Blake, Jr., and W. G. Eden.) — Eight insecticides were tested at Cullman for control of melonworms and pickleworms on fall cantaloupes. Of these insecticides parathion, lindane, Dylox, Guthion, and Thiodan appeared to be effective. Results of the experiment were inconclusive because of adverse weather conditions, that caused low yields of cantaloupes.

(7) CONTROL OF SWEETPOTATO WEEVIL. (G. H. Blake, Jr. and W. G. Eden.) — Experiments on control of the sweetpotato weevil, *Cylas formicarius elegantulus* (Sum.), were conducted at the Gulf Coast Substation. Even though heavily infested potatoes were used in the potato bed and scattered throughout the experimental area, the weevil infestation was too low to evaluate the control measures.

**Control of Insect Pests Attacking Corn and Grain Sorghum.** (W. G. Eden.) — Experiments were conducted in 1955 and 1956 on control of the corn earworm, *Heliothis zea* (Boddie), in sweet corn. Results revealed that length of interval between DDT sprays for earworm control was highly significant and that a close-interval spray program was more important during the first part of the protection period than during the latter part. In experiments where a con-

stant spray interval was maintained, intervals of less than 3 days between sprays resulted in best control of earworm. Flat fan nozzles were superior to hollow cones. Spray programs begun the first day after the first silks appeared were superior to those begun later. Irrigation, rate of nitrogen fertilization, and spacing had no effects on extent of damage by the earworm in sweet corn.

Results of experiments on the European corn borer, *Pyrausta nubilalis* (Hbn.), on Sand Mountain showed that the insect had three complete generations in 1955 and 1956. Four species of corn borer parasites were released and apparently became established in 1956. They were *Chelonus annulipes* Wesm., *Macrocentrus gifuensis* Ashm., *Lydella grisescens* R. D., and *Horoglyphus punctorius* (Roman).

Corn varieties found to be most resistant to stored grain insects, primarily the rice weevil, *Sitophilus oryza* (L.), and the Angoumois grain moth, *Sitotroga cerealella* (Oliv.), at harvest were Louisiana 521, North Carolina 27, Coker 811, Woods S-211, Pfister 655, McCurdy 1002B, Dixie 33, and Dixie 18.

**Control of Insect Pests of Legumes: (1) IMPORTED FIRE ANT.** (G. H. Blake, Jr., and W. G. Eden.) — A continuation of experiments on control of the imported fire ant, *Solenopsis saevissima richteri* Forel, at the Black Belt Substation revealed that 2 pounds of dieldrin and heptachlor or 4 pounds of chlordane per acre was effective for 3 years. In one unreplicated experiment, dieldrin has been effective for 4 years. In another experiment 2 pounds of heptachlor per acre in fertilizer mixture has been effective for 2 years, while lower rates of heptachlor and dieldrin were ineffective after the same period.

(2) CONTROL OF ARMYWORMS. (G. H. Blake, Jr.) — Experiments on con-

trol of armyworms were conducted in 1955 at three locations. Two experiments were on control of the armyworm *Pseudaletia unipuncta* (Haw.). Dusts applied at rates to give 2 pounds of DDT, 0.50 pound of dieldrin, 0.25 or 0.50 pound of endrin, or 4 pounds of toxaphene effectively controlled armyworms. Granules of the materials were much less effective. A single experiment on control of the fall armyworm, *Laphygma frugiperda* (J. E. Smith), with insecticidal sprays was conducted at the Wiregrass Substation. The following treatments resulted in a mortality of armyworms of greater than 90 per cent: 0.50 pound dieldrin, 0.25 and 0.50 pound endrin, 2 pounds DDT, and 4 pounds of toxaphene.

(3) PEA APHID CONTROL. (G. H. Blake, Jr.) — Several phosphorus-containing insecticides were tested for control of the pea aphid, *Macrosiphum pisi* (Kltb.) on Caley peas. Several of the materials, AC528, demeton, Diazinon, Dylox, and malathion, compared favorably with parathion. All resulted in yield increases of more than 100 pounds of peas per acre over check.

