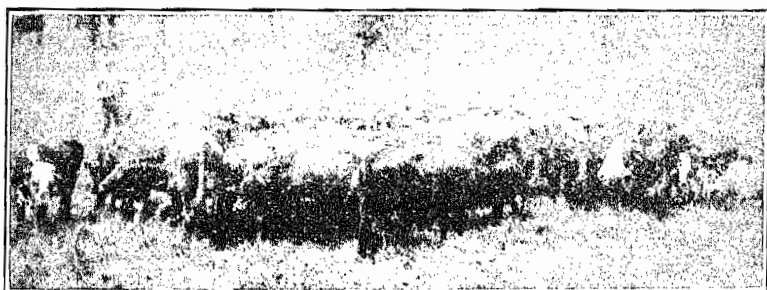


THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
Knoxville

FORTY-SECOND ANNUAL REPORT
1929



Soil Builders

Printed by
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Knoxville, Tenn.

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION
Knoxville

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*Cooperative with Office of Cereal Investigations, 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, Tenn., January 1, 1930

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 1929. 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, 1928-29

Receipts

	Hatch Fund	Adams Fund	Purnell Fund
U. S. Treasurer.....	\$15,000.00	\$15,000.00	\$50,000.00

Disbursements

Salaries	\$ 9,595.75	\$13,356.00	\$40,147.83
Labor	1,901.69	427.17	420.42
Stationery and Office Supplies.....	162.27	2.25	127.45
Scientific Supplies, Consumable.....	32.87	67.89	712.77
Feeding Stuffs .....	.....	.....	.....
Sundry Supplies	96.71	75.72	417.32
Fertilizers	3.00	.....	9.45
Communication Service	225.64	.30	36.02
Travel Expenses	177.61	292.49	1,868.88
Transportation of Things.....	43.03	51.08	194.68
Publications	945.75	.....	16.13
Heat, Light, Water and Power.....	1,207.15	157.58	107.68
Furniture, Furnishings and Fixtures	33.06	60.10	716.58
Library	448.51	60.65	257.72
Scientific Equipment	39.95	319.01	942.61
Livestock .....	.....	.....	.....
Tools, Machinery, and Appliances....	73.07	1.45	199.58
Buildings and Land.....	11.38	128.31	3,824.68
Contingent Expenses	2.56	.....	.....
Unexpended Balance .....	.....	.....	.....
Total	\$15,000.00	\$15,000.00	\$50,000.00

FORTY - SECOND ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF TENNESSEE, FOR 1929

C. A. MOOERS, Director

The annual report for 1928 was printed in popular form; the achievements and work of the Station being presented as far as possible by means of illustrations. This form of report did not admit of an orderly statement of publications, changes in staff, and progress of experiments. The forty-second report will therefore include such reference to 1928 as may be necessary to connect the more important events with the report for 1927.

THE PURNELL FUND

Beginning with July, 1925, the Station has been getting the benefit of the Purnell fund, a Congressional appropriation, which has increased annually and will, during the fiscal year 1929-30, reach the maximum of \$60,000.00 provided for by the act. This fund has been used to great advantage, and is responsible for well-organized departments, such as those of Entomology and Plant Pathology, which could not have been properly supported from other income at the Station's command. Certain outstanding results can be attributed directly to it. One of these is the discovery and development of the flucsilicates as insecticides for farm and garden crops. The discovery of a new wilt disease of cotton that was doing much damage in West Tennessee is another item to its credit. An effort is now being made to work out a method for controlling this trouble, which formerly was looked upon by the growers as a common rust disease due to faulty nutrition of the crop. Investigations in the biochemical laboratory, supported entirely by the Purnell fund, have resulted in a practical method for the removal of garlic flavor and odor from milk. Within the past year the Biochemist has also devised a very simple method for removing bitterweed flavor from cream. Much of the Station's investigational work in soil chemistry and in horticulture is supported by this fund.

One of the new projects of the year relates to the better utilization of sweet potatoes. This crop is well adapted to large areas in the State, especially in West Tennessee. At the Jackson Station, for example, the yield for a number of years has averaged more than 350 bushels per acre. Last year the yield in the varietal trials was over 500 bushels, and one variety produced over 900 bushels. It is evident that only the low price of the crop, together with the difficulty of carrying it through the fall and winter, prevents its being very

extensively grown. The numerous possibilities of sweet potatoes appear not to have been thoroughly investigated by any one up to the present time. This year, in one of our laboratories, it was found that a high-grade vinegar can easily be made from culls.

Following is a list of Purnell projects begun in 1929:

1. Influence of soil and fertilizer on quality of Burley tobacco.
2. Cotton wilt caused by *Verticillium albo-atrum*.
3. Poultry-yard disinfection.
4. Vitamin content of mineral-oil-treated and untreated milk.
5. The availability of soil potash as influenced by liming.
6. The making of vinegar from sweet potatoes.
7. A study of lamb standardization and grading.

A new and important project begun in 1928 and not previously mentioned in an annual report is cotton-market price studies by the Department of Agricultural Economics.

An excellent greenhouse for the Department of Plant Pathology was built this year with money derived from the Purnell fund.

ADAMS FUND

The only new project under the Adams fund relates to the effect of liming on the fate of the phosphoric acid from applied acid phosphate.

