

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
Knoxville

FORTY-FOURTH ANNUAL REPORT
1931



THE UNIVERSITY OF TENNESSEE AGRICULTURAL EXPERIMENT STATION Knoxville

H. A. MORGAN, President

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LESTER WEAKLEY, Assistant, Mericourt Exp. Sta., Clarksville
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WANDA M. SMITH, Stenographer
NEDA SWANNER, Stenographer
MILDRED GALLAHER, Stenographer

*Cooperative with Office of Cereal Crops and Diseases, U. S. D. A.

The Agricultural Building, containing the offices and laboratories of the Experiment Station, the College class rooms, and the headquarters of the Agricultural Extension Service, is located at the University Farm, on Kingston Pike, about one mile west of the main campus. Farmers are cordially invited to visit the building and the experimental grounds.

Bulletins of this Station will be sent, upon request, free of charge, to any farmer in the State.

LETTER OF TRANSMITTAL

Knoxville, Tennessee, January 1, 1932

To His Excellency, Henry H. Horton, Governor of Tennessee.

Sir: I have the honor to transmit herewith, on behalf of the Board of Trustees of The University of Tennessee, a report of the work and expenditures of the Agricultural Experiment Station for the year 1931. This report is submitted in accordance with the law requiring that the Board having direction of the Experiment Station shall annually submit to the Governor of the State a report of its operations and expenses.

Very respectfully,

H. A. MORGAN, President.

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION

In account with

The United States Appropriations, 1930-31

Receipts

	Hatch Fund	Adams Fund	Purnell Fund
U. S. Treasurer	\$15,000.00	\$15,000.00	\$60,000.00

Disbursements

Salaries	\$10,264.33	\$12,769.33	\$48,853.25
Labor	1,803.87	621.25	1,120.56
Stationery and office supplies	178.26	4.00	82.33
Scientific supplies, consumable	.30	307.95	1,084.20
Feeding stuffs.....			
Sundry supplies	168.33	124.96	585.41
Fertilizers	40.34	7.05	42.46
Communication service	267.68	1.95	32.14
Travel expenses	219.78	71.54	1,586.33
Transportation of things	37.71	27.50	339.90
Publications	706.89		261.00
Heat, light, water, and power	581.98	126.91	256.44
Furniture, furnishings, fixtures	74.58	210.69	458.63
Library	574.02	99.84	223.44
Scientific equipment		577.44	3,187.43
Livestock			14.85
Tools, machinery, and appliances	73.76	14.85	788.01
Buildings and land	2.90	34.74	1,082.40
Contingent expenses	5.27		1.03
Total	\$15,000.00	\$15,000.00	\$60,000.00

FORTY-FOURTH ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF TENNESSEE, FOR 1931

BURLEY TOBACCO STATION, AT GREENEVILLE

Burley tobacco has been grown in Greene County for thirty years or more. The area devoted to it has been greatly increased within the last ten years, and now extends into a majority of the counties of East Tennessee. The value of this crop depends to an unusual extent on quality, no other important crop grown in the State requiring so much painstaking care. The selection of a suitable soil, proper manurial and fertilizer treatment, and the exacting requirements from the seedbed to time of marketing, demand knowledge, skill, and patience to an unusual degree. Successful growers of Burley select a deep, fertile soil, apply farmyard manure liberally, and in addition use fertilizer. At present there is no reliable information as to the kind or amount of fertilizer that can be most profitably used under the various conditions which prevail. Certainly if no manure is used, the kind of fertilizer which may be expected to give best results will be different from that where manure is applied. It is reasonable also to suppose that the amount of manure used per acre will affect the amount and composition of the fertilizer which can be used to the greatest advantage. There is little information available in regard to the economical use of the manure, the effects of preceding crops, and various cultural practices—time of topping, for example—about which growers differ widely in opinion and practice.

In addition to the matters mentioned, growers are concerned with the control of the hornworm and the flea beetle. A few years ago the method of getting rid of the hornworm was hand-picking. Now this pest is killed by poisoning. Control of the destructive flea beetle was an unsolved problem until recently, when the Station Entomologist, Dr. S. Marcovitch, found that certain fluorine compounds, such as barium fluosilicate and cryolite, were effective. This discovery is a good example of the practical value of the Experiment Station. Tobacco diseases are a very serious problem in the older tobacco-growing sections. This is especially true of root rot, which tends to become more and more prevalent wherever Burley tobacco is grown. Burley requires a fertile soil, but unfortunately both lime and manure greatly favor root rot. The

proposal that offers the most promise of success in overcoming the trouble is the use of a highly resistant strain. Such a strain appears not to have been obtained up to the present time, although various "resistant" strains are advertised. In addition to cultural practices and insect and disease control, the subject of tobacco curing needs to be investigated and placed on a better basis.

In 1928 the Station was asked by Mr. Clyde B. Austin, a well-known tobacco-buyer of Greeneville, to consider the establishment of a tobacco station for the Greeneville section. In this request Mr. Austin had the support of a number of prominent buyers and growers. The idea took practical shape during the session of the 1930-1931 Legislature, and a bill was passed granting \$25,000.00 for the purchase of land, and improvements, for the establishment of a tobacco station in cooperation with the Tennessee Agricultural Experiment Station and the Office of Tobacco and Plant Nutrition Investigations, Bureau of Plant Industry, U. S. Department of Agriculture. Afterward, this appropriation, along with others, was reduced 15 per cent, to \$21,250.00, in a called session of the Legislature. In the fall of 1931, 164 acres of land, with buildings, were selected by representatives of the Station and the U. S. Department of Agriculture, and bought by the duly appointed committee representing the State. With proper support, which now seems uncertain, this Station should be able to contribute practical information, based on study and investigation, to the growers of tobacco, not only in Tennessee but also in adjoining states where this crop is grown.

NEW PROJECTS

Two new projects of importance, supported by the Purnell Fund, were begun this year:

An analysis of the economic and social problems of the Tennessee highland area.—This project is being carried on in cooperation with other agricultural experiment stations, and various divisions of the U. S. Department of Agriculture.

Early-spring-lamb feeding and grazing—cooperative with the Bureau of Animal Industry, of the U. S. Department of Agriculture.

COMPLETE LIST OF PROJECTS

Following is a complete list of the projects under which the work of the Experiment Station is now being conducted. The list is grouped by subjects and sources of support. Detailed reports on many of the projects will be found in the reports by departments.

Chemistry and Agronomy

ADAMS FUND

1. Humus investigations—a study of various factors affecting the humus content of the soil.—For report, see Bulletin No. 135.
2. A comparative study of the nitrogen economy of the soil (a sub-project to No. 1).—For report, see Bulletin No. 135.

Chemistry of Soils

ADAMS FUND

1. The decomposition of calcium and magnesium carbonates in soils under field conditions, including leaching investigations.
 2. Sulphur conservation in soil as influenced by lime and magnesia.
 3. Influence of form and derivation of magnesium oxides and carbonates upon carbonation and silication in soils.
- Note.—Numerous articles on all these projects have appeared in "Soil Science" and other journals.

PURNELL FUND

1. The effects of single and cumulative additions of calcic and magnesian materials on soil constituents—a lysimeter study.—Numerous articles have appeared in "Soil Science" and other journals.
2. The migration, fixation availability, and nature of the combinations that ensue when P_2O_5 is supplied to the soil by superphosphate with and without supplements of limestone and dolomite.

Plant Pathology

ADAMS FUND

1. Wheat root rot and wheat head blight in their relation to deterioration and reduction in yield of wheat.
2. Fusaria causing wilt in Tennessee.
3. Prevention of crown gall.
4. Strawberry blackroot.

PURNELL FUND

1. Control of tobacco wild fire and black fire.
2. New fungicides and their relative efficiency.
3. Verticillium wilt of cotton.—See Circular No. 24.
4. Apple- and pear-blight control in blossoms.
5. Peach brown-rot-control experiments.
6. Cherry leaf-spot control.
7. Control of black rot and other diseases of apples.

Entomology

ADAMS FUND

1. The woolly aphis—life-history and control.
2. Ecology and control of cutworms.

PURNELL FUND

1. The fluosilicates as insecticides and the manner of their action.—A number of publications have appeared on this subject, in science journals and in Station bulletins and circulars.

2. Plum curculio control.

3. Oriental peach moth control.

Botany

PURNELL FUND

1. Production and improvement of cotton varieties suitable to Tennessee conditions.

2. Leaf spot of tomato—a control study.—See Circular No. 31.

3. Red clover—selection for improvement, with special regard to disease resistance.

Economics

PURNELL FUND

1. The effect of industrial development on the welfare of the rural population.

2. Study of cooperative marketing associations in Tennessee.

3. Taxation as it affects agriculture.

4. Cotton market price studies.—In cooperation with U. S. Department of Agriculture and other Southern Experiment Stations.

5. Southern Appalachians—an economic study in cooperation with the Bureau of Agricultural Economics, of the U. S. Department of Agriculture.

Bacteriology

PURNELL FUND

1. Acid sodium sulphate as a disinfectant of poultry yards.—For report, see Bulletin No. 143.

Home Economics

PURNELL FUND

1. The nature, origin and function of "bios."—A number of articles have been published in science journals.

2. Bitterweed flavor in milk—its nature and control.—See Circular No. 26.

3. Sweet potato vinegar—an investigation of methods, with special regard to home production.

4. Sweet potato syrup—an investigation of possibilities for home production.

Animal Husbandry

PURNELL FUND

1. Influence of standardizing lambs on quality of meat.

2. Value of supplemental feeds for lambs on pasture.

HATCH FUND

1. Beef-cattle-feeding experiment, to determine the feeding value of molasses as compared with ground shelled corn when added to a standard steer-fattening ration consisting of cottonseed meal, silage, and dry roughage.
2. Grazing experiment with steers on soybeans without supplemental feed.
3. Continuation of the lamb-standardization experiment, comparing the knife with the emasculator.
4. Swine-feeding and grazing experiment, comparing high-grade tankage and buttermilk for pigs being finished on pasture.
5. Swine-feeding and grazing experiments, comparing Sudan grass, soybeans, and lespedeza pasture.
6. The control of Bang's disease in the dairy herd.

STATE FUND

At Middle Tennessee Station, Columbia

1. Beef-cattle-production experiments to determine—
 - a. Cost per year of keeping cows for spring calves.
 - b. Cost per year of keeping cows for fall calves.
 - c. Cost of producing spring and fall calves up to different periods of age.
 - d. The commercial difference (profit or loss) between spring and fall calves finished for baby beef.
 - e. The commercial difference between the production of baby beef and feeder cattle.
 - f. The commercial difference between baby beef finished on winter feed and baby beef finished on grass.
 - g. The commercial difference between calves finished as baby beef, either winter-fed or on grass, and calves finished as 2-year-olds, either on pasture or winter-fed.
2. Steer-feeding and grazing experiment.
3. Control of Bang's disease in the beef-cattle-breeding herd.
4. Projects with sheep.
 - a. Breeding efficiency of early versus late ewe lambs.
 - b. Comparison between lambing in the open and lambing under shelter.
 - c. Study of the efficiency of 5 different breeds of sheep under Tennessee conditions, including the Hampshire, Southdown, Shropshire, Dorset, and Rambouillet.

STATE FUND

At West Tennessee Station, Jackson

1. Steer-feeding experiment to determine the value of molasses on rate and cost of gains in a ration for winter fattening and finishing of 2-year-old steers.

2. Control of Bang's disease in the dairy herd.
3. A dairy-cattle project is being continued for the study of dairy problems peculiar to West Tennessee.

Agronomy

PURNELL FUND

1. Fertility studies and soil adaptability of Burley tobacco.—See Circular No. 33.

HATCH FUND

At Knoxville Station

1. Fertilizer, lime, and green-manure experiments in a rotation of cowpeas and wheat—the 27th year of this series and the 54th crop in succession. Where the cowpea crop has been removed as hay, the yield of wheat, which was nearly 30 bushels per acre at the outset, has fallen to 10 bushels. Where the cowpea crop has been turned under each year, the yield of wheat remains now in the neighborhood of 20 bushels. The average yield of both cowpea hay and wheat has been appreciably higher on the limed than on the unlimed areas.—For complete report, see Bulletin No. 135.
2. Manure and fertilizer experiments in a 5-year crop rotation—the 27th year of this series. Only with the aid of both manure and lime has red clover proved to be a dependable crop; that is, the omission of either material in the course of the rotation has made the clover crop uncertain. The application of manure as a winter top-dressing to the wheat has greatly favored the stands of grass and clover, but sometimes results in the crowding out of the clover.
3. Varietal trials of corn, wheat, oats, barley, rye, lespedeza, alfalfa, soybeans, and tobacco.—For a complete list of the best varieties of these and other crops, see Circular No. 10.
4. Rate-of-planting experiments, with spring oats and with a number of varieties of corn.—The data relating to spring oats are favorable to 2 bushels of seed per acre. The data show the necessity of considering both the variety of corn and the fertility of the soil.—Bulletin No. 124 contains tables for the practical use of the results obtained.
5. Corn-breeding experiments—object: to get pure lines established from a few of the best varieties, and then, by hybridization and selection, to get varieties of superior productivity.—Several years are required in order to establish a pure line. The lines obtained by the Station are now being investigated with regard to yield and value when the most promising strains are hybridized. This project is cooperative with the Office of Cereal Investigations, of the U. S. Department of Agriculture.
6. Experiments in thinning corn, with reference to the effects of lateness of thinning.—This experiment has not been carried

to completion. Undoubtedly early thinning, when the plants are only a few inches tall, is desirable.

7. Effects of replanting on the yield of corn.—Replanting is often a waste of time, but an effort is being made to determine when it may be justified.

8. Date-of-planting trials with corn and with soybeans.—Early May planting of corn has, on the average for the nearly 20 years of trial, given a slightly higher yield than any other time for both early- and medium-late-maturing varieties.

The yield of soybean hay decreases appreciably with the lateness of planting. The data are very favorable to early April planting of all kinds of soybeans.

STATE FUND

At Knoxville Station

1. Breeding and selection experiments with soybeans.—Some promising hybrids have been obtained, but none can be recommended for distribution.

2. Yields of soybean hay obtained from March planting on fall-sown oats.—Includes effect on yield of oats.

3. Heavy yields of soybean hay have been obtained from plantings of this kind, but the seasons have been favorable.—The yield of oats is reduced so that the practical outcome is in doubt.

4. Comparison of red clover from seed of different sources.—The Tennessee Resistant strain developed by this Station continues to prove decidedly the most dependable for practical use and its production throughout the State is urged.