(4) CLOVER HEAD WEEVIL CONTROL. (G. H. Blake, Jr.) — Clover head weevils, *Hypera meles* and *H. nigrirostris* (F.), caused considerable damage to white clover in 1956. Experiments revealed that dusts of 3 per cent BHC, 1½ per cent dieldrin, or 2½ per cent heptachlor were highly effective for control of the pests.

(5) TOXICITY OF INSECTICIDES TO LIVESTOCK GRAZING ON TREATED PASTURES. (G. H. Blake, Jr.) — Experiments to determine toxicity of DDT, methoxychlor, and toxaphene to sheep and cattle grazing on treated pastures were concluded in 1955. Residues of the insecticides persisted on the forage for at least 40 days after treatment. The insecticidal residues were high in

the fatty tissues of animals placed on pastures treated with recommended rates of the insecticides; however, the residues disappeared from the animals when they were placed on an untreated pasture for 4 weeks. Toxaphene at 2½ times the recommended rate (10 pounds per acre) caused death of all animals placed on the pasture immediately after treatment. Residues were highest following spray applications, considerably lower from dust applications, and quite low following application of insecticides in granular formulation.

#### Control of Insects of Ornamental Plants.

(L. L. Hyche and R. H. Mount.) Continuation of experiments on control of insect pests of ornamental plants at the Ornamental Horticulture Field Station, Spring Hill, revealed that Thimet at 1 and 2 pints of 48 per cent emulsifiable concentrate per 100 gallons of water was equal in effectiveness to demeton for control of tea scale, *Fiorinia theae* Green, on camellias and Burford holly and of camellia scale, *Lepidosaphes camellia* Hoke, on camellias. Both soil and foliage applications were effective. Ferttox exhibited no systemic activity and failed to reduce infestations of tea and camellia scale.

A new and possibly undescribed species of mite belonging to the genus *Phyllocoptes* was discovered damaging *Magnolia grandiflora* and *M. soulangeana*. Spray applications of malathion, demeton, Thimet, or AC-528 effectively controlled the mite.

Insecticide phytotoxicity tests with BHC and lindane showed that wettable powder suspensions of both compounds were phytotoxic to the azalea variety Hinodegari at rates of 0.12 to 0.36 pounds gamma isomer per 100 gallons of water. Neither compound at these rates produced phytotoxic symptoms on pyracantha or the azalea variety Formosa.

**Control of Peanut Insects.** (L. L. Hyche and R. H. Mount.)—Experiments were conducted in southeastern Alabama on control of soil and foliage insect pests of peanuts. Systemic insecticides, Thimet at 1, 2.5 and 5 pounds technical per acre and Bayer 19639 at 2.5 and 5 pounds technical per acre, applied in the row at planting time significantly controlled thrips, *Frankliniella fusca* (Hinds). Subsequent yield increases ranged from 204 to 617 pounds of peanuts per acre. One application of 10 per cent DDT, 2 per cent endrin, 5 per cent Guthion, or 20 per cent toxaphene was highly effective in reducing infestations of the red-necked peanutworm, *Stegasta bosqueella* Chamb. Infestations of wireworms, *Conoderus* sp., attacking seed and seedlings were substantially reduced by soil treatment using 2 pounds technical per acre of aldrin, dieldrin, heptachlor, or lindane. Seed treatment with heptachlor or aldrin wettable powder was also somewhat effective.

**Toxicology of Insecticides:** (1) INVESTIGATIONS ON THE DEVELOPMENT OF RESISTANCE TO CHEMICALS BY THE HOUSE FLY. (B. L. Owen and W. G. Eden) — Research was begun in 1956 on nature of resistance of the house fly to chlorinated hydrocarbon insecticides. Methods for developing resistant strains by mixing insecticides with the larval medium have been developed. The LD-50's of a basic non-resistant strain of house flies have been established as follows: DDT, 0.38  $\mu$ g. per fly; endrin, 1.07; TDE, 1.97; and dieldrin, 43.00.