FERTILIZERS FOR WEST TENNESSEE

One of the outstanding results of the Station's work is the dividing of West Tennessee into two sections, whose soils have been found to be materially different in fertilizer needs. In the eastern part of West Tennessee—about one-third of the entire area—the soils are decidedly deficient in phosphoric acid, and respond readily to phosphate. In the western two-thirds, on the other hand, the soils have been found to have a low phosphoric acid requirement. Both sections are highly responsive to nitrogenous fertilizers, such as nitrate of soda and ammonium sulphate. At the West Tennessee Station, long-continued fertilizer experiments show little response to any kind of phosphate, high response to nitrogen, and medium response to potash, which has been found to be decidedly deficient only in gray-colored "crawfishy" soils. Definite fertilizer recommendations were made in Circular No. 20, published in November, 1928. The recommendations were widely followed in 1929, with highly satisfactory results. During the coming year it is hoped that extensive data will be obtained from field experiments conducted in numerous counties of West Tennessee, and that more positive fertilizer recommendations can be made for this part of the State.

COORDINATION OF INVESTIGATIONAL WORK

The coordination of experimental and investigational work is considered important, and is being carried out as far as seems practicable. A good example is found in our work on cotton, which is being studied from both agronomic and economic points of view, as may be seen from the departmental reports. The strawberry crop is another example, the Departments of Horticulture, Economics, and Plant Pathology having projects on this subject. A third example is crown gall, which is being cooperatively investigated by the Departments of Horticulture and Plant Pathology.

PUBLICATIONS

Bulletins

Bulletin No. 139—Studies on toxicity of fluorine compounds, by S. Marcovitch. 48 pp. Mar. 1928. This bulletin discusses the poisoning effects of fluorine compounds in the case of insects and of higher animals. Experimental data are given showing the comparative toxic values of fluorine compounds and arsenicals.

Bulletin No. 140—Cryolite and barium fluosilicates: their use as insecticides, by S. Marcovitch. 19 pp. Nov. 1929. This bulletin calls particular attention to the need of insecticides other than arsenicals and to the special fitness of the two materials named, which are cheap, abundant, and highly effective and cause little foliage injury. Directions for practical use are given.

Bulletin No. 141—The comparative values of different phosphates, by C. A. Mooers. 18 pp. Nov. 1929. This bulletin gives the results obtained in a 10-year series of experiments near Crossville, in Cumberland County. In the experiments acid phosphate, rock phosphate, Thomas slag meal, and a manufactured basic phosphate were compared as to their effects on crop yield when applied at different rates under both limed and unlimed conditions. The basic phosphate ranked the highest in returns, where no liming was done, for corn, oats, and clover and grass. Acid phosphate proved best for Irish potatoes and was superior to rock phosphate for general use on unlimed land. On limed land it ranked along with the basic phosphates. Under liming, rock phosphate gave decidedly inferior returns, and where no lime was applied it ranked the lowest of the materials tried in returns per dollar invested.

Circulars

Circulars reporting practical results of the Station's work have been published as follows:

Circular No. 18—New fertilizers on the market for 1928, by C. A. Mooers. Feb. 1928.

Circular No. 19—The spacing of cotton, by C. A. Mooers. Feb. 1928.

Circular No. 20—Fertilizers for West Tennessee, by C. A. Mooers. Feb. 1928. (Reprinted Nov. 1928).

Circular No. 21—Washington asparagus in Tennessee, by J. A. McClintock. Mar. 1928.

Circular No. 22—Control of dodder in lespedeza, by S. H. Essary. Apr. 1928.

Circular No. 23—Pulverizing limestone on the farm, by F. D. Jones. Dec. 1928.

Circular No. 24—Cotton diseases of special importance in Tennessee, and their control, by C. D. Sherbakoff. Jan. 1929.

Circular No. 25—The value of certified Irish potato seed, by J. A. McClintock. Dec. 1929.

Circular No. 26—The removal of bitter flavor from "bitterweed" cream, by Margaret B. MacDonald. Dec. 1929

Circular No. 27—A select list of varieties of vegetables, by H. I. Fackler. Dec. 1929.

Other Publications

The article on "Tennessee," in the new edition of the Encyclopedia Britannica, published in 1929, was prepared by C. E. Allred.

Retention of farm wealth, by C. E. Allred. A paper prepared for the Institute of Public Affairs, held at the University of Virginia, in 1929. This paper has already been published in mimeographed form by the Institute, and is being included as one chapter in a book under the editorship of Dr. Wilson Gee.

Tennessee, economic and social, by C. E. Allred, S. W. Atkins, and G. H. Hatfield. Sept. 1929. This was published as a bulletin by The University of Tennessee Division of University Extension. It is considered to be the most complete statistical analysis of the economic and social conditions of the counties of the State that has ever been published. It contains more than 200 pages, is based on the latest data, and gives about 1200 facts regarding each county.

Effect of industrial development on rural life in Sullivan County, Tennessee, by C. E. Allred and J. C. Fitch. May 1928. This was published by the Division of University Extension. It is a preliminary report covering the first half of the field work on our project, Effect of Industrial Development on Rural Life.

An analysis of farming in Overton County, Tennessee—a mimeographed report—was written by C. E. Allred and S. W. Atkins, and issued by the Department of Agricultural Education in December, 1928. This was a cooperative project with the U. S. Bureau of Agricultural Economics and The University of Tennessee Agricultural Extension Service.