5. Garden-pea-breeding experiments for cold- and disease-resistance—numerous hybrids made with the Austrian winter pea.—Promising results are being secured, but time will be required for further selection and fixation of strains. Hardy winter (fall-sown) garden peas appear to be obtainable by hybridization with Austrian peas.

6. Date of cutting the annual lespedezas to determine effect on both yield and quality of hay and on seed production.—The best quality of hay is obtained from early cutting, say, when the plants are in bloom. Further data are needed before definite practical recommendations can well be made.

7. *Lespedeza sericea* (a perennial lespedeza) in a mixture with each of a number of common grasses.—This is a promising new crop which the Station is trying out from numerous points of view. There is basis for hope that it will prove highly valuable, especially for poor and waste lands.

8. Experiments with the seed of *Lespedeza sericea* to determine the best practical method of increasing quickness of germination.—Scarification is the best practical method so far found, but dry-heat treatment appears of promise.

9. Trials of rye drilled into lespedeza sod.—Rye drilled into lespedeza sod may make a fair crop, but further evidence is required before the practice can be advised by the Station.

10. Sodium chlorate as a weed-killer—experiments with Johnson grass and Bermuda grass with the salt applied at various rates both in dry form and in a water solution.—Sodium chlorate was found to be undoubtedly an effective weed-killer, but the expense of treatment limits its usefulness to small areas or spots which it is highly desirable should be freed from some weed pest.

STATE FUND

At Mericourt Station, Clarksville

1. Varietal trials of corn, lespedeza, rye, and soybeans.—Neal Paymaster, Jarvis Golden Prolific, and Thompson Prolific have given the highest yields. Italian rye is very promising. Tokio beans appear best suited to this section. The lespedeza trials were inconclusive.

2. Experiments with new concentrated fertilizers in comparison with standard mixtures, under both limed and unlimed conditions for each of five crops: cabbage, beets, tomatoes, cucumbers, and sweet corn.—Two parts of ground limestone to one of the concentrated fertilizer (either Nitrophoska or Ammo-phos-ko) greatly increased the fertilizer effects. The standard mixture gave better results than the concentrated when no lime was used.

3. Lime, inoculation, and fertilizer experiments with garden peas.—The combination of liming, phosphating, and inoculation gave decidedly the best yields. Inoculation was highly effective only where lime and fertilizer were applied.

4. Trial of *Lepedeza sericea*.—This new perennial lespedeza has done very well on the poor land of this Station, and additional areas are to be sown to it.

5. Green-manure and liming experiments with various truck crops.—Sweet clover, red clover, and lespedeza were used under comparable conditions as green-manure crops. The very dry seasons which have prevailed since this series was begun, in 1930, have greatly interfered with the progress of the experiments.

6. Fertilizer-placement and rate-of-application experiments with corn.

7. Coal dust as a fertilizer.—The results were unfavorable.

8. Fertilizer experiments in a young orchard.—Although the soil was very poor in all the elements of plant food, nitrate of soda gave decidedly the greatest growth increases.

At Middle Tennessee Station

1. Varietal trials of corn, soybeans, grass, clover, alfalfa, lespedeza, wheat, oats, and rye.—Neal Paymaster corn, Tokio soybeans, Gladden wheat, Fulghum oats, and Italian rye have all done especially well.

2. Date-of-seeding experiments with various grasses, rye, wheat, alfalfa, red clover, vetch, crimson clover, and Austrian peas.—The large accumulation of data can not be briefly summarized. A publication on the subject at an early date is anticipated.

3. Rate-of-seeding experiments with oats, wheat, barley, rye, alfalfa, and red clover.

4. Effects of nurse crops and kind of preparation on the stand of alfalfa and red clover.

5. Liming experiments with various crops.—Liming at the Middle Tennessee Station was found profitable for alfalfa and clovers and has materially helped the pastures, though fair crops are obtained without liming.

6. Pasture experiments with numerous crops, including common clovers and grasses, and kudzu, alfalfa, soybeans, Sudan grass, and rye; cattle, sheep, and hogs being utilized in the experiments.—Without supplemental feeds, neither kudzu nor soybeans did little more than furnish a maintenance ration. Excellent gains were obtained with cattle on early grass and clover pastures of different kinds, and later in the season exceptionally favorable results were obtained with both Sudan grass and lespedeza. Both these crops are highly recommended for farm use.

7. Experiments in the eradication of sedge grass in a bluegrass pasture.—Sedge grass proved to be readily eradicated under close grazing, coupled with the early spring application of either 200 pounds of nitrate of soda per acre or 150 pounds of ammonium sulphate. Mowing two or three times a year is important where close grazing can not be done. Bluegrass and yellow clover, when sown in a thick stand of sedge grass, soon gained the ascendancy under grazing, so that a fine bluegrass and clover pasture was obtained in about three years with nearly complete elimination of the sedge grass.

8. Experiments regarding the value of nitrate of soda as a fertilizer for both pastures and cereal crops.

Forestry

Experiments in the development of a locust grove.

At West Tennessee Station

1. A comparative study of various crop rotations.—Red clover, alfalfa, crimson clover, and sweet clover have proved, in the Station's trials, to be the most effective crops in a rotation for soil-improvement purposes. Annual legumes, like cowpeas and soybeans, proved of little value as soil-improvers unless pastured off or turned under.

2. Effects of liming on various farm crops—a comparison between burnt lime and ground limestone included.—Liming was found necessary to the production of alfalfa, sweet clover, red

clover, and alsike. Liming was usually profitable for corn, wheat and other grain crops; for cowpeas, soybeans, lespedeza, and crimson clover; and for most garden crops. Little or no difference was found between the effects of 2 tons of ground limestone and 1 ton of burnt lime per acre.

3. Green-manuring experiments with cowpeas to determine the effect of the cowpea crop on wheat immediately following.—This experiment has been continued for 22 years. For the last 6 years the average yields of wheat have been as follows:

Where cowpeas were turned under.....	27.0 bu.
Where the cowpeas were removed as hay.....	15.9 "
Where no cowpeas were grown.....	16.0 "

4. Tillage experiments with both corn and cotton—object: to determine best depth of plowing and best method of cultivation.—Neither subsoiling nor extra-deep plowing proved profitable for either corn or cotton. Cotton responds less than corn to changes in depth of plowing and of cultivation. At the Jackson Station, breaking the land 3 inches deep appeared ample for this crop.

5. Varietal trials of various farm crops, including corn, cotton, soybeans, grass, clover, lespedeza and alfalfa.—Much effort has been put forth by the Station to find the most productive varieties of farm and garden crops. The list of those recommended can be found in Circular No. 10 for the farm crops and Circular No. 27 for the garden crops. New varieties are being constantly tried.

6. Rate-of-application experiments with nitrate of soda for (1) corn, (2) cotton, (3) sweet potatoes, and (4) tomatoes.—All these crops respond readily to nitrating. The results indicate that not more than 200 pounds of nitrate per acre can ordinarily be used for either cotton or tomatoes. As a rule, 100 pounds per acre is a safe amount, but crop prices and the responsiveness of the soil must be carefully considered. In the case of either corn or sweet potatoes, 80 to 100 pounds per acre of nitrate appear practical.

7. A comparison of various nitrogenous fertilizers for (1) corn, (2) cotton, (3) sweet potatoes, and (4) tomatoes.—This series has been continued for 5 years at the West Tennessee Station. Equal quantities of nitrogen from each of the materials mentioned have been applied, and a record kept of the yields. The ranking, in order of yield, is as follows:

- 1st—Nitrate of soda
- 2nd—Ammonium sulphate
- 3rd—Cyanamide
- 4th—Cottonseed meal

8. Improvement of Fulghum oats by selection.—Promising strains of this valuable variety have been obtained. An effort is being made to get a hardier strain suitable for fall planting.

9. Experiments with crimson clover and rye as green-manure crops preceding tomatoes, cabbage, and sweet potatoes.—At present the data are insufficient for detailed conclusions, but crimson clover appears to be the most reliable and most efficient green-manure crop of all those tried by the Station.

10. Corn grown continuously with various manure and fertilizer treatments.—This experiment has been continued for 22 years. The average yields per acre are as follows: Without manure or fertilizer, 27.8 bushels; with 5 tons of manure per acre each year, 44.1 bushels—an increase of 3.3 bushels of corn for each ton of manure applied.

11. Sorghum grown continuously, both with and without manure.—This experiment has been continued for 22 years. The average yields per acre are as follows: Without manure, 9.67 tons of green matter; with 5 tons of manure per acre each year, 15.15 tons of green matter—an increase of 1.1 tons of green matter per ton of manure applied. One ton of green matter was found to give .34 ton of air-dry substance.

12. Sorghum grown continuously for forage, both with and without cowpeas.—This experiment has been continued for 22 years. Sorghum planted alone gave an average annual yield of 11.73 tons of green substance per acre, but when planted with cowpeas the average yield was 13.08 tons.

13. Cotton grown continuously under various fertilizer treatments.—On this farm, phosphate has not been profitable. On the gray, or "white," land, muriate of potash at the rate of 50 pounds per acre has proved highly profitable. Elsewhere on the farm the potash did not prove of value. Nitrate of soda was found profitable on all the soils of the farm.

14. The effects of sweet clover as a soil-improving crop.—The results have been very favorable to sweet clover for this purpose. Data are given in Bulletin No. 142.

15. Experiments with *Lespedeza sericea* to determine yield and feeding value of hay as compared with alfalfa. Also a trial of the same variety as a pasture crop for sheep.—This is a newly-introduced perennial lespedeza and is of much promise, especially for the poorer lands of the State. In feeding value it appeared inferior to alfalfa, but is probably superior to grass hay. For further information, see Circular No. 42.

16. Time-of-application experiments with nitrate of soda for cotton. No conclusion as to best time has been reached, but an application at time of first hoeing gives a good account of itself.

17. Date-of-planting trials of cotton.—On the average for the 12 years for which records have been obtained, plantings made the first half of May have given a somewhat better yield than those made the latter half of April. For the earlier period the

average yield is 1669 pounds of seed cotton per acre, and for the later period 1737 pounds.

Horticulture

PURNELL FUND

1. Root-knot nematode control.
2. Fire-blight resistance.
3. Inheritance in cultivated strawberries.—A promising new strawberry, the "McClintock," has been developed, and is now being distributed.

STATE FUND

At Knoxville Station

Early cabbage.—Premature seed development. Varietal trials.

Rhubarb.—Breeding and selection for crown-rot resistance.

Pyrethrum.—Selecting for health and vigor; also for high pyrethrumate content. Commercial possibilities of this crop.

Irish potatoes.—Tests of a very promising new variety for the fall crop in comparison with other standard varieties. Tests of U. S. D. A. seedlings and selections in comparison with standard varieties for the spring crop. Source of seed; time and methods of seeding.

Sweet potatoes.—Varietal trials. Influence of potash on shape and quality of sweet potatoes.

Tomatoes.—Pruning, staking, and spacing tests. Varietal trials.

Bush beans.—Varietal trial.

Peas.—Varietal trial.

Asparagus.—Depth of planting.

Red raspberry breeding.—Trying to produce a variety well adapted to the South.

Lilacs.—The influence on and value of privet stock for French varieties of lilacs. Trial of French varieties for southern conditions.

Ornamental shrubs and trees.—Trial of promising plants of this group that have been imported by the U. S. D. A. Foreign Plant Importation Office. Also anything new and promising along this line.

Carrots.—Commercial possibilities as a spring crop for canners. Also a varietal trial. Carrots as a crop for cold-frame gardening.

Greens.—Spring-sown, fall-planted and cold-frame-grown. Varieties to use.

Lettuce.—As a cold-frame crop. Commercial possibilities of head lettuce for Tennessee.

Sweet corn.—Trials of sugar-corn varieties compared with varieties less susceptible to corn earworm.

Strawberries.—The use of nitrate of soda and sulphate of ammonia on strawberries. Trials of promising varieties from the U. S. D. A. and other experiment stations.

Peaches.—A pruning experiment. Varietal trials of U. S. D. A. foreign plant importations. New strains and varieties from other stations.

Plums.—A comparison of a very promising new variety from Africa with standard varieties.

Cherries.—Tests of new strains and varieties from other stations.

Fruit stocks.—Tests of promising species or kinds of stocks for various fruits.

Watermelons.—Tests of promising new varieties in comparison with standard ones.

Squash.—Tests of promising new strains or varieties in comparison with standard ones.

Apples.—Tests of new bud sport strains and new varieties in comparison with standard ones.

At Middle Tennessee Station

Asparagus.—Rust-resistant asparagus as a crop for Middle Tennessee.

Apples.—Early varieties for Middle Tennessee.

At Mericourt Station

Pyrethrum.—Spacing experiment and commercial crop possibilities.

Asparagus.—Male versus female plants.

Strawberries.—Growing McClintock plants for distribution.

Raspberries.—Varietal trials.

Fall-crop irish potatoes.—A trial of the possibilities of a very promising new variety in comparison with standard sorts.

Sweet potatoes.—Varietal trials.

Ornamental plants.—Soil requirements and preference for flowering shrubs and plants.—To be started in 1932.

Rhubarb.—Selecting crown-rot-resistant plants and propagating them by crown division.

At West Tennessee Station

Asparagus.—Early asparagus production, using rust-resistant varieties and shipping the crop north.

Strawberries.—The use of nitrate fertilizer on strawberries.—Promising seedling test from the Knoxville Station and other parts of this country. Plant production of the new McClintock variety for distribution. (Partly Federal.)

Early cabbage.—Test to determine causes of premature seed-stalk development.

Tomatoes.—Pruning test. Varietal trials. Fertilizers for tomatoes.

Sweet potatoes.—Fertilizer tests.

Carrots.—As a crop sown in the spring.

Irish potatoes.—Varieties for spring planting. Commercial possibilities of a certain variety for the fall crop.

Greens.—Varieties for both spring and fall sowing.

Cantaloupes.—Varietal trials.

Peaches.—New and promising varieties.

Pears.—(Federal work).

Plums.—New and promising varieties.

Apples.—Crown gall.

Raspberries.—Varietal trials.

Roses.—A comparison of "Ragged Robin," "Manetti" and "Multiflora" stocks for outdoor roses.

PUBLICATIONS

Bulletins

Due to shortage of funds, no bulletins were published this year.

Circulars

Circulars reporting data and practical conclusions from the Station's work were published as follows:

Circular No. 34—Increasing the profits from phosphates for Tennessee soils, by C. A. Mooers, January, 1931.