(2) CONTROL OF HOUSE FLIES IN BARN. (B. L. Owen and W. G. Eden) — Hog barns were sprayed with 2.5 per cent emulsion and wettable powder suspension sprays of malathion, 1.0 per cent emulsion and wettable powder suspension sprays of Chlorthion, and 1.0 and 2.0 per cent wettable powder sprays of Dipterex. The fly populations

were greatly reduced within 24 hours after treatment, not only in the treated stalls but also in the untreated ones. This indicated that flies in untreated stalls migrated to treated stalls and were killed by the insecticides. All treatments were killing flies 8 days after application. The treatment with Chlorthion emulsion spray continued to kill flies for 42 days.

**Control of Livestock Pests.** (George H. Blake, Jr.) — An experiment was conducted at the Black Belt Substation in 1955 to control flies on dairy cattle. One gallon of a spray concentrate containing 0.5 per cent pyrethrins and 5 per cent piperonyl butoxide applied twice a week from a treadle sprayer effectively controlled barn, stable, and house flies on 24 cows for a period of more than 3 months.

**Farm Ponds.** (H. S. Swingle, E. E. Prather, J. M. Lawrence, J. S. Dendy, and Ray Allison) — In a 4-year-old pond stocked with 10 species of pond-fishes, the percentages by weights of total catch of the principal species were: bluegills 50.4, red cats 39.8, largemouth bass 4.8, and shellcrackers 2.4. Black crappie and warmouth contributed less than 1 per cent, while smallmouth bass, chain pickerel, and round fliers contributed nothing.

Channel catfish stocked at 1,000 to 2,000 per acre and fed a dry mixed feed produced 700 to 1,300 pounds fish per acre. Red cats stocked at 3,000 and 4,000 per acre and fed produced 850 to 900 pounds per acre. The cost of feed and fertilizer varied from 11.6 to 20.7 cents per pound of fish produced, depending upon the rates of feeding.

A mixture of 35 per cent soybean meal, 35 per cent peanut meal, 15 per cent fish meal, and 15 per cent distillers dried solubles was found to be efficient for supplemental feeding of fish. This mixture, designated as Auburn No. 1 fish feed, was fed daily at rates varying from 1 to 5 per cent of body weight.

Survival of fatheads in winter holding ponds averaged 60 per cent when the fish were fed a peanut meal-fish meal dry food, whereas 82 per cent survived when fed the Auburn No. 1 fish feed. The conversion factor for the former was 3.2 and for the latter 2.8.

Diesel fuel used as a carrier for 2,4-D weed spray around pond edges caused undesirable flavors in bluegills.

The Israeli strain of mirrow carp and an Asiatic pond fish, *Tilapia mossambica*, appeared promising for control of filamentous algae in ponds.

Potassium permanganate proved effective in counteracting toxicity of rotenone during marginal and sectional poisoning.

**Survey of the Parasites of Pondfishes in Alabama and Their Control.** (Ray Allison) — A tin compound, di-n-butyl tin oxide, was found to be an effective anthelmintic against the fish tapeworm, *Corolobothrium* sp., and the intestinal fluke, *Alloglossidium* sp., when administered in the food at the rate of 250 mg. per kg. of body weight.

Formalin and potassium permanganate at concentrations of 15 and 4 p.p.m., respectively, were found to be effective anthelmintics for treating parasitized fish in ponds. *Gyrodactylus* sp. and *Tricodina* sp. were effectively controlled.

**Chemical Control of Weeds in Ponds.** (J. M. Lawrence) — A series of ponds stocked with bluegills received the following sodium arsenite treatments: 2 applications of 4 p.p.m.  $As_2O_3$  1 month apart, and 2 applications of 8 p.p.m.  $As_2O_3$  1 month apart. In the ponds receiving 2 applications of 4 p.p.m.  $As_2O_3$ , the bottom organism production was reduced 34 per cent and bluegill production was reduced 42 per cent. In the ponds receiving 8 p.p.m.  $As_2O_3$ , the bottom organism production was reduced 59 per cent as the bluegill production was reduced 65 per cent.

One application of sodium arsenite at the rate of 4 p.p.m.  $As_2O_3$  to ponds that had received the previous year either 8 or 16 p.p.m.  $As_2O_3$  materially reduced bluegill production in a 5-month test period. The reduction in fish production was primarily accounted for by absence of small fish. Less reduction in subsequent fish crops resulted where arsenic-treated ponds were flooded and drained several times before restocking.