Importance of leaf spot in the selection of pear varieties used as

stocks for budding, by J. A. McClintock. Proc. Amer. Soc. Hort. Sci. 1928.

New wraps for buds and grafts, by J. A. McClintock. Proc. Amer. Soc. Hort. Sci. 1928.

The relation of phony peach and other troubles to the sale of southern nursery stock, by J. A. McClintock. Proc. Sou. Nurserymen's Asso. 1929.

Marianna plum seedlings versus rooted cuttings as root stock, by J. A. McClintock. Proc. Amer. Soc. Hort. Sci. 1929.

American Mazzard cherry seedlings as root stocks for cultivated cherries, by J. A. McClintock. Proc. Amer. Soc. Hort. Sci. 1929.

Yellows-resistant cabbage for Tennessee, by J. A. McClintock and H. L. Fackler. Cir. No. 19, Univ. of Tenn. Agr. Ext. Serv. 1929.

Inhalation the chief factor in onion or garlic contamination of milk, by Margaret B. MacDonald and M. Jacob. Science. Vol. LXVIII: pp. 568, 569. 1928.

The chemical and physical behavior of certain synthetic fertilizer salts when mixed with limestone and dolomite, by W. H. MacIntire and K. B. Sanders. Jour. Am. Soc. Agron. Vol. 20: pp. 764-770. 1928.

The absorption of $\text{Ca}(\text{OH})_2$ - CaSO_4 by soil as a possible index to colloidal alumina and silica, by W. H. MacIntire and W. M. Shaw. Proceedings First Int. Congress of Soil Sci. Vol. II: pp. 279-313. 1928.

Report on soils and liming materials, by W. H. MacIntire. Jour. A. O. A. C. Vol. 11: p. 150. 1928.

The role of the lysimeter in soil chemistry research. President's address, by W. H. MacIntire, Jour. A. O. A. C. Vol. 11: pp. 16-25. 1928.

Report on liming materials, by W. H. MacIntire. Jour. A. O. A. C. Vol. 12: pp. 144, 145. 1929.

Soil Reaction: Method of statement. Report of committee on revision of methods of soil analysis, by W. H. MacIntire. Jour. A. O. A. C. Vol. 12: pp. 63, 64. 1929.

The relation between the absorbed and the exchangeable calcium and magnesium content of a soil four years after additions, by W. H. MacIntire and K. B. Sanders. Soil Sci. Vol. XXVIII: pp. 289-300. 1929.

A substitute for arsenic, by S. Marcovitch. Scientific Monthly. Vol. 27: pp. 459-462. 1928.

Studies on toxicity of sodium fluosilicate, by S. Marcovitch. Jour. Phar. and Exp. Ther. Vol. 34: pp. 179-186. 1928.

Control of the Mexican bean beetle, by S. Marcovitch. Cir. No. 8, Univ. of Tenn. Agr. Ext. Serv. 1928.

Control of green lice on turnips, by S. Marcovitch. Cir. No. 17, Univ. of Tenn. Agr. Ext. Serv. 1928.

Sodium fluosilicate as a fly poison, by S. Marcovitch. Jour. Econ. Ent. Vol. 22: p. 602. 1929.

The control of the tobacco beetle in upholstered furniture, by S. Marcovitch. Jour. Econ. Ent. Vol. 22: p. 602. 1929.

Control of insect enemies of melons, cucumbers and squash, by S. Marcovitch. Pub. 115, Univ. of Tenn. Agr. Ext. Serv. 1929.

An issue raised in "A new type of lysimeter at the New Jersey Agricultural Experiment Station, by C. A. Mooers and W. H. MacIntire. Science. Vol. LXX: pp. 611, 612. 1929.

Determination of the caustic value of lime, by W. M. Shaw, W. H. MacIntire, and J. E. Underwood. Ind. & Eng. Chem. Vol. 19: pp. 1-8. 1928.

Effects of certain impurities upon the determination of causticity of limes by modifications of the sugar and Scaife methods, by W. M. Shaw and W. H. MacIntire. Ind. & Eng. Chem. Vol. 19: pp. 1-14. 1928.

Report on liming materials. W. M. Shaw. Jour. A. O. A. C. Vol. 11: p. 152. 1928.

A utility shaking machine. W. M. Shaw. Ind. & Eng. Chem., Anal. Ed. Vol. 1: p. 93. 1929.

Washingtonia palm leaf spot due to *Cylindrocladium macrosporum* n. sp., by C. D. Sherbakoff. Phytopathology. Vol. 18: pp. 219-225, fig. 2. 1928.

Verticillium wilt of cotton, by C. D. Sherbakoff. Paper read before the Phytopathological Society. Abst. Phytopathology. Vol. 19: p. 94. 1929.

Report on fluorine compounds, by G. A. Shuey. Jour. A. O. A. C. Vol. 11: p. 147. 1928.

CHANGES IN STAFF

New Members

Mr. S. W. Atkins became Assistant Agricultural Economist July 16, 1928. He is a graduate of the University of Tennessee with the M. S. degree, and had previous experience in economics work under Professor Allred. Mr. Atkins was transferred to his present position from the University of Tennessee Junior College, at Martin, where he was on the teaching staff.

Mr. P. B. Boyer became Assistant Agricultural Economist August 1, 1929. Mr. Boyer graduated in 1924 from Denison University, Granville, Ohio, and spent two years in graduate study at the University of Chicago. He was a graduate assistant at Michigan State College for two years, 1927-1929, majoring in Rural Sociology.