Circular No. 35—The Tokio soybean, by C. A. Mooers, February, 1931.

Circular No. 36—Canker treatment for fire-blight control, by J. A. McClintock, March, 1931.

Circular No. 37.—Apple scab spraying experiments in Tennessee, by C. D. Sherbakoff and J. O. Andes, April, 1931.

Circular No. 38—Control of flea beetle and hornworm on tobacco, by S. Marcovitch and W. W. Stanley, December, 1931.

Circular No. 39—Curing pork on the farm, by L. R. Neel, December, 1931.

Other Publications

Department of Chemistry

MacIntire, W. H. The relation of native and added calcic and magnesian materials to the availability of potassium (Summary Symposium Contribution). Jour. Am. Soc. Agron., Vol. 23: page 1054. 1931.

Shaw, W. M. Determination of carbon dioxide in soil carbonates—a modification of the official method. Jour. A. O. A. C., Vol. XIV: pp. 283-292, May, 1931.

Shuey, G. A. Report on fluorine compounds. Jour. A. O. A. C., Vol. XIV: pp. 126-132. 1931.

Department of Economics

Allred, C. E., and Boyer, P. B. Estimates of possible revenues from certain specified taxes. 52 pages. Published by Division of University Extension. March, 1931.

Department of Entomology

Marcovitch, S., and Stanley, W. W. A preliminary report on arsenical substitutes for peach spraying. Jour. Econ. Ento., Vol. 24: pp. 844-850. 1931.

Marcovitch, S., and Stanley, W. W. A preliminary report on the effectiveness of sodium fluosilicate as compared with borax in controlling the house fly. Jour. Econ. Ento., Vol. 24: pp. 490-497. 1931.

Marcovitch, S., and Stanley, W. W. A preliminary report on arsenical substitutes for peach spraying. Proc. Tenn. State Hort. Soc. pp. 86-92, 1931.

Stanley, W. W. Altitude records for *Diabrostica duodecimpuncta* (Fabricius) in Tennessee. Jour. Econ. Ento. Vol. 24: p. 1311. 1931.

Department of Horticulture

Drain, Brooks D. New strains from old varieties. Proc. Tenn. State Hort. Soc., pp. 33-37. 1931.

McClintock, J. A. Studies on cultural practices in relation to brown-rot control. Proc. Tenn. State Hort. Soc., pp. 67-70. 1931.

McClintock, J. A. Breeding better strawberries for Tennessee. Proc. Tenn. State Hort. Soc., pp. 71-74. 1931.

McClintock, J. A. Cross-inoculation experiments with Erigeron yellows and peach rosette. Phytopathology, Vol. XXI: pp. 373-386. 1931.

McClintock, J. A. The relation of canker treatment to fire-blight control. Phytopathology, Vol. XXI: pp. 901-906. 1931.

CHANGES IN STAFF

New Members

Brooks D. Drain, Associate Horticulturist, beginning September 1. Mr. Drain comes from the Massachusetts Agricultural College, at Amherst, where he was Assistant Professor of Pomology.

Paul H. Hornburg, Assistant Plant Pathologist, beginning July 1. Mr. Hornburg comes from Cornell University, where he did special work in plant pathology.

Resignations

J. A. McClintock, Horticulturist and Associate Plant Pathologist, resigned September 1, to accept a superior position at Purdue University, Indiana. Mr. McClintock came to the Tennessee Station in 1922, and during his stay here he organized and expanded his department to its present size and efficiency. Prob-

ably his most outstanding practical achievement was the development of the McClintock strawberry, which resembles the Klondike in a number of respects, but has proved to be superior in both yield and size of fruit.

E. J. Hopkins, Assistant Agricultural Economist, resigned to accept a position at Ohio State University. Mr. Hopkins was with the Tennessee Station only a short time, but proved to be a capable and well-trained worker, whom the Station was sorry to lose.

REPORTS BY DEPARTMENTS

AGRONOMY

C. A. Mooers

Weather

The seasonal conditions were generally much better this year than in 1930. At both the Middle Tennessee and Mericourt Stations, however, the summer and fall rainfall was very light, so that crop yields were greatly reduced. At Knoxville the rainfall of the summer was below the average, and that of the fall was very light. The rainfall at the West Tennessee Station was more favorable both in summer and fall.

Cooperative Fertilizer Experiments with Cotton

The fertilizer experiments with cotton, begun in 1930, in cooperation with West Tennessee farmers, were continued in 1931. The season was nearly normal and the results secured would come much nearer being of value as a practical guide than those obtained in the very dry year of 1930.

One of the striking results obtained is the marked response to a complete fertilizer on the so-called "white" lands, which are to be found usually in small areas scattered over this section of the State. Three hundred and fifty pounds of a fertilizer analyzing 5 per cent nitrogen, 9 per cent phosphoric acid, and 7 per cent potash gave outstanding results on this type of soil. On the typical gray-brown soil of the western two-thirds of West Tennessee (see Circular No. 20), phosphate did not prove profitable, but a combination of nitrate of soda, top-dressed at the time of the first hoeing at the rate of 100 pounds per acre, and 50 pounds of muriate of potash applied in the row before planting, was highly profitable. In the eastern area a complete fertilizer proved best, and may well be of the same composition as that found effective on "white" land.

It is hoped to continue these experiments until more conclusive evidence can be obtained.

Cooperative Varietal Trials of Corn

The cooperative varietal trials of corn, conducted under the supervision of Prof. O. W. Dynes, were continued in each of a number of counties as in previous years. The superior yielding capacity of Neal Paymaster continues in evidence. Also the adaptability of both Jarvis Golden Prolific and Thompson Prolific to average uplands continues. The former variety is the best yellow corn found by the Station, and the latter is without doubt a very superior early variety of field corn. Both varieties are extra sound but neither equals Neal Paymaster in productiveness.

Lespedeza Sericea

The perennial lespedeza, *Sericea*, which has been grown by the Station since 1927, continues to attract much attention as a new hay and pasture crop of promise. Its adaptability to medium and poor lands, its longevity, and its ability to maintain itself under unfavorable conditions, are greatly in its favor. Every effort is being made to find out its true value and place on the farm and to ascertain the best cultural methods. Seed will be distributed to farmers for trial in all parts of the State. Unfortunately, the scarcity of seed greatly restricts the amount that can be sent out by the Station.

Two strains have been tried by the Station and seed sent out for trial will be limited to the somewhat earlier but more vigorous and productive strain received from the Office of Forage Crops, of the U. S. Department of Agriculture, as No. 04730.

The list of agronomy projects on pages 10-15 will serve as a summary of work being done by this Department. In addition, the special reports, such as those on corn improvement, which immediately follows, and cotton improvement (page 26), are on important lines of agronomic endeavor that may easily prove of great practical value to the State's agriculture.

CORN IMPROVEMENT

L. S. Mayer

Progress is being made in the corn-improvement project, cooperative between the Office of Cereal Crops and Diseases of the U. S. Department of Agriculture and the Tennessee Experiment Station. This work includes agronomic, genetic, and cultural studies, varietal comparisons, and breeding experiments.

Inbreeding

Inbreeding through self-fertilization is being done with Neal Paymaster, Delta Prolific, Jarvis Golden Prolific, a hybrid yellow dent, and two white dent varieties of lesser commercial importance. In addition, selfed lines from 5 varieties of roasting-ear

corn taken over from other members of the Station staff are being continued, in reduced numbers.

There were 756 field rows planted in 1931 for self-pollination, 14 for some miscellaneous crossing, and 90 rows of sweet corn double crosses for observation, marketing test, and chemical analysis of sugar content.

Sweet Corn Double Crosses

The analyses of these sweet corn double crosses were made by Mr. G. A. Shuey, Associate Chemist of the Station, who reports them in table 1. The data show the wide variations found in the sugar content of the various strains.

TABLE 1—*Analyses of sweet corn double crosses*

Kernels were removed from 6 ears of freshly plucked corn of known age. The material was thoroughly mixed, and samples weighed out for analysis.

Double-cross designation	Date silk	Date sampled	Water	Solids	Sugars as dextrose	
					Wet	Dry
			Per cent	Per cent	Per cent	Per cent
A	July 27	Aug. 11	77.61	22.39	3.54	15.81
B	July 27	Aug. 11	75.70	24.30	3.25	13.37
C	July 27	Aug. 11	71.77	28.23	3.36	11.90
D	July 27	Aug. 11	69.88	30.12	2.97	9.86
E	July 27	Aug. 11	71.36	28.64	3.12	10.89
F	July 27	Aug. 11	71.67	28.33	3.78	13.34
G	July 27	Aug. 11	74.55	25.45	3.31	13.05
H	July 27	Aug. 11	75.50	24.50	2.83	11.55
I	July 27	Aug. 11	75.92	24.08	3.82	15.86

Remnant seed of the two most desirable double crosses has been placed with several commercial market-growers in North Georgia and Southeastern Tennessee, through the agency of Mr. H. L. Fackler, Agricultural Agent for the L. and N. Railroad. These growers will further test these double crosses and begin selection work for market type. Tests of the 8 crosses which were used to make the double crosses show several of them to be superior in tonnage per acre to the standard commercial varieties and much superior with respect to per cent of earworm infestation.

Yields of Crosses Between Self-Fertilized Lines

The past season was much more favorable than that of 1930, and the yields were considerably higher. The average yield of the two Paymaster strains used as checks in the yield test of crosses was 48.42 bushels of shelled corn per acre, as compared to 34.82 bushels in 1930. The check strains were grown by Mr. John W. Davis, a certified grower in East Tennessee, and Mr. W. H.

Neal, the variety originator, in Middle Tennessee. The test rows were 10 hills long, thinned to an even stand of 10 plants to the row, and the number of replications was 9. Beginning with the first row, after a guard row on the outside of the field, every tenth row was a check, using Neal Paymaster and Davis Paymaster alternately. There were 173 direct and reciprocal crosses tested, involving 22 different selections, of which 15 were from the 7 major-project types mentioned in previous reports. These types include 10-, 14-, and 18-kernel-row selections and varying kernel shapes and endosperm densities.

The yields of each group of direct and reciprocal crosses were compared with the average yields of the two adjacent checks. That is, test rows 2 to 10 were compared individually with the average of check rows 1 and 11. Of the 140 test crosses from the regular type selections, 44 are 100 per cent or better, with several showing significant differences. The 7 selections from the 8-, 12-, and 16-row types, involved in 33 crosses only, show 32 of these to be 100 per cent or better, with those between the 12- and 16-row types generally outstanding.

Several of the best- and poorest-yielding selections in these crosses will be used in 1932 for making double crosses. Also other selections from the 7 types will be used for single crosses for further testing. The unsatisfactory families will be eliminated from the breeding field, and the better lines enlarged.

Disease Susceptibility

Several families in the major Neal Paymaster lines are showing evident susceptibility to *Helminthosporium* infection. A check of these families in the field will be made in 1932 and a note of the results made elsewhere.

ANIMAL HUSBANDRY

M. Jacob

Beef-Cattle-Feeding Experiments

In November, 1930, a steer-feeding experiment was begun at the Knoxville Station to determine:

1. The feeding value of molasses as compared with ground shelled corn when added to a standard steer-fattening ration consisting of cottonseed meal, silage, and dry roughage when fed for winter finishing in dry lots during the entire feeding period.

2. The feeding value of molasses as compared with ground shelled corn when added to a standard steer-fattening ration consisting of cottonseed meal, silage, and dry roughage, when fed for winter finishing during the last half of the feeding period. In this experiment 40 uniform 2-year-old steers of good grade,

divided into 4 groups of 10 steers each, were started on feed, and were finished and marketed in March, 1931, after being on feed 120 days. The time on experimental feed was divided into 4 periods of 30 days each.

In this year's work the addition of molasses or corn to the standard ration of normal silage and cottonseed meal did not increase the daily gains, improve the finish or appearance of the cattle, or raise the selling price of the finished cattle. Similar feeding trials will be continued for at least two years before an attempt is made to draw definite conclusions.

In November, 1930, a similar steer-feeding experiment was begun at the West Tennessee Experiment Station, located at Jackson, to determine the effect of molasses on rate and cost of gains in a ration for winter fattening and finishing steers.

The steer-feeding and grazing experiment at the Middle Tennessee Station, started in 1929, was continued in 1931. The object of this experiment is to determine the maximum amount of grain necessary to feed 2-year-old steers being finished on grass in order to produce the most economical gains with sufficient finish to meet market requirements. For this year's trials 35 uniform 2-year-old steers of medium grade were selected and divided into 5 groups of 7 steers each. Group I was again used as a check lot, being grazed without grain, and the other groups were grazed and fed the same ration as the corresponding groups in 1929 and 1930, except that oat straw was substituted for hay for one of the groups. Unfortunately, during the summer of 1931 we had a severe drouth in Middle Tennessee, which interfered with this trial to some extent and necessitated marketing the steers somewhat earlier than during previous years of the experiment. However, the results for this year again showed that heavy grain feeding to 2-year-old steers was not economical when they were being finished on grass for mid- or late-summer market. This experiment will also be continued until we are justified in drawing definite conclusions.

The beef-cattle-production experiment at the Middle Tennessee Station is still under way, but with the likelihood that breeding for fall calves may be discontinued after this year. It is our belief that this work will have been continued long enough to justify drawing definite conclusions as to the relative merits of spring and fall calving under Tennessee conditions. The indications now point toward results most favorable for spring calving. If these results are verified, the entire beef-breeding herd will after this year be bred for spring calving, and a study of the other factors originally included in the experiment will be continued.

Lamb Studies

This is the second year of an experiment in cooperation with the Bureau of Animal Industry, U. S. Department of Agriculture, to study the influence of standardization (docking and castration) of early spring lambs on market grading, carcass grading, and quality of meat. In May, 1931, the second annual shipment, consisting of 36 uniform lambs, of the most desirable weights, including both standardized and unstandardized, were shipped to the U. S. Animal Husbandry Farm, Beltsville, Maryland, for a continuation of carcass and meat studies. The results for the two years are sufficiently uniform to justify discontinuing this experiment. The details of the experiment and the results will be published jointly with the Bureau of Animal Industry.

Further study was made this year at the Knoxville Station in the use of the emasculatome on young lambs. It had been suggested that when this instrument was used alone for docking lambs not over 14 days old, the tail would drop off within a week or ten days after the operation. An attempt was made to dock 17 lambs of the proper age by the use of this instrument alone, with the result that 16 tails remained intact. One tail dropped off in a little less than three weeks after the operation. These results indicate that the emasculatome alone is unsatisfactory for docking young lambs.