A mixture of equal parts of 10 per cent Roccal and Delrad 50-S produced a better kill of *Pithophora* than Delrad alone, and its effect was usually of longer duration (2 to 4 weeks).

Borascu, at a concentration of 5 p.p.m. boric acid, showed promise as an inhibitor of growth of certain forms of filamentous algae.

An application of copper sulfate at the rate of 1 pound per surface acre successfully controlled *Microcystis* in ponds.

**Ecology and Management Studies of the Bobwhite Quail.** (Arnold O. Haugen and Dan W. Speake.) — Examination of crop contents of 78 bobwhites from the Piedmont Substation revealed that *Lespedeza bicolor* ranked first as food by occurrence and volume. Corn was second in importance. Partridge peas and beggar-weeds were also of considerable importance.

Artificial quail feeders were tested at Flint Creek Island near Decatur. The feeders failed to increase quail on parts of the area where the birds were already established. Feeders also failed to re-establish coveys on areas once occupied by quail but with reduced and inadequate quail food and cover. The recent carrying capacity of Flint Creek Island is about one quail per 9 or 10 acres. Feeders did not change this. The December 1955 population of 75 birds, in which year no feeding was done, was just as large as the average fall population in the 3 previous years when feed was provided. It is

recognized that feeders may have some value to quail in sections of Alabama where quail cover is adequate but foods are scarce.

**Statewide Bobwhite Productivity Study.** (Arnold O. Haugen and Dan W. Speake.) — Productivity of the bobwhite in 1955 and 1956 was determined from 19,707 quail wings submitted by cooperating sportsmen throughout the State. The sample indicated that the quail population consisted of 80.2 per cent young in 1956 as compared with 83.5 per cent young in 1955. This slight decrease in percentage indicates that on a per-hen basis there were almost two chicks fewer per brood in 1956. An abundant breeding population carried over into the spring of 1956 seemed to compensate for the decrease in number of chicks per hen.

**Waterfowl Use of Creeks, Beaver Swamps, and Small Impoundments in Lee County, Alabama.** (Dan W. Speake.) — Studies on eight sample areas of small impoundments, swamps, and creeks in Lee County, Alabama, between October 1953, and January 1955, indicated a relative abundance of the more important waterfowl as follows: (1) ring-necked duck, (2) mallard, (3) wood duck, (4) coot, and (5) scaup. Ducks in general showed a fall migration peak during the first half of November in 1953 and in the latter part of the month in 1954.

Several species of ducks exhibited a definite habitat preference. On small impoundments ring-necked ducks predominated, on creeks mallards were most abundant, and on a beaver swamp wood ducks outnumbered all others.

Although 19 species of waterfowl were observed on the sample areas, only the wood duck was a summer resident. Five broods, four of which probably hatched between April 1 and May 7 were observed.

It was concluded that the first and

most important step in future waterfowl management in central Alabama would be to improve the quality of existing wetlands.

**Food Habits of the Bobcat in Alabama.** (James R. Davis.) — Contents from stomachs of 145 bobcats collected between 1947 and 1954 were examined.

Rabbits provided 65.1 per cent of the food for bobcats during the year. Rabbit was the main food for the cat in every month of the year.

Deer provided 14.5 per cent of the food. Deer are eaten mostly in January and February. No deer meat was found in bobcats' stomachs from May through August. Most of the deer eaten by the bobcat may consist of dead or wounded animals, since this food item was usually consumed during and following the hunting season.

Wild turkey was found in only one stomach. Quail was found in two stomachs and made up less than 2 per cent of the diet. Domestic chickens were found in three stomachs, for a total percentage of 3.5. Remains of one mallard duck, several song birds, and one hawk were found. Squirrels made up 4.3 per cent of the bobcats' food and were eaten most frequently in December, January, and February. Rodents, including rats and mice, amounted to 5 per cent of the diet. They were eaten in greatest numbers from June through August. Raccoons and opossums constituted 4.3 per cent of the diet.