Miss Adelaide Glaser was made Assistant in Biochemistry, beginning September 16, 1929. Miss Glaser is a graduate of the Kansas Agricultural College at Manhattan.

Mr. G. H. Hatfield, a University of Tennessee graduate, with M. S. degree, was a student assistant in Agricultural Economics in 1928-29, and was made a regular member of the staff beginning July 1, 1929.

Mr. Ben P. Hazlewood, who has both a B. S. and an M. S. degree from the University of Tennessee, was appointed Superintendent of the West Tennessee Station, beginning October 1, 1929. Mr. Hazlewood is a native of Rutherford County. He was recently employed by the Pet Milk Company at Greeneville, Tennessee, and his knowledge of dairying is expected to be a valuable asset to the West Tennessee Station.

Mr. B. F. Lucas, a graduate of Cornell University, joined the Agricultural Economics Department October 1, 1929, as Research Assistant, and has been assigned to work on the Cooperative Marketing project.

Mr. Brooks Robinson was added to the staff as Assistant Soil Chemist August 1, 1929. He is a graduate of Mississippi A. & M. College.

Mr. A. C. Seymour was added to the staff as Research Assistant July 1, 1929, and assigned to work on the Farm Taxation project.

Mr. W. C. Stone was added to the staff as Research Assistant July 1, 1929, and is working on some phases of the Cooperative Marketing project.

Resignations

Miss Francis A. Briggs, who came to the Station as Assistant in Biochemistry September 1, 1928, resigned September 1, 1929, to pursue further study. She was highly satisfactory in her position here, and her resignation was received with regret.

Miss Esther M. Crawford, who very acceptably filled the position of Assistant Biochemist from September 1, 1926, resigned July 1, 1928.

Mr. Robert McAlpin, who had been on the Agricultural Economics staff for a year, resigned July 1, 1928, to become a member of the faculty of the Berry School in Georgia.

Mr. S. A. Robert, Superintendent of the West Tennessee Station from August 1, 1909, resigned October 1, 1929, to accept an attractive position as Development Agent for the Birmingham and Great Northern Railway Company. Mr. Robert had filled his position as Superintendent for so long a time, and so well, that his decision to leave was received with great regret by the officials of the Station and University. He was especially successful in making the Station popular with all classes of people, and his many friends throughout West Tennessee were sorry to hear that he had gone to another State.

Mr. T. L. Robinson, who joined the staff on July 1, 1927, as Research Assistant in Agricultural Economics, resigned July 1, 1928, to take a position as county agent in North Carolina.

Mr. K. B. Sanders, who began work as Assistant Soil Chemist September 1, 1925, resigned September 1, 1929, to do graduate work at the Michigan State College. Mr. Sanders did excellent work while connected with the laboratory force, and the Station regretted to lose him.

Mr. Odom Stewart, who had been on the Agricultural Economics staff for nearly a year, resigned July 1, 1929, and became affiliated with the Tennessee Dairy Products Association.

REPORTS BY DEPARTMENTS

AGRONOMY

C. A. MOOERS

The Station's work with farm crops is scattered rather widely over the State. Reference is made in other reports to the work being done at the substations. At the Knoxville Station more attention than usual was given in 1929 to experiments with Burley tobacco, a crop that has greatly increased in importance in East Tennessee within the past few years. A study of the methods followed by the growers reveals the need for much more information in regard to the best methods of fertilizing this crop, which at present is usually grown on the best land, well manured, and rather highly fertilized. The problem seems to be, How much manure is justified, and what fertilizer materials give the most profitable returns in connection with the manure? Another question of considerable moment is the effect of the various treatments on the burning quality of the crop. In addition, more information is needed as to the effects of soil type on quality.

As in the past, numerous varietal trials of various farm crops are being conducted at the Knoxville Station. New varieties of promise are transferred for trial to the substations. A promising new variety of corn found by O. W. Dynes, Professor of Agronomy in the University, is Thompson's Prolific. This variety has been included in the Station's trials for the past two years, and has proved to be an excellent early-maturing variety, yielding on a parity with Jarvis Golden Prolific. The Thompson corn is white, with a white cob, and is above the average in soundness.

The new perennial lespedeza continues to be by far the most promising variety of its kind ever tried by the Station. In order that it may be tried extensively in the State, an earnest effort is being made to increase seed production.

Both this year and last a fairly extensive series of experiments was carried out with a view to getting a good stand of corn. Poor stands undoubtedly cut down the State's yield to a material extent. At present there seems no practical method except to plant much too thick and then thin to the proper stand. Planting for the desired stand will not result in a full crop. Even under favorable conditions, a loss of 10 per cent follows such a practice. One of the objects of the agronomic work is to find out the effect of various factors that concern the economical production of farm crops. Each one by itself

may not seem highly important at first glance, but if the possibilities be applied to the State as a whole, results of considerable consequence appear, and if several of these factors be taken together the possibilities reach large proportions.

Pasture Experiments

Data from rather extensive pasture experiments at the Middle Tennessee Station were obtained in both 1928 and 1929. So far no combination has surpassed that of Kentucky bluegrass and white clover. In 1929 the season was very favorable for white clover, and the combination with Bermuda grass gave returns approaching those from bluegrass and white clover.