Other studies in sheep and lamb production were continued, consisting of a comparison between purebred flocks of the Hampshire, Southdown, Dorset, Shropshire, and Rambouillet breeds; influence on growth and maturity of breeding early versus late ewe lambs; and also not breeding ewe lambs until one year old, and lambing in the open versus lambing under shelter. Definite conclusions can probably be drawn from some of this work at the end of another year.

Pig-Feeding and Grazing Experiments

A comparison of Sudan grass, lespedeza, and soybeans as grazing crops when supplemented with shelled corn, tankage, and mineral mixture as a fattening ration for pigs, is under way at both the Knoxville and Columbia Stations. While any attempt at this time to draw definite conclusions would be premature, we do have enough information to justify the recognition of Sudan grass as furnishing dependable and economical pasture for pork production. With another year of work we should be ready to publish the results.

At the Knoxville Station a pig-feeding and grazing experiment was conducted, comparing high-grade tankage and buttermilk for pigs being finished on pasture. Some pigs out of each group were used in a comparative carcass study.

Bang's-Disease Control

Work on the control and eradication of Bang's disease has been under way in the breeding herds at Columbia and Jackson. The Jersey herd at the West Tennessee Station, which was originally established on an abortion-free basis, as determined by a negative reaction to the agglutination test for Bang's-disease infection, is still free from this disease and maintains a normal breeding efficiency. The status of both the beef and dairy herds at the Middle Tennessee Station is gradually being converted from heavy infection to freedom from infection. Blood testing, isolation, sanitation, and proper herd management have been basic, and give promise of an early success in freeing the herds from this disease.

Those associated with the writer in livestock experimental work include Prof. H. R. Duncan at Knoxville, Mr. L. R. Neel and Mr. John T. Davis at the Middle Tennessee Station, and Mr. Ben P. Hazelwood at the West Tennessee Station.

BOTANY

S. H. Essary

Cotton Improvement

Varietal Trials

So far, 129 varieties and strains of cotton have been tested. Of these, only 11 have been retained as of sufficient promise for further study at the three locations: West Tennessee Station at Jackson, Middle Tennessee Teachers' College at Murfreesboro, and the Experiment Station at Knoxville. Plantings were made in replicated plots with checks, and comparisons made as to earliness, yield, and length of lint, and other characters, and their general adaptability to the different sections of the State. Most of the plots are now devoted to trials of our own selections from the best standard varieties.

Selections

Several hundred individual stalk selections have been made from year to year. Most of these have been discarded as no better than the parent strain, but many were carried on in further trials. From the best stalks, seed is saved for future tests, to be made in the same manner as the varietal trials. New selections are being made each year both from Station plots and from fields over the cotton-growing sections of the State.

Self-Pollinated Selections

The most promising selections are self-pollinated to prevent crossing. Uniformity of type and production is sought. Some

have been selfed for a number of years, and a very uniform cotton has been obtained. Seed from these selfed strains are planted in isolated plots to secure pure seed for field trials. Seed of improved strains will be distributed to farmers as soon as possible.

Crosses

Many hundred crosses have been made during the last five years between good varieties. Within the last three years, crosses have been made between self-pollinated selections only. Many other selections are now being selfed for the purpose of making crosses between very uniform selections. Only good upland varieties are now being used for crossing. Formerly, they were made between upland and Sea Island types, but during many years' trial they never became uniform in type, the progeny being so diverse in type and product that little could be expected from them. At first, hybrid vigor was so marked that they seemed of great promise, but our own experience and that of Kearney, Cook, and others in the U. S. Department of Agriculture, and also of workers in other experiment stations, give little hope of accomplishing much in this direction. Our best crosses are grown in progeny and mass-selection rows like the common selections. A comparison is being made between the lint of the hybrids and their parents. This is being done by determining the length and percentage of lint, and the uniformity and distribution of the different lengths by the aid of a lint sorter. A study of inheritance in lint characters is being made. The selections and crosses are tested at each of the three stations mentioned, special attention being given at the station to which each selection or parent seems best adapted.

Lint Comparisons

Not only is a critical study made of the lint from different varieties and selections, but the lint from the same strains grown in the different sections is compared. Thus far little difference is found between the lint either in percentage or length, whether it is grown in West, Middle, or East Tennessee. Neither does the season have any marked influence on these characters. We find also that the fertility of the soil has little effect upon the character of the lint, as shown from differently fertilized plots in the same field. The total yields vary widely, but the lint characters do not.

Inheritance of Characters in Cotton

Using our crosses as material, we are studying the inheritance of many characters, as habit of branching, whether of cluster, semi-cluster, or open branching; color of seed; size of seed; color, length, and uniformity of lint; and size of boll.

Blooming Count

Certain rows are set aside for blooming counts each year, a record being made daily of the blooms that open in time to maturity. Flowers are tagged and dated, and the date at which bolls open is noted on the tags. These bolls are also harvested for lint studies from different blooming dates, and from different parts of the plant. By the aid of the sorter, it is found that the lint varies from the different locations on the plant, and even in the same boll from different parts of the lock. This work will be enlarged during the next season.

Varietal Effect

Experiments were carried out to determine whether one variety exerts any effect upon the yield of another variety grown next to it. Rank-growing varieties are being grown in comparison with smaller varieties.

Laboratory and Equipment

A small laboratory has been fitted up and purchase made of a moisture-control apparatus, with a hygrometer, a drying oven for bringing samples to a uniform moisture condition before weighing in lint studies, a compound binocular microscope, and a Suter-Webb cotton-lint sorter. The lint sorter is very necessary for determining the true value of the lint of a cotton variety. We find that certain varieties that seem to be of good length and quality are very inferior when the lengths of lint are sorted and weighed.

TABLE 2—*Analysis of lint from seed in different parts of the boll—Half and Half variety. 1931 crop at Knoxville*

Location of seed in the boll	Per cent weight by lengths of lint—mean of 50 samples from each section							
	1 inch	15/16 inch	7/8 inch	13/16 inch	3/4 inch	5/8 inch	1/2 inch	Below 1/2 inch
Stem	.33	3.1	13.6	29.9	25.9	9.0	8.6	9.0
Middle	.95	5.4	15.1	28.1	26.2	8.8	7.2	7.7
Blossom	.69	3.5	11.6	29.0	26.6	11.0	9.2	9.4
Mean of 150 samples noted above								
	.67	4.0	13.4	29.0	26.2	9.6	8.3	8.8

The data presented in table 2 were taken on combed samples by means of the Suter-Webb sorter. These samples were taken from bolls that were in turn gathered at random in plots of Half and Half at Knoxville. "Stem" is the designation for the two seeds in the lock at the lower end of the boll; "Middle" is the seeds in the middle of the lock or boll; "Blossom" is the two

seeds at the end of the lock. The object was to find whether there is any difference in the lengths of lint as represented by the seeds in these different locations.

The data are preliminary, but they show differences. The commercial classification of this variety was 13/16, whereas the data show that other large percentages of different lengths are to be found.

Red Clover

The study of the inheritance of resistance of red clover to the anthracnose disease has been continued. In the spring of 1930, 12 plots of red clover were planted, and the resultant crop was kept through 1931. The seed was sown in hills 30 by 18 inches apart and the plants were thinned to 1 per hill. In this way about 9000 individual plants were obtained for study. Seed were collected in 1930 from a few select plants for pot culture in the greenhouse. The greenhouse plants were sprayed with cultures of the anthracnose fungus and a great many of the plants became infected and died. The plants which survived were placed in the field, but failed to make seed. A second seeding was made, and the healthy plants are preserved for seed production in 1932.

The plants in the plots made two crops of seed in 1931. Many selections were made on the basis of vegetative characters, as earliness of maturity and habit of growth, such as size of stem and leaf, color, smoothness, leaf spot, color of flower, and finally, color of seed.

Many of the plants were self-pollinated, and seed was collected from 300 selfed plants. Seed was also selected from about 400 open-pollinated plants. These were divided according to seed color. The three characteristic seed colors are yellow, violet, and violet-green. It was noted that the seed from most of the individual plants was uniform in color. They are to be planted in individual rows, the open-pollinated seed in 10-hill rows, and the selfed seed in 5-hill rows, for study in 1932. An attempt will be made to inoculate the whole field with anthracnose. Seed from the best plants will be collected for greenhouse work.

If strong resistance is found, an attempt will be made to correlate some of the vegetative characters with resistance. Crosses will be made between the best resistant plants and plants from ordinary non-resistant seed for the study of the inheritance of resistance, which is the main purpose of this project. If a new resistant strain is developed, the hope is that it will have a uniform seed color to distinguish it from any other strain, as all samples of red clover seed are composed of a mixed lot of colors.

Tomatoes

The study of tomato leaf spots has been carried on under the following heads: (1) Planting at different dates; (2) soil treat-

ments—(a) in seedbed, (b) in cold-frame; (3) field treatment—(a) dusting, (b) spraying, with checks; (4) varieties—old and new; (5) selections. Record was made of the yield of fruit, as affected by dates of planting, the various treatments, etc.

Dates of Seeding in Hotbed

Seed of several varieties were planted in the greenhouse hotbeds on 5 dates. The results are given in table 3.

TABLE 3—*Average yields of all varieties from different dates of seeding*

Date seeded	Date set in field	First ripe fruit	No of days from seeding	Average yield per acre
				Bu.
Feb. 1	April 20	June 29	149	278
Mar. 1	May 12	July 8	129	266
Apr. 1	May 25	July 27	118	171
May 1	June 23	Aug. 29	121	121
June 1	July 17	Sep. 17	109	(Very small)

The weather was very dry and hot during most of the summer, and the yields were influenced by these conditions. The February 1 plants were heavily infested with *Fusarium* wilt, and died prematurely; hence, the yield was lower than it would have been. The other seedings were influenced by the hot, dry weather. The June seeding was set out in an extremely dry and hot period, and many of the plants died.

In the column showing number of days from seeding, it will be noticed that the April 1 and May 1 seedings ripened very nearly in the same number of days. This can be accounted for by the very cool weather of over a week's duration which occurred in August, when ripening was about to take place. It will be noticed that the period of ripening is much shorter for the late seedings than for the early, and that it shortens consistently, with the exception noted above. The same has been observed for a number of years. This is probably due both to the higher temperature of the later periods and to the length-of-day factor.

Soil Treatment

All the soil in the greenhouse was thoroughly soaked with a 1 per cent solution of acetic acid a week before the first seeding. The soil in the cold-frame was divided into three sections, one of which was steamed, one treated with acetic acid, and the third left untreated. Plants from the different sections were set out in fields on the same date, and treated alike throughout the season. The plants from the steamed soil were larger at time of setting in the field than those of either the acid-treated or the

untreated sections. The same varieties were used in all three sections. The average yields of the three sections in the field are given in table 4.

TABLE 4—*Yields of tomatoes from plants started under different conditions of soil treatment*

Treatment	Bushels per acre
Steamed	263
Acid	280
None	263

The differences in yield are not considered to be significant.

Field Treatment: Dusting versus Spraying

Plants from the March 1, April 1, and May 1 plantings were set out in separate plots from other experiments, on soils as uniform as could be found, for observation on the prevalence of leaf spots. The results of the treatments were judged from the yields, as given in tables 5-7.

TABLE 5—*Dusting versus spraying for tomato leaf spots*

Experiment I. Seeded March 1, set in field May 3

Treatment	Variety	Yield per acre		Weight per 100 fruits
		Pounds	Bushels	Pounds
Dusted	Marglobe	18,821	336	36.0
	Tenn. Pink	17,484	312	24.0
	Break O'Day	18,307	326	31.6
	Gulf State	18,204	325	26.9
	Average		325	
Sprayed	Marglobe	13,473	240	31.6
	Tenn. Pink	16,147	288	23.9
	Break O'Day	13,987	249	28.6
	Gulf State	16,250	290	24.8
	Average		266	
Check	Marglobe	15,221	271	31.2
	Tenn. Pink	15,941	284	22.6
	Break O'Day	17,793	317	31.8
	Gulf State	13,870	238	24.0
	Average		277	

TABLE 6—*Dusting versus spraying for tomato leaf spots*
Experiment II. Seeded April 1, set in field May 25

Treatment	Variety	Yield per acre		Weight per 100 fruits
Dusted		Pounds	Bushels	Pounds
	Tenn. Pink	8,330	148	22.7
	Tenn. Red	9,976	178	28.1
	Break O'Day	11,827	211	31.4
	Marglobe	12,033	214	29.8
	Norduke	11,622	207	30.5
	Average	.....	191	.....
Sprayed	Tenn. Pink	11,107	197	.....
	Tenn. Red	7,713	137	27.3
	Break O'Day	8,845	157	30.4
	Marglobe	8,330	148	32.1
	Norduke	7,199	128	28.6
	Average	.....	153	.....
Check	Tenn. Pink	9,669	172	23.3
	Tenn. Red	9,153	163	25.4
	Break O'Day	11,622	207	28.2
	Marglobe	9,873	176	28.2
	Norduke	7,713	137	29.0
	Average	.....	171	.....

TABLE 7—*Dusting versus spraying for tomato leaf spots*
Experiment III. Seeded May 1, set in field June 23

Treatment	Variety	Yield per acre		Weight per 100 fruits
Dusted		Pounds	Bushels	Pounds
	Gulf State	7,610	135	24.6
	Marglobe	8,433	150	31.5
	Tenn. Red	8,433	150	27.7
	Tenn. Pink	4,319	77	20.0
	Average	.....	128	.....
Sprayed	Gulf State	7,610	135	28.9
	Marglobe	8,228	146	29.1
	Tenn. Red	6,890	123	31.6
	Tenn. Pink	5,553	99	22.6
	Average	.....	124	.....
Check	Gulf State	6,479	115	25.4
	Marglobe	6,993	124	28.8
	Tenn. Red	6,993	124	25.0
	Tenn. Pink	4,731	84	23.2
	Average	.....	112	.....

In all of the tomato experiments the plants are started in the greenhouse, transferred to a cold-frame in 4-inch dirt bands, and removed to the field when danger of frost is over, where they are pruned and tied to stakes. Dust and sprays are applied so as to keep the plants well covered. When the fruit is ripening, the dusting and spraying are discontinued. The fruit is picked about twice a week, and a careful count and weighing made of each row.