**Denning, Breeding, and Range of Activity of Foxes in Alabama.** (Edward G. Sullivan.) — Reproduction, denning, range, and weights of Alabama gray and red foxes were studied. Evidence indicates that the peak of the gray fox mating season is reached in February. The male gray fox is fertile from mid-November to mid-April. The average litter size for gray foxes is 3.8, with a variation from 1 to 5 young per litter.

Gray fox dens were found in slab piles, hollow logs, under rocks, and in the ground. All dens were within  $\frac{1}{4}$  mile of water. Returns of three tagged gray foxes, one of which was twice retaken, showed distances of capture site of  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, and  $4\frac{1}{2}$  miles. The average weights of gray foxes were: males 8.2 pounds and females 7.8 pounds. The heaviest fox handled was a male weighing 11.2 pounds.

It appears that gray and red foxes can be classified dependably as adults or as young of the year through November by means of X-rays of the distal epiphyses of the radius and ulna. Some young foxes were distinguishable through most of December. This indicated that ossification is completed in foxes between 8 and 9 months of age.

**Population and Life History Studies of the Cottontail Rabbit.** (Edward Majors.)

— Results of studies show that the average cottontail litter size was 3.1 young and the breeding season extending from January to September. There was an annual turnover of 75 per cent in the population studied. A sex ratio of 93.3 males per 100 females was found.

Land bordering improved pasture maintained a higher cottontail population than similar land adjacent to idle fields. Where cattle were allowed to destroy woody cover next to an improved pasture, the cottontails declined but recovered after the cattle were removed. Abandoned land studied was found to harbor a population of 12.8 cottontails per 100 acres in February. A farm woodlot was found to have a maximum population of 24 cottontails per 100 acres in December. This is still only about half the population of 51.8 cottontails per 100 acres flushed from an idle field when it was burned.



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- No. 295 Seasonal Variations in Prices Received by Alabama Farmers. MORRIS WHITE and J. H. YEAGER. 1955.
- No. 296 Economics of Pastures in Feeding Systems for Dairy Cows. WADE F. GREGORY. 1955.
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- No. 54 Cost Comparisons of Johnsongrass Silage and Hay. W. B. KELLEY and L. A. SMITH. 1955.
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- No. 58 Report of Herd Improvement by Crossbreeding. K. M. AUTREY. 1955.
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J. E. CAROTHERS, M.S.	Assistant Forester
*B. M. COOL, M.S.	Assistant Forester
*A. R. GILMORE, M.F.	Assistant Forester
K. W. LIVINGSTON, M.F.	Assistant Forester
H. G. POSEY, M.S.F.	Assistant Forester
E. W. JOHNSON, M.F.	Assistant Forester
DONALD W. WOODS, B.S.	Assistant in Forestry
F. E. GOODRICK, B.S.	Assistant in Forestry

### Home Economics

MARION W. SPIDLE, M.A.	Head, Home Economics Research
RUTH ALBRECHT, Ph.D.	Home Economist
KATHRYN PHILSON, Ph.D.	Associate Home Economist
MILDRED S. VAN DE MARK, M.A.	Associate Home Economist
MARY E. PRATHER, M.S.	Assistant in Home Economics

### Horticulture

L. M. WARE, M.S.	Head of Department
WALTER GREENLEAF, Ph.D.	Vegetable Breeder
C. L. ISBELL, Ph.D.	Horticulturist
TOKUJI FURUTA, Ph.D.	Associate Horticulturist
T. B. HAGLER, Ph.D.	Associate Horticulturist
HUBERT HARRIS, M.S.	Associate Horticulturist
SAM T. JONES, Ph.D.	Associate Horticulturist
H. P. ORR, M.S.	Associate Horticulturist
W. A. JOHNSON, M.S.	Assistant Horticulturist
R. L. LIVINGSTON, M.S.	Assistant Horticulturist
J. M. BARBER, B.S.	Assistant in Horticulture
J. W. PATE, B.S.	Assistant in Horticulture
TROY KEEBLE, B.S.	Greenhouse Manager