The results from pasturing kudzu were of interest because the steers pastured on this crop lost 124 pounds per acre in the course of the season, whereas steers on bluegrass and white clover gained 425 pounds. In neither case was any supplemental feeding done.

In the case of sagegrass, small gains were made early in the season, but afterward the animals lost in weight, so that at the end of the season the total loss was 247 pounds per acre.

A gain of 151 pounds per acre was made from lespedeza. At first sight this seems low, but it is a good gain when both the period of grazing and the time of year are taken into consideration, because the lespedeza furnished most of its grazing in hot weather, when the bluegrass was nearly dormant. Also the time of year is unfavorable for the best gains.

Corn Improvement

L. S. MAYER

The corn-improvement program at the Tennessee Experiment Station, in cooperation with the Office of Cereal Crops and Diseases, U. S. D. A., is continuing along the lines previously indicated.

Inbreeding

Inbreeding through self-pollination is being done with 10 commercial varieties, chief of which are Delta Prolific, Neal Paymaster, Jarvis Golden Prolific, Tennessee Red Cob, and a hybrid yellow dent. The many selfed strains, or families, have been inbred for from 3 to 13 generations. In 1928, 800 field rows for breeding and 160 rows for crossing gave approximately 10,000 selfs and crosses. In 1929 there were 720 breeding rows and 240 crossing rows. The number of strains included in these inbred lines in 1929 was over 700. Half of this number is confined to one variety, Neal Paymaster, which is an outstanding variety not only in Tennessee but elsewhere in the South. The F_5 strains are now showing decided specific characteristics. The field and laboratory notes are being made as comprehensive as pos-

sible in order that sufficient data for later correlation study may be at hand. A brown-cob factor and a golden-plant factor have been isolated, and their genetics are being studied. The golden-plant factor is unusual in that the plants produce normal ears.

The lines of investigation being pursued include the relation of endosperm density to yield and disease-resistance; relation of kernel-row number to yield; relation of prolificacy to yield; cob color, with respect both to the genetics involved and the possible relation of color of the ligneous part of the cob to yield; relation of rate and extent of primary and secondary root growth in the young seedling to vigor of mature plants in selfed strains.

A New Hybrid Yellow Corn

A promising segregate has been obtained from a hybrid yellow dent. In 1922 a cross was made between a selfed strain of No. 201 (Delta Prolific) and Jarvis Golden, the latter furnishing pollen from the unselected open-fertilized variety. This cross grown in 1923 showed much promise, and several selfs were made. From these, after 5 generations of inbreeding, have come several segregates of possible value, giving good-sized ears, of attractive color, and as prolific as Neal Paymaster. The small quantity of seed available was increased in 1929, and thorough yield tests throughout the State will be made in 1930. There is need for an adapted high-yielding yellow corn in a large section here, and this hybrid seems to promise the fulfillment of this need. It has about the same growth period, and is somewhat harder in starch content and sounder in quality than Paymaster. Crosses and double crosses between selfed strains of this hybrid yellow will be tested for further improvement.

Yields of Crosses between Inbred Strains

Crosses between inbred lines of Delta Prolific, Neal Paymaster, and Jarvis Golden, made in 1928, were tested for yield in 1929. The yields obtained, in the case of Delta Prolific, were, in general, in accord with previous tests already reported. The yield-test plots were replicated 5 times and checked with open-fertilized Neal Paymaster in the plots of the Delta Prolific and Paymaster crosses, and checked with open-fertilized Jarvis Golden in the plots of the Jarvis crosses. Previous varietal yield data have indicated Neal Paymaster to be somewhat higher-yielding than the commercial Delta Prolific. Table 1, giving the ratio of the yield of the cross to the yield of the check as 100 per cent, shows increases in yield of over 20 per cent in 3 cases and over 10 per cent in 16 cases. In the long selfed lines of Delta Prolific the 2-2, 5-1, 7-4, and 10-3 families show again their yielding ability when crossed, while the 3-1 family is also effective. Not all the strains in these families are equally good, however. In the Paymaster and Jarvis varieties, the strains involved in the several crosses have been inbred 5 and 6 years. Here again a wide range in yielding ability is shown. In Jarvis one cross gave 27 per cent increase over the