Varieties Used

In the 1931 crop, 14 varieties and selections were used, of which 7 were old varieties that had been used in previous years, and 7 were new varieties and selections. Such varieties as showed very poor yields, or susceptibility to *Fusarium* wilt, were discarded and are not to be used in further experiments. One variety, however, showed an entire lack of resistance to wilt and will be used as a check on wilt land. Both the red- and pink-fruited varieties were used. Gulf State Market, Globe, and Tennessee Pink gave the best yields of the pink; and Tennessee Red, Marglobe, Break O'Day, and Marglobe selection 7, of the red varieties. Tennessee Pink, Tennessee Red, and Marglobe selection 7 are selections made at the Station.

Crosses

A number of crosses were made between different varieties in an attempt to improve the yields and quality of fruit. The crosses will be grown in the season of 1932.

Conclusions

From the 1931 tests, several conclusions may be drawn. Most of these are noted in previous reports.

Of all the varieties and selections used, very little difference was noticed in the susceptibility to leaf spots. There seems very little to expect from selection for resistance. The experiments show that the leaf spots can be controlled by seedbed and cold-frame soil disinfection, and by the use of clean soil in the field. They show that both spraying and dusting with copper-lime dust will keep tomato plants free from leaf spots, but that the dusting gives the larger yield of fruit. The spray used was 5-5-50 bordeaux mixture. Counts of fruit showed that spraying reduces the number of fruits set. Check rows with neither dusting nor spraying often showed a higher yield than sprayed rows in previous years, but this is true in only one case out of three in 1931. Too frequent spraying during the time fruit is being set on the plants should be avoided. Dusting does not seem to cause a shedding of fruit.

The best yield of fruit is obtained from the earliest fields set out. This has been noted a number of years, and seems to be a well-established fact. There may be exceptions to this rule,

resulting from frost injury, poor soil, drouth, or other causes. Early plants have a longer ripening season, as shown in previous years, and as appears from table 3.

The method of soil disinfection in the beds seems to have little effect upon the amount of fruit harvested, although plants from steamed soil are usually larger at setting time.

CHEMISTRY

W. H. MacIntire

General Chemistry

Chemical studies of insecticides have been continued by Mr. G. A. Shuey, the Associate Chemist in general chemical investigations. In an effort to perfect methods for the analysis of fluorine compounds, much attention has been given to the two important insecticides, sodium aluminum fluoride (cryolite), and barium fluosilicate. A volatilization method for the determination of fluorine was described in the Jour. of the A. O. A. C., Vol. XIV: p. 126. This method has been adopted as a tentative procedure by the Association. It appears in the recent revision of "Methods of Analysis" and is being studied further.

The need for information by the Department of Entomology led to a brief preliminary study of spray residues on peaches. The object of this study was to ascertain the residual amounts of fluorine and arsenic. The results demonstrate that an accurate estimate of the relative amounts of residual fluorine and arsenic can not be made by observation. The retention of fluorine from cryolite and barium fluosilicate sprays was greater than that found for lead arsenate, but this was shown only by chemical analysis. The work is being continued.

Several tobacco samples were examined quantitatively for arsenical spray residues. The results show that, when arsenate of lead is used as a spray for tobacco, a high arsenical residue remains.

The copper-fluorine compound furnished to the Crop Protection Institute in 1930 was subjected to collaborative trial. It was found that in the concentration prescribed the material is not sufficiently effective to control yellow leaf (*Coccomyces hiemalis*) of cherries. No other reports have been received. Compatibility studies of fluorine compounds (barium fluosilicate and cryolite) with other substances, including by-product sulphurs, are being made.

Mr. Shuey has continued his investigations with a view to increasing the usefulness of the sweet potato, and has succeeded in making excellent jelly, syrup, and vinegar. Progress was made

in perfecting a home recipe for sweet potato jelly. A study of possible uses of the syrup in cooking, baking, and preserving is in progress. A high-grade vinegar has been prepared experimentally, but the work has not developed to the point where directions can be given for making large quantities in the farm home.

Considerable analytical work has been done for other departments of the Station, and a number of complete analyses of various clovers, soybeans, alfalfa, and silage have been made. One problem carried out for another department involved the analyses of 10 samples of sweet corn. These analyses showed variations between 10 and 16 per cent in sugar content.

Biochemistry

The biochemical investigations have continued under the direction of Dr. Margaret B. MacDonald, assisted by Mrs. Norabelle Duncan Weathers. The bitter substance from bitterweed has been extracted in quantity; its identity has been tentatively established, and its chemical and physical properties have been studied. A quantitative method for determining the bitter principle in water solution and in milk has been perfected and thoroughly tested. It seemed desirable to develop a qualitative test for the occurrence of the bitter substance in milk. This was done. The test devised consists of the development of an orange-red color through the addition of a picric acid solution and a solution of sodium hydroxide to milk. The test is not so sensitive as taste, however, in the determination of small quantities of the bitter principle in bitter milk. When the bitter principle is extracted from milk serum by ether and then brought into aqueous solution, the test is more dependable and can be used quantitatively by color comparison against standards.

An exhibit has been planned for display at the coming International Exposition at Chicago. It is proposed to show specimens of the plant and samples of the bitter substance in various stages of extraction and purification, together with color standards to indicate the various concentrations of the bitter substance.

The "bios" problem is near completion, and it is expected that a final report will soon be prepared.

Soil Chemistry

The soil chemistry laboratories have been engaged primarily in analyzing lysimeter leachings and acquiring cumulative data on the long-period investigations of the outgo of different forms and amounts of the several calcic and magnesian materials and their effect upon other soil components. The function of the subsoil in altering the composition of the outgo that passes from additions of 7 different calcic and magnesian materials to the surface

soil is being shown further by a comparison between shallow and deep tanks. The particular value of the findings is due to the cumulative data that show the distinct capacity of the sub-soil to effect transitions that would not be demonstrated during brief intervals without the parallel between the deep and shallow tanks.

The termination of the studies on the oxidation of sulphur materials, as induced by lime and magnesia, released a series of tanks that are now being used to register the residual effects of liming upon the fixation of annual additions of potash, as measured by the outgo of both potassium and the sulphate radical. The data on the repressive effect of liming upon potash additions for characteristic East Tennessee loams have been conclusive, and the phenomenon is being studied further with other types of soil. A paper based on previously published data and additional unpublished data from the Tennessee and Virginia Stations was used as the basis of a contribution to the symposium on lime and magnesia held by the American Society of Agronomy. A summary of this contribution appeared in the December, 1930, issue of the Journal of the American Society of Agronomy. The study of the anion effect upon conservation of added potash, as influenced by limestone and by dolomite, is being continued to the point where the results will justify conclusions relative to this problem.

The behavior of the phosphate ion in the soil as influenced by limestone and by dolomite is being studied further. Calcium and magnesium phosphates are used and the transitions are effected before and after incorporation with the soil. The cumulative effect of the relatively small phosphate additions must be permitted before the lysimeter soils can be utilized for laboratory study. The leachings already register an appreciable difference in the outgo of magnesium and calcium phosphates. In preliminary studies on this project, laboratory mixes of commercial phosphates were studied by means of CO_2 evolutions and periodic analyses by the conventional methods. The results are pertinent to the problem of the joint use of dolomite and limestone as supplements to supply calcium and magnesium to superphosphate mixes and, in particular, to the use of the newer chemical manurial concentrates. The chemistry of home-mixing of superphosphate with the two types of limestone and the effect of these two materials upon the P_2O_5 content of aged commercial mixes is dealt with in a contribution that has been prepared for publication. Further laboratory studies as to the reactions between water-soluble phosphates and the calcium and magnesium carbonates of limestone and dolomite are being pursued as time permits.

The accurate determination of residual carbonates in this and other projects has been greatly facilitated by the use of a CO_2

method perfected by Mr. W. M. Shaw, Associate Soil Chemist. ("Determination of carbon dioxide in soil carbonates—a modification of the official method." Jour. A. O. A. C., May number, 1931, p. 283-292.) This method utilizes stannous chloride to eliminate the tendency of the liberative acid to act upon organic matter and evolve CO_2 . The principle is embodied in the official A. O. A. C. method.

The increasing use of barium fluosilicate as a soil insecticide raised the question of the effect of this compound, with and without limestone and dolomite, upon the availability of soil nutrients. To date, it appears that the availability of soil sulphates is materially affected by the use of barium fluosilicate.

Little is known as to the permanence of changes induced by steam sterilization of soils that are treated in bulk and left exposed. The influence of steaming, as it affects the principal nutrients, is being studied further in exposed lysimeters.

One more year will be required to complete the original outline of the joint Virginia-Tennessee lysimeter study of the cumulative effect of 4 liming materials. The use of liming materials in single additions, cumulative fractions, and repetitions, of both full additions and fractions with full-depth and also surface-zone incorporation, will undoubtedly throw light upon the problem of judicious liming.

In the joint Chemistry-Agronomy projects, the problem of the conservation of nitrogen is being pursued further by a comparison of 6 different nitrogenous materials in large tanks in the original lysimeter installation. This study promises interesting results as to the behavior of some of the newer concentrates.

The present availability of nutrients, as influenced by differences in fertilization, fallowing, and cropping, over a long period, is being studied in lysimeters by the use of soil from different plats of the cowpea-wheat rotation experiments.

The 4-year lysimeter study of the inoculation effect induced by two Colorado soils has been terminated. The lysimeter data and the composition of the soil mixes at the beginning and at the end of the period will be compiled for publication.

The Russian, English, and American types of lysimeters are being compared further. No report of this comparison is contemplated until the results are obtained for a period that will embrace variations in climatic conditions. The study of the movement and recovery of the NO_3 ion from equivalent additions of sodium, calcium, and magnesium nitrates in the lysimeters of 6-foot depth was terminated. The recovery of NO_3 and the several cations will be reported shortly. The equipment thus released will be utilized for a related study of several ammonium salts.

Miscellaneous

The Associate Chemist, Mr. Shuey, continues as Associate Referee for Fluorine Compounds in collaborative studies for the A. O. A. C., on methods for the determination of fluorine. The Chemist and the Associate Soil Chemist continue, respectively, as Referee and Associate Referee, for "Liming Materials and Soils" and "Liming Materials," in collaboration with the A. O. A. C. The Chemist also continues as the A. O. A. C. designate on the Board of Governors of the Crop Protection Institute.

In the 1930 report, mention was made of the Lime Conference held at this institution upon the suggestion of the Director. The "Proceedings" of this conference were edited by the Chemist and 300 copies were made available by subscription of workers and libraries.

ECONOMICS

C. E. Allred

Marketing Cotton

The cotton-marketing project, which is cooperative with the Federal Bureau of Agricultural Economics and with almost all the other experiment stations in the Southern States, was pursued very actively during the past year, one member of the staff devoting his entire time to it, and another member almost half his time.

The general plan of procedure has been the same as in previous years, with one man visiting ginners continuously during the ginning season for the purpose of gathering the required information. Several supplementary phases have been developed during the year, among which may be mentioned a study of the movement of cotton before ginning; the movement of Tennessee cotton after ginning; the type and topography of soil on which the cotton is grown; kind and amount of fertilizer used; the cost of ginning; production trends in the different sections of the State; size of farms selling cotton in the seed; and the question why farmers in some sections of the State sell cotton in the seed while in other sections they prefer to have it ginned before selling. It is expected that work on several of these supplementary phases will be completed the coming year.

During the early summer season, the Assistant Agricultural Economist who does the field work spent several weeks in the office assisting in tabulating, analyzing, and interpreting the results of the previous year's work. These were written up and typewritten for ready reference, making a preliminary report of 200 pages.

Cooperative Organizations

A large amount of work was done during the year in pushing forward the project relating to the cooperative marketing of strawberries and sweet potatoes.

Marketing of strawberries.—Just previous to the beginning of this calendar year a considerable amount of field work had been done in gathering data on the cooperative organizations handling this crop. During 1931 these data have been tabulated, analyzed, interpreted, and partially written up, and will make a preliminary report of about 130 pages.

A supplementary phase of the project was developed in cooperation with the Horticultural Department, by which the shipping qualities of berries were measured. Arrangements were made with a competent person at Columbus, Ohio, to receive the berries and render us a complete report of their condition and appearance upon arrival, and of their keeping qualities. Berries of different varieties and with various fertilizer treatments, from the experimental plots, were then shipped to him by express.

Marketing of sweet potatoes.—Work on the marketing of this commodity has followed somewhat the same lines as that for strawberries. Data on the cooperative organizations handling sweet potatoes were secured on the same trip as those for the strawberry organization, during the fall of 1930. These data have been worked up during 1931, and a preliminary report prepared and typed, making a volume of 269 pages.

Farm Taxation and County Government

Work on the taxation project was continued actively during the past year, and especially during the first half of the year. One field trip was made to lower East Tennessee.

Data were secured during the year from 12 counties showing the actual amount of taxes paid by specific pieces of property during each year from 1913 to date. This was done through informal cooperation with the Agricultural Extension Service, and with the Federal Bureau of Agricultural Economics, which is making a study of that phase of the project for the Nation as a whole.

Two other supplementary phases to which attention was given during the year include a study of special legislation for individual counties and its effect on farmers; and the tax-exemption situation in the State in its relation to taxation of farmers. The results of the year's work have been written up and typed for ready reference, making a preliminary report of 401 pages.

In addition to the work on our regular taxation project, we were requested by the Tennessee Public School Officers' Association to prepare, for the use of the Legislature, a bulletin on possible revenues from each of several possible excise taxes in

Tennessee. This was done, and the bulletin was published by the Division of University Extension under the title "Estimates of possible Tennessee revenues from certain specified taxes."

Southern Appalachian Study

Active work on a survey of the economic and social problems of the Southern Appalachian area was begun July 1, 1931. It is a cooperative project between this Station and a number of other agencies, including the Federal Bureau of Agricultural Economics, Federal Forestry Service, Federal Office of Education, Federal Bureau of Home Economics, Institute for Social and Religious Research of New York, West Virginia Experiment Station, Virginia Experiment Station, Kentucky Experiment Station, North Carolina Experiment Station, and Georgia Experiment Station. The area embraced in the study includes all of the 44 Tennessee counties in the eastern end of the State and extends to the western edge of the Cumberland Plateau, both the Smoky Mountains and the Cumberland Plateau, with the intervening valley, being considered as part of the Appalachian Highlands.

Previous to the formal inauguration of the project a great deal of work was done by the agencies interested in the proposed study, in formulating plans for its definite prosecution; and four regional conferences were held for the purpose of discussing, modifying and approving the programs for various sections of the study which had been worked out by committees previously appointed for that purpose. This preliminary work resulted in a more complete meeting of minds on the part of all persons concerned than is usually the case where so many agencies are participating.