### Poultry Department

D. F. KING, M.S.	Head of Department
G. J. COTTIER, M.A., D.V.M.	Poultry Husbandman
S. A. EDGAR, Ph.D.	Poultry Pathologist
ETHEL MCNEIL, Ph.D.	Associate Poultry Pathologist
J. G. GOODMAN, M.S.	Associate Poultry Husbandman
G. R. INGRAM, Ph.D.	Associate Poultry Husbandman
C. H. MOORE, Ph.D.	Associate Poultry Husbandman

### Publications

KENNETH B. ROY, B.J.	Head of Department
B. H. SELLERS, A.B.	Associate Agricultural Editor
R. E. STEVENSON, B.S.	Assistant Agricultural Editor

\* Leave of absence.

### Zoology-Entomology

F. S. ARANT, Ph.D.	Head of Department
A. O. HAUGEN, Ph.D.	Leader, Cooperative Wildlife Research Unit
H. S. SWINGLE, M.S.	Fish Culturist
J. S. DENDY, Ph.D.	Associate Zoologist
W. G. EDEN, Ph.D.	Entomologist
E. E. PRATHER, M.S.	Associate Fish Culturist
*B. WAYNE ARTHUR, M.S.	Assistant Entomologist
G. H. BLAKE, JR., M.S.	Assistant Entomologist
J. A. GRIFFIN, JR., M.S.	Assistant Entomologist
DAN W. SPEAKE, M.S.	Asst. Leader, Cooperative Wildlife Res. Unit
J. M. LAWRENCE, Ph.D.	Assistant Fish Culturist
R. L. ROBERTSON, M.S.	Assistant Entomologist
LACY L. HYCHE, M.S.	Assistant Entomologist
H. F. TURNER, M.S.	Assistant Zoologist

### Substations

W. H. HEARN, B.S.	Records Assistant
BLACK BELT, Marion Junction, Dallas County	
L. A. SMITH, B.S.	Assistant Superintendent
CHILTON AREA HORTICULTURE, Clanton, Chilton County	
C. C. CARLTON, B.S.	Superintendent
GULF COAST, Fairhope, Baldwin County	
OTTO BROWN, M.S.	Superintendent
J. E. BARRETT, B.S.	Assistant Superintendent
H. F. YATES, B.S.	Assistant Superintendent
FRANK GARRETT	Part-Time Assistant in Horticulture
LOWER COASTAL PLAIN, Camden, Wilcox County	
LAVERN BROWN, B.S.	Superintendent
JOHN B. SANDERS, B.S.	Assistant Superintendent
NORTH ALABAMA HORTICULTURE, Cullman, Cullman County	
T. S. MORROW, B.S.	Superintendent
PIEDMONT, Camp Hill, Tallapoosa County	
E. L. MAYTON, M.S.	Superintendent
SAND MOUNTAIN, Crossville, DeKalb County	
S. E. GISSENDANNER, B.S.	Superintendent
TENNESSEE VALLEY, Belle Mina, Limestone County	
J. K. BOSECK, B.S.	Superintendent
C. H. YEAGER, B.S.	Assistant Superintendent
UPPER COASTAL PLAIN, Winfield, Fayette County	
W. W. COTNEY, B.S.	Superintendent
WIREGRASS, Headland, Henry County	
C. A. BROGDEN, B.S.	Superintendent
MAX SCONYERS, B.S.	Assistant Superintendent
J. G. STARLING, B.S.	Assistant Superintendent
ORNAMENTAL HORTICULTURE FIELD STATION, Spring Hill, Mobile County	
RAYMOND, L. SELF, Ph.D.	Plant Pathologist

\* Leave of absence.