TABLE 1—Yield of crosses between inbred strains of corn—1929

Variety	Pistillate parent	Staminate parent										
	Strain No.	2-2	3-1	5-1	7-1	7-4	9-2	10-3	12-1	13-1	15-1	
Delta Prolific	2-2	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	
	3-1	.....	99.9	84.9	106.1	112.1	112.3	.....	99.5	113.0	116.8	
	5-1	.....	.....	103.6	103.1	110.5	.....	123.4	101.9	95.0	92.2	
	7-1	.....	.....	.....	101.1	94.0	67.8	122.7	79.9	99.9	91.5	
	7-4	.....	.....	.....	.....	119.9	119.9	104.4	109.8	.....	90.5	
	9-2	.....	.....	.....	.....	.....	98.1	106.3	.....	.....	.....	
	10-3	.....	.....	.....	.....	.....	.....	68.7	71.0	88.2	74.5	
	12-1	101.4	.....	.....	.....	.....	.....	.....	93.6	.....	.....	
	13-1	.....	.....	.....	.....	96.2	.....	.....	.....	91.8	76.7	
	15-1	.....	.....	.....	.....	103.5	.....	.....	.....	.....	83.1	
Neal Paymaster	Strain No.	P30	P34	P35	P36	P37	P41					
	P 30	.....	.....	.....	95.3	86.9	77.8	.....	.....	.....	.....	
	P 34	85.6	.....	90.3	105.7	95.2	95.0	.....	.....	.....	.....	
	P 35	100.4	.....	.....	.....	89.3	98.6	.....	.....	.....	.....	
	P 36	.....	.....	115.1	.....	93.2	93.5	.....	.....	.....	.....	
	P 37	.....	.....	.....	.....	.....	84.7	.....	.....	.....	.....	
Jarvis Golden Prolific	Strain No.	3-2	5-1	5-2	5-5	7-2	7-6	8-6	10-5			
	3-2	.....	83.2	102.7	58.8	127.2	95.3	101.0	93.4	.....	.....	
	5-1	.....	.....	83.2	79.3	114.2	67.8	101.0	101.8	.....	.....	
	5-2	.....	.....	.....	106.1	103.7	76.9	63.8	.....	.....	.....	
	5-5	.....	.....	.....	.....	117.1	98.3	74.6	118.3	.....	.....	
	7-2	.....	.....	.....	.....	.....	94.3	113.4	112.0	.....	.....	
	7-6	.....	.....	.....	.....	.....	.....	61.1	.....	.....	.....	
	8-6	.....	.....	.....	.....	.....	.....	.....	108.4	.....	.....	
	10-5	.....	.....	99.8	.....	.....	95.2	.....	.....	.....	.....	

Note.—Neal Paymaster variety, used as check against Delta and Paymaster crosses, yielded 62.67 bushels of air-dry shelled corn per acre. This is taken as 100 per cent. Jarvis Golden Prolific, used as a check against Jarvis crosses, yielded 57.22 bushels of air-dry shelled corn per acre. This is taken as 100 per cent.

average of the open-fertilized variety (Jarvis seed from the originator), which was 57.22 bushels of air-dry shelled corn per acre. Other crosses show 18, 17, and 14 per cent increases. In the crosses involving 10 inbred families of Paymaster, only one combination gave a substantial increase, 15 per cent. There are now at the Station 480 strains from 87 families out of 105 original ones with which work was started 5 years ago. Selected strains of these families will be crossed in 1930. With the larger number, the possibility of isolating high-yielding strains for recombination is much better.

Double crosses between strains of Delta, Jarvis, and Paymaster, made in 1929, will be tested throughout the State and section in 1930. Sufficient double-crossed seed is available to permit a rather thorough yield test. In the Delta Prolific variety these double crosses involve a change of 1, 2, and 3 lines, which it is hoped will give some index of the potency of the several families entering the combination.

Disease-Resistance of Selfed Lines

Owing to pressure of more urgent work, the study of the selfed strains of Neal Paymaster for disease-resistance, in cooperation with the Plant Pathologist, Dr. C. D. Sherbakoff, has fallen somewhat be-

hind, but it will be brought abreast of the breeding work the coming year.

Regional Strain Test

The third year of the state-wide regional type-yield tests has brought out some interesting results. In this test 30 varieties were used, 7 yellow and 23 white. Of the white varieties, 12 were Paymaster strains, and of the yellow, 4 were Jarvis strains. The first 11 ranking varieties for the whole State were strains from certified Neal Paymaster growers. The average yield of dry shelled corn for all fields was 61 bushels. The average yield of the 12 Paymaster strains was 66.2 bushels. The average of all other white varieties was 55.7 bushels. All the yellow varieties gave an average yield of 53.4 bushels, while the 4 Jarvis strains gave 53.0 bushels. The low yields of one yellow variety, Sure Crop, tended to reduce materially the average of the yellow varieties.

The results of these tests for the 3 years point to these conclusions: Varieties of seed corn from outside the State are usually lower in yield than native varieties; the semi-prolific varieties are more productive than either the 1-ear or the true prolific types; growers who are careful in selecting seed corn in the field from healthy standing stalks are maintaining the yielding capacity of their particular strain or variety.

In view of the fact that there is some prejudice in the minds of many farmers against Neal Paymaster because of its so-called unsoundness, an attempt was made to ascertain the relative soundness among the white dent varieties tested in the Knox County field on the University farm. All ears in any way damaged by ear worm, birds, or visible disease were classed as unsound, and only the strictly sound ears were classed as marketable corn. A comparison of the 12 Paymaster strains with 12 other white dent varieties showed that the average per cent of marketable corn for all Paymaster strains was 92.5, against 91.2 for the other varieties. In each group 3 strains, or varieties, fell below 90 per cent, while the highest per cent for Paymaster was 96.6, and for the other white varieties 95.9. More data along this line will be secured in subsequent yield tests.

These tests, conducted by the Tennessee Crop Improvement Association, in cooperation with the State Experiment Station and the Office of Cereal Crops and Diseases, U. S. D. A., will be materially expanded in 1930, and will include, for the first time, double crosses of inbred lines.

BOTANY

S. H. ESSARY

Cotton

During the season of 1929 the same lines of investigation were followed as in the previous year. Plantings were made at Jackson, Murfreesboro, and Knoxville along 4 different lines.