During the latter half of 1931 good progress was made in organizing the work on the project in this State.

Effect of Industrial Development

The time of only two and one-half men is available for all of our projects except the cotton marketing project, and it has seemed desirable for one of these men to devote considerable time during the year to the cotton project, which is being carried on in cooperation with the U. S. Department of Agriculture and has been very active. At the same time it was necessary for us, in the middle of the calendar year, to inaugurate the new Southern Appalachian project and get it under way. This is also a cooperative project with the U. S. Department of Agriculture, and has been very active since July first.

This combination of circumstances has rendered it necessary that work in completing some of the projects be delayed temporarily. The project on industrial development is the one that was

left dormant. The staff hopes that conditions will permit an early resumption and completion of this project.

Improvement in Methods

Staff members of the Department are constantly trying to make improvements in methods of research, whether it be to increase the accuracy of the initial results, devise means of checking that accuracy, or find ways of saving time or expense. A number of such devices have been originated or adopted during the year. In line with this ideal, one of the staff members, Mr. S. W. Atkins, spent half of the present year and a portion of the previous year at Cornell University, where he devoted special attention to an advanced study of methods and subjects which would be helpful in the work of this Department. The national Social Science Research Council, which has been active in promoting improved methods of research in agricultural economics and rural sociology during the past few years, upon our application awarded a fellowship to Mr. Atkins to enable him to finance the study.

Research Projects Requested of Us

There is a widespread demand for accurate economic information, and many requests have been received by this Department recently. A large number of these requests have been of such nature that to furnish reliable answers would require us to inaugurate and develop entirely new projects.

But it takes a great deal of labor and time to carry through an investigation with sufficient thoroughness to secure reliable conclusions, and to check the results so that we may be able to speak with authority on the subject. Obviously the Department has already had under way as many projects as its personnel could develop in any reasonable length of time, and it would be unwise to drop a half-completed project in order to take up a new one. At the same time we have recognized the need for the information requested, and would have been glad to undertake to meet this need had our circumstances made it practicable to do so.

The following may be briefly mentioned as examples of projects of this kind which have been requested of the Department recently:

1. A study of the cooperative creameries of the State.
2. A study of the truck-crop marketing situation in West Tennessee, to determine whether or not a regional cooperative organization is desirable.
3. A study of farm prices in Tennessee over a series of years, with index numbers; in cooperation with the U. S. Department of Agriculture.

4. A study of types of farming in different sections of Tennessee; in cooperation with the U. S. Department of Agriculture.
5. A study of standards of living in a selected county of Tennessee.
6. A study of the marketing of woodland products in Tennessee.
7. A study of the cost of producing strawberries in each of the principal strawberry districts of the State; in cooperation with the U. S. Department of Agriculture.
8. A study of the livestock marketing situation in Middle Tennessee, to determine whether or not a regional cooperative selling organization is desirable in the Nashville district.
9. An economic, social, and educational survey of Loudon County, in cooperation with the College of Education of the University and the county superintendent and teachers of that county.
10. A study to determine the best farm-management principles and practices for various sections of the State.
11. An analysis of the methods and practices of some of the most successful farmers of the State; in cooperation with the Agricultural Extension Service.
12. A project designed to furnish fundamental economic information each year on which to base the agricultural outlook reports.
13. A study of the municipal markets of the State, and of the possibilities for their expansion and improvement.
14. A study of the adequacy of the diet of each of the groups of farm people in different sections of the State.
15. A study of the farm practice in the feeding of livestock, in different sections of the State.
16. A study of the services rendered farm people by the rural newspapers of the State, and of practical means of improving that service.

We hope to have an opportunity to take up some of these within the next few years.

Need for a Service Economist

The Agricultural Extension Service of this State has five men who are giving full time to farm-management extension; it has the equivalent of four persons who are doing marketing extension; and three who are engaged in what is in reality rural sociology extension. In addition to these, the State Bureau of Markets has some persons engaged in marketing extension; and there are about 125 teachers of vocational agriculture in the high schools of the State who are required to teach farm management and marketing of farm products in terms of the economic conditions prevailing in their sections of the State.

Each of these groups makes demands upon this Department for the information needed; and the responsibility rests with this Department to supply their needs, for it is the function of extension workers and teachers to carry to the people the results of Station research and not to conduct research themselves.

Much of the information desired is of a more or less fragmentary character, and is wanted in a very short time. And while the knowledge, ability, and equipment of a well-trained economist is very necessary in order to insure safe conclusions, the information wanted could in some cases be secured by a man of that type without very extensive investigation.

If, however, our staff as now constituted should undertake to comply with these requests, there would be no opportunity for more fundamental research. Besides, there would not be time enough to prepare the necessary project form on each problem and send it to Washington for consideration. And even if time and personnel permitted, projects of this kind would not meet the requirement of the Office of Experiment Stations that expenditures of Purnell funds shall be for projects of a fundamental character.

In view of the demand and the need for research of this character, and of the inability of the Department at present to meet them, the suggestion is made that perhaps the best solution would be the placing in the Department of a "service" economist, whose particular function would be to conduct special investigations of a brief character to meet urgent current needs.

In the absence of such facilities the Agricultural Extension Service finds itself in a position requiring its large staff and its county agents either to make recommendations on many economic questions on which they have no accurate information, or to conduct some research on the subjects themselves; neither of which alternative is desirable.

Such an economist should be well trained, and should be paid either from extension funds or State funds, or from the two jointly. He should have his office with the Station staff, because the accumulated data, library, labor-saving equipment, and counsel of the Department would be indispensable to him. Administratively he should be responsible to the Station for the accuracy of his results, but available to the Extension Service and others for any reasonable investigations.

Properly coordinated, the more fundamental research projects of the Department and these service investigations would tend to be supplementary, each proving helpful to the other.

Preliminary Reports

Instead of allowing the research data on a given project to accumulate over a period of years, it is the practice of this De-

partment to analyze and interpret the accumulating data at frequent intervals, and prepare a preliminary report on the same. This is in the nature of a report of progress on the project, in which the outstanding aspects of the situation are defined and all available pertinent facts analyzed. This report is not for publication; it is a kind of trial balance, a checking up, before the next attack. We find this to be very useful in clarifying our objectives.

Teachers and others have sometimes raised the question as to why these preliminary reports are not published. The answer is that work on the projects has not progressed to the point where the staff feels that publication is justified. All conclusions are tentative, being based on a small accumulation of data, and many of the influences bearing on the subject have not yet been analyzed. Under these circumstances it often happens that conclusions drawn from such early data, if published, would be entirely misleading; and then to announce later and different conclusions would lead to great confusion.

Research in agricultural economics and rural sociology is relatively new in this State. No background data have been available, and no contributing data from other projects already completed. It has been necessary to work up such data in connection with each of the projects the Department has had under way.

In the course of time it seems that the publication stage, in connection with a given project, should be reached more quickly than was possible during the early development of the Department, because of the use that can be made of accumulated data and information. In this connection an analogy may be drawn between the growth of a new department and that of a tree. It requires several years of growth before either reaches the full productive stage.

The financial nourishment available for the growth of this Department during the first several years was small, only half the time of one man being available; and there was no labor-saving equipment; no clerical assistance, and no library in this field.

Publications

In view of the circumstances outlined above, it seems that the publication record of the Department is an excellent one. Without mentioning the publications in detail, the record may be summarized as follows:

Collaboration on three bulletins published by the U. S. Department of Agriculture.

Chapters in two books, by leading publishers.

Two extensive encyclopedia articles.

Two statistical bulletins, total almost 300 pages.

Two syllabi, total almost 200 pages.

Two county bulletins, total 182 pages.

One state tax bulletin, 52 pages.

Three extension bulletins.

Several addresses before scientific societies, published in proceedings:

Several mimeographed bulletins.

Several journal articles.

Of the above, the following were published during 1931:

Allred, C. E., and Boyer, P. B. Estimates of possible revenues from certain specified taxes. 52 pages. Division of University Extension, March 10, 1931.

Allred, C. E., Consolidation of counties. Progressive Farmer, October 1, 1931.

Allred, C. E., Our present small expensive counties. Progressive Farmer, October 15, 1931.

Manuscripts on certain other phases of our studies will soon be completed.

Miscellaneous

During the year the Agricultural Economist prepared and read papers at the annual meeting of the Southeastern Economic Association, in Atlanta; before the Agricultural Economics Section of the Association of Southern Agricultural Workers, in Atlanta; at the annual meeting of the Tennessee Public School Officers' Association, at Nashville; and at the annual meeting of the East Tennessee Superintendents' Association. He also prepared material on land utilization for a national committee that is making a study of the subject; attended a conference at Roanoke to assist in formulating plans for a cooperative study of Southern Highlands; acted as State representative of the American Farm Economic Association; and, with the assistance of Mr. P. B. Boyer, Assistant Agricultural Economist, worked out for the College of Education a schedule to be used in its county economic, social, and educational surveys.

At the request of the President of the University, Mr. Boyer worked up a rather thorough preliminary analysis of the effect of the tariff on Southern agriculture, and made an investigation of the organization and work of the New England Economic Council, and of the possible application and usefulness of the plan to the Southeastern States.

ENTOMOLOGY

S. Marcovitch

Control of Arsenical Injury on Peach

In the investigations comparing fluorine compounds and lead arsenate as sprays on peach, it was noticed that the latter material

defoliated the trees at Kingston but not at Knoxville. Since the same spray schedule, consisting of 4 applications at the rate of 1 pound to 50 gallons, was used in the two cases, a difference in soil fertility was suspected. A series of fertilizer experiments was therefore inaugurated to test the effect of fertilizers in overcoming arsenical spray injury.

In all cases where the nitrogenous fertilizers were used the injury and defoliation was reduced to a minimum, while the unfertilized trees showed such severe defoliation that a new crop of leaves in October appeared. It is now generally believed that arsenic poisons the cell through its reactions with the SH group of glutathione, which is necessary for oxidation. Since this material is closely allied with the growing process, a vigorous, rapidly growing tree is supplied with an abundance of glutathione, which is believed to be the natural antidote for arsenical poisoning. A more complete report of this work will appear in the *Journal of Economic Entomology*.

Experiments with Barium Fluosilicate and Cryolite on Peach

The experimental work with arsenical substitutes for peach spraying was continued as in the previous year. Due to the abnormally dry weather, a scarcity of plum curculios and Oriental fruit moths made it impossible to get reliable figures. Since peaches are not injured by more than 4 sprays of barium fluosilicate, some of the plots received as many as 7 applications. The best control, 87 per cent sound fruit, was obtained with 7 sprays of barium fluosilicate, used at the rate of 1 pound to 50 gallons of water. The regular schedule, 3 lead arsenate sprays and 1 fungicide spray, gave 74 per cent sound fruit. If we are able to repeat these results another year, the additional sprays will give better brown-rot and curculio control, and may in time do away with the supplementary measures now advocated, such as picking up drops and clean-up work.

Tobacco Flea Beetle

A large amount of damage was done to the tobacco crop last season by the flea beetle. As the importance of the tobacco crop increases, the flea beetle will have to be controlled in order that a good grade of tobacco may be produced. Until recently no adequate control measure was known, since the beetle will not feed on arsenic readily. For the past two seasons we have been able to keep it in check by the use of a barium fluosilicate dust. With this dust, as high as 96 per cent of the insects were killed, whereas lead arsenate caused but 36 per cent mortality. More complete information is contained in Circular No. 38, entitled "Control of the flea beetle and hornworm on tobacco."

Insect Pests of the Year

The Department of Entomology answers each year a large number of inquiries for information on insect pests. The hot, dry summers of the past two years seem to have been favorable for many insects. The following are worthy of special mention:

The red-legged flea beetle (*Crepidodera rufipes*).—This little beetle was found swarming on peach flowers April 15. The foliage was also eaten. The locust seems to be the normal host plant, and orchards set near locust clearings are therefore most apt to be injured. On May 1 the pests were reported as attacking strawberry flowers.

Tiger moths (*Apantesis rectilinea*).—This insect was not known as a pest, but last summer it attacked corn and pasture grasses in many localities of East Tennessee and in the vicinity of Lewisburg. In Lincoln County 500 acres of corn were said to be destroyed by it and many pastures completely stripped.

Euptoieta claudia.—The larva of this butterfly was also reported for the first time as attacking beans, sweet potatoes, and cowpeas at Lewisburg. The native host plant seems to be the vine of the passion flower.

Sod webworm (*Crambus* sp.).—This pest seemed more abundant than usual. Specimens were sent in from Middle and East Tennessee with complaints of injury to corn and tobacco. In one field, where 30 acres of corn were destroyed, there were 3 to 5 larvae per hill. The most effective control measure for this pest is early fall plowing of sod land that is to be used for planting corn or tobacco.

Sweet potato beetle or "gold bug" (*Cassida bivittata*).—This beetle was found eating sweet potato foliage, on July 2, at Paris and Huntingdon. The larvae are easily recognized by the curved spine turned over the back like a squirrel's tail.

Cabbage aphid (*Rhopalosiphum pseudobrassicae*).—Due to the cool, rainy weather prevailing in April, the cabbage aphid was very plentiful and injurious to cabbage.

Diamond-back moth (*Plutella maculipennis*).—This insect is present more or less every year, but was unusually abundant on cabbage at Newport. Dry weather must have favored the multiplication of the pest.

Chinch bug (*Blissus leucopterus*).—This well-known pest injured corn at Memphis.

Seed corn maggot (*Hylemyia cilicrura*).—In many localities beans and corn failed to come up. In all these cases it was found that a sod such as crimson clover was plowed under previous to planting. On the Station plots a crimson clover sod was turned March 24 and beans planted April 13. Not a single bean seed came up. The adult flies are attracted to decaying organic mat-

ter, such as sod or manure. To prevent injury by this pest, therefore, cover crops should be plowed in the fall, or at least several weeks prior to planting, so that they will be less attractive to the egg-laying flies.

HORTICULTURE

Brooks D. Drain

Strawberry Improvement

Plans for introducing a superior seedling strawberry, named "McClintock," have been completed and plants will be offered for sale in the spring of 1932. This variety continues to be the outstanding one in the breeding work at the Station. Extensive shipping tests indicated that it will ship and handle well. Several other promising seedlings were crossed during the past season, with the McClintock as one of the parents.