## CHANGES in STATION STAFF

### 1955 Appointments

FRED ADAMS, Ph.D.	Assoc. Soil Chemist
RUTH ALBRECHT, Ph.D.	<i>Home Econ. (Joint employee with School of Home Econ.)</i>
HERMAN BOUWER, Ph.D.	Assoc. Agr. Engineer
HENRY H. FUNDERBURK, JR., B.S.	Assistant in Botany
RUTH A. HAMMETT, M.S.	Assistant in Agr. Economics
ARTHUR E. HILTBOLD, Ph.D.	Assoc. Soil Microbiologist
TROY KEEBLE, B.S.	Greenhouse Manager
EDWARD E. KERN, JR., M.S.	Assoc. Agr. Economist
GEORGE K. KIESEL, D.V.M.	<i>Animal Pathologist (Joint employee with School of Veterinary Medicine)</i>
EMORY K. KIRKWOOD, M.S.	Assistant Agr. Economist
BEE EUGENE LANDRUM, B.S.	Assistant Agr. Editor
ETHEL McNEIL, Ph.D.	Assoc. Poultry Pathologist
ROBERT EDWARD POPPY, B.S.	Assistant in Forestry
MARY E. PRATHER, B.S.	<i>Assistant in Home Econ. (Joint employee with School of Home Econ.)</i>
DAN W. SPEAKE, M.S.	<i>Assistant Leader, Cooperative Wildlife Research Unit</i>
MARION W. SPIDLE, M.A.	<i>Head, Department of Home Economics (Joint employee with School of Home Economics) Dean School of Home Econ.</i>
ROY EUGENE STEVENSON, B.S.	Assistant Agricultural Editor
ROBERT LEONARD SPIGNER, M.S.	Assistant in Horticulture
HAROLD L. STREETMAN, M.S.	Assoc. Agricultural Economist
REDDING S. SUGG, D.V.M.	<i>Head, Department of Animal Disease Research (Joint employee with School of Veterinary Medicine) Dean School of Vet. Med.</i>
LEON WALKER TURNER, D.V.M.	Asst. in Animal Pathology
MILDRED S. VAN DE MARK, M.A.	<i>Assoc. Home Economist (Joint employee with School of Home Econ.)</i>
WILLIAM MICHAEL WARREN, Ph.D.	Assoc. Animal Breeder

### 1955 Resignations

MOORE J. BURNS, Ph.D.	Assoc. Animal Nutritionist
J. OLAN COOPER, B.S.	Assoc. Agr. Editor
WILLIAM LYLE DORRIES, Ph.D.	Assistant Agr. Economist
THOMAS McDONALD EDEN, JR., B.S.	Greenhouse Manager
PRYCE B. GIBSON, Ph.D.	Assoc. Plant Breeder
KEITH E. GREGORY, Ph.D.	Assoc. Animal Breeder
WADE F. GREGORY, M.S.	Assoc. Agricultural Economist
BEE EUGENE LANDRUM, B.S.	Asst. Agricultural Editor
CHARLES K. LAURENT, Ph.D.	Assoc. Agricultural Economist

### Deceased

HOMER B. TISDALE, M.S.	Plant Breeder
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### 1956 Appointments

JAMES MCCOY BARBER, B.S.	Assistant in Horticulture
EDWARD T. BROWNE, JR., M.A.	Assistant Botanist

E. D. CHASTAIN, JR., Ph.D.	Assoc. Agr. Economist
EDWARD M. CLARK, M.S.	Assistant Botanist
WILLIAM G. DACRES, Ph.D.	Bacteriologist
FORREST E. GOODRICK, B.S.	Assistant in Forestry
JOHN L. HILL, D.For.	Forester
JAMES G. LINK, JR., B.S.	Assistant in Agronomy
CLAUDE H. MOORE, Ph.D.	Assoc. Poultry Husbandman
PAUL F. PARKS, B.S.	Assistant in Animal Husbandry and Nutrition
JAMES W. PATE, B.S.	Assistant in Horticulture
CHARLES A. ROLLO, M.S.	Assoc. Agricultural Engineer
ROY OTIS RUSSELL, JR., B.S.	Assistant in Agr. Economics
JOHN B. SANDERS, B.S.	Asst. Superintendent, Lower Coastal Plain Substation
BERYL H. SELLERS, A.B.	Associate Editor
HENRY F. TURNER, M.S.	Assistant Zoologist
JACK L. TURNER, M.S.	Assistant in Agr. Economics
EARL L. WIGGINS, Ph.D.	Assoc. Animal Breeder