1. Varietal trials.—Of the leading varieties of cotton, 20 were planted in the same order at the 3 locations. At Jackson, 10 replications were made, at Murfreesboro 9, and at Knoxville 8, with one variety used as a check on every tenth plot. All varieties were given the same treatment and observations were made on their behavior throughout the season. Early, medium, and late pickings were made, and weights taken of each picking. Second and third pickings were made at Jackson and Murfreesboro. At Knoxville, 2 pickings were sufficient, as the first was very late, on account of the lateness of opening. The varieties were divided into 3 classes according to the earliness of first pickings. In this experiment, an attempt is being made to determine the fitness of varieties for different cotton-growing sections of the State; Jackson being considered as typical of West Tennessee conditions, Murfreesboro of conditions in the Middle Tennessee cotton counties, and Knoxville of conditions near the northern border of cotton-growing. It was noted that all varieties open first at Jackson, next at Murfreesboro, and last at Knoxville, there being several weeks between Jackson and Knoxville. From the observations of the last 2 years, and from similar work in previous years, the conclusion is drawn that only under conditions prevailing in years especially favorable to cotton maturity, combined with favorable price levels, would cotton-growing in the latitude of Knoxville be profitable.

2. New strains.—Another set of plots was devoted to trials of new varieties and strains obtained from other experiment stations and plant-breeders. They were planted at the 3 locations and given the same treatment, and harvested as in the varietal trials, except that they were planted in one 3-row block each at all the locations. Those new strains that show much promise are placed the following year in the regular varietal trials. Some of our most promising varieties have been obtained in this way. These trials, while less extensive than the varietal trials, give a fair indication of a strain, since it is grown in 3 widely separated localities.

3. New selections.—Promising plants of any variety, wherever found, are selected for propagation. As many cotton fields as possible are searched for good plants—those that produce good lint and have other desirable features. Such plants are selected, and from them seed are collected for progeny-row trials the following year. These selections are divided and planted at all locations, if possible. The

most promising of these selections are selected and afterward treated as new varieties. They are tested for earliness, prolificacy, and lint quality. Several hundred promising selections of many varieties are under test at present. Some of them are a decided improvement over their parent varieties, especially some of the Trice selections. The number is constantly cut down as selections fail to show decided improvement over the parent plants. In order to keep the seed pure, the selections are planted in isolated blocks, or are self-pollinated by hand to prevent crossing. Any that are very good will be placed in breeding blocks to increase the seed supply, and then placed in field trials. A good proportion of our plots, and of the time of the workers, is devoted to this phase of the cotton-improvement work.

4. Cotton crosses.—Many crosses of cotton varieties have been made, to combine the desirable characters of the varieties. Hundreds of crosses are now in hand, which are planted and handled in the same manner as the selections. They are self-pollinated to prevent further crossing. This is necessarily a slow process, and will require a number of years to establish the value of the crosses. In the first and second generations a number of the crosses have shown qualities superior to those of their parents. Certain crosses, made a number of years ago to improve the quality of the lint, have shown desirable characteristics and have segregated some good strains. The object in making these crosses has been to combine earliness with good lint qualities, and this is being accomplished. The work is being continued as more is learned about the varieties. Only plants that have been self-pollinated for a number of years are used in making crosses.

A close study has been made of the price ranges of the various staple lengths of cotton. From this study, aided by the reports of the U. S. Department of Agriculture, we have learned much about the importance of growing varieties that produce cotton lint of the most desirable type, and which consequently bring the farmer the best prices. It is noted that the short-lint cottons are in the greatest abundance, while those of the longer lint, which are most in demand by American and foreign spinners, are least abundant. Lint of 7/8 inch or under, which constitutes the bulk of the Tennessee crop, is in least demand, while that of an inch and over is in greatest demand. In some of the largest cotton-producing counties 60 per cent or more of the crop is of the short-staple varieties. The farmer has been growing cotton at a discount, as he could realize a higher price on good 1-inch cotton. This condition has come about because certain short-lint varieties give a higher-lint turnout at the gin than those better varieties which make 1-inch lint. Our experiments at Jackson show that the better-lint varieties produce, on the average, a greater money value than the short varieties.

One must consider, in this connection, the fact that the true value of good lint is not always realized. A community is rated by the cotton-buyer on the variety of lint most commonly sold in that sec-

tion. All cotton from a community that has been selling short-staple cotton will sell at the price of short staple if care is not taken in ginning and marketing to separate the various grades, and this is seldom done in our present method of marketing. It is important that communities, especially gin communities, adopt a particular variety, or several varieties of similar character. A 1-variety community is best and a marketing system should by some means be inaugurated in which true values are given to lints of different lengths. The Experiment Station can recommend the varieties, and help in the organization of 1-variety communities. Several varieties that have been under test are suggested for use in such organized communities. Where short varieties are the most commonly grown, it is not worth while for a few farmers to grow a better variety and sell it according to the marketing system at present in vogue. The farmer growing good-quality cotton does not often get its true market value, either because he does not know its value, or because the buyer takes advantage of the situation and buys the better-quality cotton at the short-staple prices.