Trial of several U. S. Department of Agriculture seedling strawberries were continued this year. Neither Blakemore nor Bellmar was entirely free from leaf spot. The former gave a good yield per acre, although the fruit was only medium in size.

The New York State Agricultural Experiment Station seedlings that have been tested at Knoxville were all more or less subject to leaf spot. Several gave large yields and all will be tested further.

Fire Blight

Pear plantings in various parts of Tennessee, with blight-susceptible top, and blight-resistant stock, including the trunk and part of the scaffold branches, have shown merit. At least, a considerable part of the tree remained free from this destructive disease. *Pyrus calleryana* continued to be a very promising stock for this purpose, from both the nurseryman and orchardist's point of view.

The question, "Will resistant stock increase the resistance of of the scion part when susceptible varieties are used?" needs further study. Very susceptible varieties have blighted badly on resistant stock. This study of stock influence is of importance and has a bearing on many phases of horticulture.

The Day-zinc-chloride treatment for blight cankers continued to be efficient in canker eradication. Some chemical injury was to be expected from the use of 53 per cent zinc chloride solution on apple. A 43 per cent solution gave good control the past season, with less chemical injury.

Breeding work on blight-resistant varieties of pears crossed with the usual cultivated ones has met with many difficulties. The curious public destroy a considerable part of this work. Others

pilfer most of the fruits before they are fully ripe. Low-quality resistant varieties blossom very early when compared with high-quality susceptible varieties. However, the Station has a good supply of breeding stock old enough to blossom, and many seedlings can soon be under test. Only a few hand-crossed seedlings have been produced to date.

Root Knot Nematode

During the past season a large collection of ornamentals were planted on nematode-infested soil to determine their susceptibility to this pest. The data will be of special interest to nurserymen when completed.

Adaptability of Stocks

Congeniality studies of peach budded on Marianna stock were continued, with emphasis on variations in anatomy of the two plants. It is possible that such anatomical differences would be accompanied by certain changes in chemical composition and furnish an explanation of this uncongeniality.

Studies on native crab stocks for apples indicated that they are *Pyrus coronaria* and *Pyrus angustifolia* or hybrids of the two. These groups of plants were almost entirely free from woolly aphis injury, but were very difficult to transplant. The latter defect was true of all selections studied to date. *Pyrus baccata* continued to be a promising apple stock for southern conditions, as it is fairly free from woolly aphis injury. Certain Spy seedlings were also of some promise, although somewhat troubled with woolly aphis.

Red Raspberry Breeding

A planting of open-pollinated seedlings of Van Fleet red raspberry was fruited and all but 6 plants discarded. Some were very susceptible to disease and others had undesirable fruit characters. Only a few control crosses have been made to date.

Peaches

Vainqueur, a variety that ripens very early, has been tested for a number of years and has proved worthy of trial. This variety was secured from the U. S. Department of Agriculture, Office of Foreign Plant Introduction.

Plums

The Methley has been tried at the Station for a number of years and has been suggested for trial by farmers. The flesh is red, and the variety ripens very early.

Pyrethrum

Plantings of *Pyrethrum cinerariaefolium* continued to do well on dry and well-drained locations, and are reasonably free from

disease. Culture and methods of handling this crop have now been tried out for several years.

Truck Crops

Rhubarb.—Crown rot was unusually destructive in the rhubarb plantings, both at Knoxville and in other parts of the State. Open-pollinated seedlings have shown very little resistance to this disease, and we are resorting to vegetative reproduction of plants that have survived in rot-infested soil.

Irish potatoes.—Cobbler continued to do well for the early crop. A seedling from the U. S. Department of Agriculture was also of promise. A good-quality variety has been secured for the fall crop and will be tested at several places in the State the coming season.

Sweet potatoes.—Nancy Hall and Southern Queen continued to lead in total yield. Late digging gave much the larger yields.

Canner crops.—Dry weather was an important factor with these crops again the past season. A quality variety of sweet corn did fairly well, although somewhat injured by worms.

PLANT PATHOLOGY

C. D. Sherbakoff

The experimental work with plant diseases has been continued much as during the preceding year, but with the addition of some new projects, such as spraying for control of cherry leaf spot, spraying of peaches for control of disease, and spraying of apple trees in full bloom for control of blossom blight.

Wheat Scab and Root Rot

The season was extremely dry and unfavorable for the development of wheat disease, and therefore no marked progress was made in the selection of disease-resistant strains. Some of the formerly promising strains have, however, been discarded, due both to their low yield and to their noticeable susceptibility to black chaff. Several new strains of promise were added to the collection because of their high yield and apparent resistance to the last-named disease.

Spraying Experiments

Apples: Time of Spraying

The experiments were carried on primarily to determine the relative value of each individual spray recommended in various spray schedules for control of scab, blotch, and bitter rot. Due to the unusually dry season, which was unfavorable for disease development, the differences between the different spray blocks were insufficient to justify any definite conclusion in regard to the value of the individual sprays.

TABLE 8—Results of spraying apple trees in blossom with 1-3-50 bordeaux mixture, 1931.

The trees were of Yellow Transparent variety, in 5 adjacent rows of 8 trees each, except row No. 2, where the last 3 trees were missing. The orchard is located near Portland.

Tree No.	Row No. 1 Sprayed early in blossom		Row No. 2 Not sprayed in blossom		Row No. 3 Sprayed late in blossom		Row No. 4 Not sprayed in blossom		Row No. 5 Sprayed early and late in blossom	
	Clusters		Clusters		Clusters		Clusters		Clusters	
	Healthy	Blighted	Healthy	Blighted	Healthy	Blighted	Healthy	Blighted	Healthy	Blighted
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
1	158	141	65	384	175	121	117	160	80	63
2	242	209	100	128	113	153	66	186	110	84
3	196	123	146	331	147	51	148	119	229	214
4	259	168	115	248	162	98	119	201	168	151
5	163	106	71	223	169	68	113	257	103	183
6	120	86	.....	.....	11	6	53	159	137	106
7	172	131	.....	.....	150	73	100	129	200	110
8	238	69	.....	.....	188	113	98	150	122	76
Tot.	1548	1033	497	1314	1115	683	814	1361	1149	987
Av.	60%	.....	27%	.....	62%	.....	37%	.....	54%	.....

For all trees sprayed in blossom, 58.7 per cent healthy clusters.

For all trees not sprayed in blossom, 32 per cent healthy clusters.

Control of Blossom Blight

Several preliminary tests of spraying in full bloom have been conducted on a small scale. In all of the tests except one the results, for various reasons, were negative, showing no appreciable effect from spraying. In one test, near Portland, on Yellow Transparent trees, the results appeared to be fairly clear-cut, and were therefore properly recorded. They are shown in table 8.

Cherries

Only one small test in the spraying of cherry trees for control of leaf spot has been carried out. The results obtained, however, appear to be clear-cut and worth reporting. The test was located near Knoxville. In the experiments, different numbers of sprays with 2-4-50 bordeaux mixture were compared with the standard concentrations of summer strength of lime-sulphur solution and of flotation sulphur.

The results show that 4 sprays with bordeaux mixture, beginning early in the season, near the first of May, and repeated approximately every 4 weeks, gave about as good control of the spot as the 7 sprays with the same mixture. Lime-sulphur solution sprayed even 7 times did not give as good results as 4 sprays with bordeaux. The flotation sulphur gave less satisfactory control of leaf spot than lime-sulphur solution. When the trees were examined, November 2, there were no leaves on the checks, or unsprayed trees; there were about 10 leaves, on the average, per foot length of twigs on the trees sprayed with flotation sulphur and on twigs sprayed 4 times with lime-sulphur solution.

On an average, per foot length of the twigs, on the trees sprayed 7 times with lime-sulphur solution there were 15.6 leaves; sprayed 4 times with bordeaux mixture, 21.5 leaves; sprayed 7 times with bordeaux mixture, 22.0 leaves.

It seems, therefore, that for the present 4 sprays with 2-4-50 bordeaux mixture, beginning about the first of May and repeating about once each month, may be safely recommended for control of cherry leaf spot.

Peaches

The experiments with peaches were conducted in an orchard near Oliver Springs. It was shown (1) that sulphur can not be omitted from the early sprays, due to scab development, if for no other reason; (2) that the use of lead arsenate with flotation sulphur, without lime, or with lime in equal amount to that of flotation sulphur, caused a foliage injury that was especially severe when the growth of the trees was poorest; and (3) that a spraying of peaches with sulphur, without lead arsenate, shortly before harvest, appears to give protection against brown rot during the period shortly after harvest.

Tobacco Diseases

Tobacco Wildfire and Angular Leaf Spot

Due to the practical absence of the bacterial leaf spots during the 1930 season, no experiments on control of the disease were undertaken during this year. The beginning of the 1931 season was also unusually dry, thus apparently justifying the decision not to carry on the experiments. With the advance of the season, however, in certain localities, especially in the region close to the mountains, a number of the tobacco fields were found to be severely affected with angular leaf spot. Tobacco culture in this region is of comparatively recent origin, and no angular leaf spot was observed there through the 1930 season, with the exception of a few fields, though a fairly careful examination of a considerable number of fields was made for the purpose. All of the growers in whose fields the angular leaf spot was found this year used commercial seed, without disinfection.

The experience points clearly to the necessity of seed disinfection and the observance of other sanitary precautions necessary for the production of healthy plants.

Tobacco Nematodes and Root Rot

A severe injury to tobacco plants by nematodes was found this year in certain spots of two fields, one at Knoxville and another at New Tazewell. Tobacco root-rot specimens were received from several localities in East Tennessee; several fields severely affected with this trouble were observed in Greene County, and one field near New Tazewell was reported as seriously affected. In the latter

case the field was used for tobacco for a number of years without any noticeable amount of root rot; then the field was put into clover, preceded by liming; this year it was again planted to tobacco, which showed, as stated before, serious injury from root rot. In this case the liming was probably responsible for stimulating the growth of the fungus.

Tobacco "Green" Leaf Spot

During recent years the attention of the writer has been called from time to time to a spotting of green color on the cured Burley leaf. The spot was of a roundish shape, with indefinite margin, of about a quarter inch in diameter, and of a green color on the naturally golden-yellow color of the well-cured leaf. Due to the very limited amount of the trouble usually reported, and to the number of causes known to lead to the production of a green color on the cured leaf—such as frost injury, sunscald, too rapid drying, and bruising—no further attention was given to it, though it did not quite fit into the other previously known causes of green color.

In 1931 conspicuous specimens of this green spot were brought in for examination, with reports indicating an extensive occurrence, which, under the prevailing poor market condition, was expected to cause a considerable financial loss to the growers. Specimens were later received from growers located in different parts of Tennessee.

The spots were suggestive of parasitic origin. It was therefore decided to study the matter from that point of view. Dr. P. H. Hornburg, an assistant in the Department, made systematic and repeated efforts at isolation of whatever organism might be present. The results of the isolations, whether from surface-sterilized or unsterilized spots, were invariably the same: the diseased material gave colonies of a fungus of relatively slow growth and of a dark greenish-gray to pinkish color, depending upon the kind of medium on which it grew, but no spores were found. The author examined a number of the spots on the specimens and always found present dark threads of a fungus, also without spores.

The appearance of the fungous growth in the cultures is much like that of other *Cercosporas* with which the author has been acquainted. His attention was therefore directed toward the probability that the green spot is an early stage—before spore production—of the well-known "frog-eye" leaf spot of tobacco, which is caused by the fungus *Cercospora nicotianae*. Investigation of the cause of the spot will be continued.

Cotton Wilt

Experiments were conducted with a view to obtaining cotton strains resistant to *Verticillium* wilt. For this purpose different

varieties of cotton were grown in the greenhouse at Knoxville and in a two-acre field near Tiptonville, in soil heavily contaminated with the fungus. In each case when the plants produced mature seed they were examined individually for the presence of the disease, by incision into the stems. The seed from plants showing marked freedom from the fungus were saved for the next year's work.

LIBRARY

Sarah C. Currell

A well-organized, workable, up-to-date library is essential to the success of an experiment station. This Station is most fortunate in having a well-balanced collection of books; scientific periodicals, of which a large number are foreign; publications from the forty-seven other state experiment stations; the works of the experiment stations located at Alaska, Guam, Hawaii, Porto Rico, and the Virgin Islands; the works of a number of foreign experiment stations; the publications of the United States Department of Agriculture; and valuable material published by the various state departments of agriculture. There has necessarily been a curtailment of expenditure, due to the financial condition of the State, which has retarded the growth and development of the library.

But the work of the Station library has in no sense been at a standstill. With very few new books to be catalogued, the time has been given to recataloguing the books belonging to the Station when the library was first organized. Hundreds of bulletins in packages which had never been opened have been classified and checked. This work has meant missing numbers supplied to uncompleted volumes. A large number of these bulletins were duplicates and were returned to the respective stations.

During the year, 252 volumes have been bound. Approximately 100 other volumes have been prepared for the bindery and will be sent as soon as funds are available.

The Experiment Station library has nearly 9000 volumes, a collection primarily for research workers. The Station has, however, given the students of the University the privilege of using the books in the reading room of the agricultural library. Any one wishing to read and study is welcome.

MERICOURT EXPERIMENT STATION

H. P. Ogden and Brooks D. Drain

Prolonged dry weather seriously affected all experiments at the Mericourt Station, at Clarksville. The effect was especially bad because of the large proportion of experimental plots in vegetables and small fruits. There were 609 of these plots and 128 in general farm crops. During the growing season, from May 1 to November 1, there was only 11.87 inches of rain, of which 2.23 inches came in one rain, on the 20th and 21st of July. This one rain made the corn crop. During the 8 weeks from September 3 through October 26 there was only .68 inch.

Fertilizer Experiments

Fertilizer experiments started prior to 1930 were continued and new ones added. Crops included were apple trees, beets, cabbage, corn, cantaloupes, cucumbers, peas, Irish potatoes, sweet potatoes, strawberries, tobacco, and tomatoes. All crops responded to phosphate, and practically all to nitrogen, though the response was not marked in some instances, and was uncertain in others, due perhaps to the drouth. For example, there was no evidence of the effect of nitrate of soda on yield, size of berry, or vigor of plants in strawberries. Both potash and lime helped most crops. The new concentrated fertilizers were decidedly more effective when mixed with ground limestone in the proportion of 1 part of fertilizer to 2 of limestone. In fact, beets failed to grow at all where the limestone was omitted.

Fertilizer-placement experiments with corn were continued. In the 1931 crop, the best yields were obtained where 500 pounds per acre of 4-10-6 were applied broadcast and disced in, while in 1930 the best yields were obtained with 125 pounds per acre applied close to the seed in the hill. Such results illustrate the difficulty of reaching dependable conclusions.