### 1956 Resignations

M. W. ALISON, B.S.	Asst. Supt. Sand Mountain Substation
RAY ALLISON, M.S.	Assistant Zoologist
JIMMY LEE BUTT, M.S.	Assoc. Agricultural Engineer
EDWIN L. HOVE, Ph.D.	Animal Nutritionist
CHARLES M. MARTIN, Ph.D.	Assoc. Animal Husbandman
FRED MOULTRIE, Ph.D.	Poultry Husbandman
ROBERT L. SPIGNER, M.S.	Assistant in Horticulture

### Deceased

WILBUR BAKER KELLEY, B.S.	Superintendent, Black Belt Substation
EMORY KYLE KIRKWOOD, M.S.	Assistant Agricultural Economist

**FINANCIAL REPORT**  
**Fiscal Year Ended June 30, 1955**

Item	Hatch	Adams	Purnell	Bankhead-Jones	Research & Marketing	All Other
BALANCE JULY 1, 1954	.00	.00	.00	.00	.00	314,969.52
INCOME	15,000.00	15,000.00	60,000.00	88,305.89	322,086.33	1,589,781.89
TOTAL FUNDS AVAILABLE	15,000.00	15,000.00	60,000.00	88,305.89	322,086.33	1,904,751.41
EXPENDITURES						
PERSONAL SERVICES	13,692.61	12,445.40	49,307.36	73,396.22	213,032.82	780,527.94
TRAVEL	28.49	171.63	1,497.15	3,489.93	16,559.38	40,049.12
TRANSPORTATION OF THINGS	61.31	16.48	58.63	47.87	923.92	6,276.71
COMMUNICATION SERVICE	79.50	23.55	311.50	176.15	1,161.54	10,687.33
RENTS & UTILITIES	229.54	535.00	1,009.91	747.71	3,567.57	30,659.52
PRINTING & BINDING			342.00		2,224.55	5,870.24
OTHER CONTRACTURAL SERVICES	179.37		1,337.07	1,102.65	7,760.54	124,442.64
SUPPLIES & MATERIALS	729.18	643.87	4,873.66	7,496.21	38,177.71	408,907.50
EQUIPMENT		1,164.07	1,262.72	1,849.15	27,706.93	105,087.94
LAND & STRUCTURES					9,129.24	44,803.68
TAXES & ASSESSMENTS						7,763.19
TOTAL EXPENDITURES	15,000.00	15,000.00	60,000.00	88,305.89	320,244.20	1,565,075.81
BALANCE ON HAND JUNE 30, 1955	.00	.00	.00	.00	1,842.13	339,675.60
TOTAL EXPENDITURES & BALANCE	15,000.00	15,000.00	60,000.00	88,305.89	322,086.33	1,904,751.41

**FINANCIAL REPORT**  
**Fiscal Year Ended June 30, 1956**

Item	Hatch	Research & Marketing	All Other
BALANCE JULY 1, 1955	.00	1,842.13	339,675.60
INCOME	551,099.85	89,510.00	1,848,580.47
TOTAL FUNDS AVAILABLE	551,099.85	91,352.13	2,188,256.07
EXPENDITURES			
PERSONAL SERVICES	381,456.89	75,371.51	860,763.20
TRAVEL	30,132.22	1,040.78	42,158.63
TRANSPORTATION OF THINGS	974.45	26.49	7,984.19
COMMUNICATION SERVICE	1,650.47	102.20	10,954.97
RENTS & UTILITIES	3,339.97	375.91	39,733.57
PRINTING & BINDING			6,364.08
OTHER CONTRACTURAL SERVICES	9,193.29	133.59	103,949.73
SUPPLIES & MATERIALS	60,810.27	6,031.57	447,071.88
EQUIPMENT	41,628.52	4,000.33	106,300.14
LAND & STRUCTURES	21,913.77	2,319.00	30,753.75
TAXES & ASSESSMENTS			8,454.36
TOTAL EXPENDITURES	551,099.85	89,401.38	1,664,488.50
BALANCE ON HAND JUNE 30, 1956	.00	1,950.75	523,767.57
TOTAL EXPENDITURES & BALANCE	551,099.85	91,352.13	2,188,256.07