Effects of phosphate, potash, and lime on Alaska peas, inoculated with various commercial inoculants, and not inoculated, showed marked differences in the efficiency of the different inoculants. The effects of lime and fertilizers were much more apparent where a good inoculant was used. No nodules were found on the uninoculated plots and very few were found even on inoculated rows, except where both fertilizer and lime were used.

Coal dust was used in amounts of from 2 to 10 tons per acre on corn, soybeans, and millet to determine its possible fertilizer value. It failed to increase the yields of any of these crops.

Canning-crop rotations were continued on limed and unlimed land, with and without potash. The land used in these tests was

too poor to grow canning crops very successfully, and the drouth was particularly disastrous, so that results were inconclusive. On the whole, there was greater response to potash than to lime.

Notes on Results of Varietal Trials

The drouth ruined the varietal trial of string beans.

Marglobe tomatoes again led in yield.

The Van Fleet surpassed in yield all other raspberries, though its quality is rated below the others.

Southern Queen sweet potatoes made the highest yield, with Bunch Little-Stem Jersey second, and Nancy Hall third.

Korean lespedeza produced the highest yield of seed. Yields of the other kinds were greatly reduced by the drouth.

Among the new millets, No. 71294, a very late variety, considerably outyielded the others in hay and was at the top in seed yield. It is a very "leafy" variety, and because of its later maturity should be better suited for growing in a mixture with cowpeas.

Abruzzi and Italian rye surpassed all others in seed and straw yield. Neither suffered winter injury. Both start growth much earlier in the spring than other varieties, a valuable feature where grown for pasture or to turn under.

Neal Paymaster corn led, with Thompson Prolific a close second.

A new variety of kidney bean, the Geneva, developed by the New York Experiment Station, was again far in the lead.

The fall drouth was particularly injurious to all of the late varieties of soybeans. The result was that the early varieties, which are usually poor yielders, were decidedly in the lead.

New types of sweet clover were received from the University of Saskatchewan. One of these, Alpha 3, appeared more vigorous than the biennial white, used as a check. In habit of growth it resembles alfalfa.

The two varieties of *Lespedeza sericea* were continued in broadcast seedings, and additional plots were seeded in rows. Fair to good stands were secured, but growth was very poor. Better stands and better growth were secured on the poor, gravelly slopes than on the level, "tight" silty soil.

Pyrethrum cinerariaefolium, planted in the spring of 1930, made vigorous growth and a good crop of blossoms even on the poorest gravelly hillside. In a spacing experiment, plants set 18 inches apart, in rows 3 feet apart, gave maximum yields of blossoms. The indications are that even closer spacing in the row might result in still further increasing the yield.

Test of Cultural Methods

Tomatoes started in hotbeds covered with glass grew off somewhat faster when set in the field, began to ripen about a week earlier, and produced appreciably larger yields during the first 10 days of picking, but were surpassed in total yield by plants started under cloth.

Staking and pruning reduced the yield of tomatoes but increased the size.

Yields from tomato plants transplanted from the seedbed to 4-inch dirt bands exceeded yields from plants set in the field directly from the seedbed by 22.4 per cent. Transplanting from seedbed to cold-frame before setting in the field increased the yield only 4.2 per cent. The transplanted plants ripened fruit appreciably earlier.

In experiments with Aroma strawberries at Mericourt and Portland, under the direction of Prof. N. D. Peacock, use of mulch delayed harvest but increased yield; deep cultivation or medium cultivation was distinctly better than shallow cultivation; and clean cultivation, continued after August 1 throughout the fall, increased yields and was profitable.

Pyrethrum *Cinerariaefolium*

A good crop of blossoms was harvested from the pyrethrum planting made in the spring of 1930. Very few plants died during the past season and the stand on all plots varied from about 90 to 100 per cent.

TABLE 9—*Plant spacing of pyrethrum*

Spacing Feet	Weight per acre of air-dry heads				Stand
	Series 1 Pounds	Series 2 Pounds	Series 3 Pounds	Average Pounds	averaged Per cent
3 x 1½	490	557	552	553	95.9
3½ x 1½	579	262	420	420	89.2
3 x 2	451	401	329	394	88.5
4 x 1½	457	227	279	321	93.5
3½ x 2	433	233	379	348	94.6
3 x 2½	499	571	382	484	97.5
4 x 2	452	360	234	349	95.1
3½ x 2½	478	229	383	363	92.5
4 x 2½	369	144	187	233	88.5

In general, the closer spacing gave a larger yield in the first crop.

MIDDLE TENNESSEE EXPERIMENT STATION

L. R. Neel, Superintendent

Suffer from Another Drouth

The crop year of 1931 was the driest on record at the Middle Tennessee Experiment Station, proving disastrous to pastures and hay crops. Hay feeding on pastures was practiced from early in July until the silos were filled in September, when cattle were placed in barn and winter feeding was started. However, the timeliness of the summer showers and less extreme heat than in 1930 resulted in a fair corn crop.

Livestock

Comparison of breeds of sheep and accumulation of flock-management data were continued through the year. Also the study of cost of producing beef calves and a comparison of methods of finishing them was conducted. A new Shorthorn bull was placed at the head of the herd. The comparison of pasture crops as a supplement in hog feeding was continued as during the previous year.

The pasture test with kudzu was brought to a conclusion, the gains made being unsatisfactory and the stand suffering from pasturing and freeze.

Four $\frac{1}{2}$ -acre plots of Sudan grass were sown at different rates for beef-cattle pasture. Record was kept of time pasture was available, gains made per acre, and number of days each acre carried an animal during the pasture season. This experiment is to be continued until definite results are secured.

The fertilizer experiment with nitrate of soda for pastures was relocated on a 3-acre block of land to remain until definite results are secured. One, two, and three annual applications of the nitrate are compared with an equal number of check plots. Record of dates of pasturing, number of animal-unit days, and pounds of gains made per acre are kept.

Crops

Experiments to determine best methods and dates of seeding grass and clover, alfalfa, etc., varietal trials, and tests of rates of seeding oats, wheat, barley, and rye were conducted as usual, such additions being made as seemed advisable. Work with broomsedge eradication was continued, accumulating increasingly interesting results. Work with corn, sorghum, soybeans, lespedeza, etc., was continued.

On the farm, pure varieties of wheat, rye, barley, and oats were sown for increase to afford a source of seed for farmers of the region. A pasture field was set aside for bluegrass-seed

production to determine the practicability of saving seed in this section. In like manner, hop clover in the pastures was protected and seed was saved for propagation purposes.

In the spring of 1932, seedings were made of alfalfa from all of the important sources that are available to farmers of this section. Seedings are to be repeated both in the fall and spring for a period of not less than five years in order that the best sources of alfalfa seed may be determined.

WEST TENNESSEE EXPERIMENT STATION

Ben P. Hazlewood, Superintendent

The West Tennessee Experiment Station continues to be a popular place for visitation and study by farmers and their families. As the soil and climatic conditions in this section are favorable for the growth and harvesting of a large number of farm, truck, and orchard crops, and the production of livestock, a wide variety of experimental work is in progress.

Cotton

The Station has tried out 129 strains of cotton, representing different varieties, and the 11 strains representing the 9 varieties listed below are those left for further consideration. The data show that Half and Half has never given cotton of tenderable length, and in addition to this it has failed to show any potential ability to yield in the class with the varieties listed. The main object in the future will be to compare these 11 strains, or other strains of these 9 varieties, with a view to obtaining one that will be adapted to Tennessee. The strains are:

Acala 44	Lightning Express 8
Acala 5-37	Farm Relief—strain 1
Cleveland 884—strain 4	Rowden 40
D. P. L. 10	Stoneville 2-732
D. P. L. 4-8	Trice 25-1
Delfos 719	

Other tests on cotton are to determine:

The influence of the season on the length and uniformity of lint.

The extent to which the yield is influenced by the number of blooms a variety has during a season.

The extent to which earliness is a factor in yield.

The difference of early, medium, and late varieties in the shedding of blooms.

The relation of the position of the boll on the stalk to maturity.

The rates and dates of seeding cotton.

Effects of various methods of preparing the soil before planting.

Fertilizer requirements.

Farm Crops

Alfalfa.—First-year yields with varieties of alfalfa show Common Kansas to give the greatest yield of the 7 varieties in the trial; this variety yielding more than 6 tons per acre.

Sweet clover.—Sweet clover was seeded after 10 years of the following rotations: 2 years sweet clover and 2 years corn; 2 years lespedeza and 2 years corn; 2 years orchard grass and 2 years corn; and continuous corn. Better stands of sweet clover were obtained where it had not been previously grown.

Soybeans.—In varietal trials with soybeans, Tokio, Easy Cook, and Haberlandt gave greatest yields of hay per acre, with Yokoten giving greatest seed yield. Where planted in corn, Yokoten gave the best yields of beans per acre.

Lespedeza.—The 4 annual varieties were continued in test, with Tennessee 76 showing the greatest yield of hay per acre and Korean showing the greatest yield of seed.

Sericea.—Much interest has been manifested in the new crop *Lespedeza sericea*. Many farmers have visited the Station to study work being conducted with this crop. Tests indicate that it is well adapted to poor land, has a low lime requirement, and maintains a stand under adverse conditions. Seed yields the first year on medium land were 300 pounds per acre, second year 800 pounds per acre. From second-year Sericea, after cutting a hay crop of 2.48 tons per acre in June, a seed crop of 540 pounds per acre of unhulled seed was harvested in October. Feeding tests with Sericea, carrying about 25 per cent crabgrass, showed it to be eaten readily by yearling Jersey heifers. Gains were not equal to those made with alfalfa, but were better than would be expected from feeding grass hay. Work with this crop will be continued. A limited amount of pasture work with sheep indicates that the crop will stand pasturing.

Corn varieties.—Jellicorse Twin and Neal Paymaster continue to give the highest yields on rich land, while on poor land Jarvis Golden Prolific, Hickory King, and Thompson Prolific made yields comparable to Jellicorse and Neal Paymaster.

Small grains.—Large yields of all small grains again showed their value in West Tennessee farming by furnishing large acre yields of feed grains at small labor cost, a winter and spring cover crop, and an early harvest, making it possible to follow the grain crop with an early-seeded winter legume.

Fertilizer.—Continued tests with fertilizers show the general need for nitrogen, and, on gray-colored "crawfishy" soil, for potash and nitrogen, and the low phosphate requirement.

Horticulture

The year 1931 produced heavy yields of all fruits. The first yield of pears in the blight-work planting were secured. In the dormant-peach-spray test no difference was shown in scale control between oil emulsion and lime-sulphur sprays. Varietal tests continue to show the value of the Vainqueur as an early peach and the Slappey as a later peach of superior quality and flavor for home use. McClintock strawberries in open express shipments graded best in comparison with Klondike, Aroma, and several seedling varieties. Plants of the McClintock berry were produced for the purpose of introducing the berry to Tennessee farmers. Varietal tests with cantaloupes show the Superfecto to be the highest yielder of quality melons. Seed were produced from the most promising stalks of rhubarb and reseeded, continuing the work toward the production of a crown-rot-resistant rhubarb.

Strawberries.—In the trial of new seedling strawberries from the Knoxville Station, the McClintock was outstanding in yield and attractiveness of fruit. This variety ripened at the same season as the Klondike and was free from leaf spot. The fruit was large and maintained good size all through the season. A small supply of plants have been grown for distribution.

Asparagus.—The Washington strain of asparagus continued to do well under West Tennessee conditions. Close and normal spacing did not give any significant difference in total yield.

Tomatoes.—In a test of 14 varieties or strains, a selection of the Marglobe gave a very large yield, but ripened more than a week later than Marvana. Tennessee Red was a promising variety.

Cantaloupes.—The cantaloupe planting did unusually well the past season. Superfecto, Pollock No. 10-25, and No. 101 Special gave the best yields. The first was a large-sized melon, the latter two were of medium size.

Cucumbers.—Improved White Spine, Davis Perfect, and Klondyke did very well in the variety trials. Klondyke was somewhat earlier.

Irish potatoes.—An early planting of spring-crop Irish potatoes gave larger yields than later plantings. Tests on rates and dates of planting were in agreement with those of previous years.

Sweet potatoes.—Rates and dates of planting, and fertilizer and variety tests were continued as in 1930.

Rhubarb.—All but a few plants in the crown-rot-resistance test died during the past season. The surviving plants will be propagated by crown division.

Tree Fruits

Plums.—The Methley variety, *Prunus salicina* x *cerasifera myrobalana*, ripened early and gave a heavy yield. This variety, imported from South Africa, is a promising one for West Tennessee.

Pears.—The blight-resistant pear planting has started to produce some fruit; a few trees produced two or more bushels.

Peaches.—A new variety of peaches that ripens at about the same time as Mayflower continued to be very promising for West Tennessee conditions. It has been a heavy producer and of better quality than Mayflower.

Apples.—The yield of apples was above average. A number of the older and badly cankered trees were removed at the close of the 1931 season.

Small Fruits

Grapes.—The varieties of grapes gave good yields in 1931. Spray experiments indicated that the recommendations presented in the University spray schedule are satisfactory for the grape.

Raspberries.—The variety test of raspberries was in agreement with those of previous years. The Van Fleet variety has remarkable vegetative characters.

Blackberries and dewberries.—Plantings of blackberries, dewberries, and sand cherries were discontinued at the close of the 1931 season.

Livestock

Dairy herd.—The dairy herd, consisting of purebred and grade Jerseys, is gradually being enlarged through its own production. As the herd becomes larger, it will be possible to carry out more completely the plan and object of the original project. The work on herd improvement was given considerable impetus this year by the addition of a proven sire furnished the Station by the U. S. Department of Agriculture, Bureau of Dairy Industry. A number of purebred bulls from the best-producing cows in the herd were placed with farmers in West Tennessee during the past year. Keeping the herd free from Bang's disease and maintaining a normal breeding efficiency continue as important lines of work.

Beef cattle.—Beef-cattle experimental work, confined to steer feeding, conducted at this Station is described in detail in the Animal Husbandry section of this report.

Hogs and sheep.—On account of limited area at this Station it has not been possible to expand the work with hogs and sheep during this year. However, the swine herd has been improved by the addition of two very select pure-bred Duroc-Jersey sows and one boar. The lamb crop from the purebred flock of Hampshire sheep was superior to those of previous years as the result of having used a better ram.