Varieties suggested.—Our experiments with cotton varieties made at the 3 widely separated localities show that certain varieties and strains are better than the short variety grown most commonly in Tennessee, which enlarges its territory each year through propaganda of sellers of the seed, often through misrepresentations of its value. This variety is known as Half and Half. All the strains of this selection so far tested produce lint of $3/4$ to $13/16$ inch in length, which is untenderable on future contracts, and has no market quotations. Its chief recommendation is its high lint turnout. On land that normally makes a half bale to the acre and over it falls below, in value, and often in actual pounds of lint per acre, the better varieties, making 1-inch lint. On poor land it has proved a very good variety as far as lint production is concerned, and it is probably adapted to that type of land. There is evidence that short cotton is going to be at a still greater disadvantage in the future. Cotton mills everywhere want a longer cotton. Short cotton is now produced in larger quantities than American mills demand, and foreign mills are beginning to ask for better American cotton. Short-lint cotton, such as Half and Half produces, is sold on foreign markets in competition with Asiatic and other short-lint varieties, which are produced at a cost below that of the American product. In view of this fact, and because foreign countries are developing cotton-growing in Africa and elsewhere to meet the competition of the American grower, the cotton must be of a better quality than America now offers if we are to hold our foreign cotton market.

The following varieties are recommended for the northern limits of cotton production:

1. Trice, an early $15/16$ - to 1-inch variety, which has about 70 per cent open cotton at first picking.

2. Lightning Express No. 7, a longer-lint cotton, but early.
3. Acala—some of the earlier strains, such as No. 5, No. 14, No. 44, or No. 5-37.
4. DPL-4-8, which has been a promising cotton in all our tests, and is becoming very popular.

This is not a complete list, by any means. There are probably many good varieties that we have not tested.

TABLE 2—*Substitutes for short-staple varieties, recommended for the established cotton-growing sections of the State*

Variety	Lint per acre	Length of lint	Open first picking	Rank in value
	Pounds	Inches	Per cent	
Lone Star 65	646	1 to 1-1/16	60	5
Stoneville 2	679	15/16 to 1-1/32	61	1
Acala 14	734	15/16 to 1	48	4
Acala 44	700	15/16 to 1	57	6
Cleveland 884	652	1 to 1-1/32	44	3
DPL-4-8	739	15/16 to 1	47	2

Tomatoes

Tomato investigations were carried out with reference to leaf-spot control. A number of varieties and selections were tested for disease-resistance. While no very definite natural resistance was noted in any variety, some of the selections made in previous years showed evidences of differences in susceptibility to the disease. Further selections were made of plants giving the most promise in this direction for further tests, under better control conditions. A number of standard varieties, used for fresh fruit, or for canning, were grown in the experiment. Table 3 shows the results of only 3 varieties considered typical.

Spraying for leaf spot.—After two seasons' work in spraying for leaf spot, the conclusion reached is that spraying will control this disease, but that control is often at the expense of yield. The table shows these results for 1928 and 1929. Half the rows were unsprayed, and half sprayed with 5-5-50 bordeaux mixture, 2 pounds of lead arsenate to the barrel of bordeaux being added to control the fruit worm. The rows not sprayed with bordeaux were sprayed with the arsenate so that worms would not interfere with the results.

It will be seen that in 1928 there was little difference in the yields of the sprayed and unsprayed rows. Four applications of the spray were made after the plants were set in the field. In 1929, 7 applications were made, covering the period from April 24 to June 28, and the yields of fruit show that the excessive spraying reduced the yield

in each case. This was probably due to the dropping of the young fruit, for the number of fruits gathered was smaller in each sprayed plot than in the unsprayed. The size of the fruits was increased slightly, due probably to the thinning caused by the spray. In another

TABLE 3—*Tomato spraying experiments*

1928					
Set out April 30. Sprayed 4 times with 5-5-50 bordeaux, plus lead arsenate.					
Variety	Sprayed Yield per acre	Unsprayed Yield per acre	Difference Yield per acre		
	Tons	Tons	Tons		
Tennessee	6.78	6.82	—0.04		
June Pink	5.70	5.46	.24		
Marglobe	6.18	6.33	—0.15		
Tennessee	5.88	5.58	.30		
June Pink	5.04	4.38	.66		
Marglobe	5.20	6.00	—0.60		

1929—First planting

Set out April 18. Sprayed 7 times from April 24 to June 28, with 5-5-50 bordeaux, plus lead arsenate

Variety	Sprayed Yield per acre	Unsprayed Yield per acre	Difference Yield per acre	Sprayed Wt. 100 fruits	Unsprayed Wt. 100 fruits
	Tons	Tons	Tons	Pounds	Pounds
Tennessee	2.70	5.02	—2.32	22.50	20.60
June Pink	4.00	5.06	—1.06	25.00	22.40
Marglobe	5.41	6.40	—0.99	32.30	29.30
Tennessee	3.82	4.56	—0.74	27.08	20.20
June Pink	3.41	5.49	—2.08	21.90	22.50
Marglobe	4.96	5.62	—0.66	30.10	30.70

1929—Second planting

Set out June 6. Sprayed once in plant-bed, once soon after setting, and once about 10 days later, with 5-5-50 bordeaux, plus lead arsenate

Variety	Sprayed Yield per acre	Unsprayed Yield per acre	Difference Yield per acre	Sprayed Wt. 100 fruits	Unsprayed Wt. 100 fruits
	Tons	Tons	Tons	Pounds	Pounds
Tennessee	6.16	4.50	1.66	40.1	34.8
June Pink	3.04	2.89	.15	28.3	25.3
Marglobe	6.45	6.16	.09	38.3	47.5

series of tests, 3 applications were made, one in the plant-bed, one shortly after the plants were set out, and one 10 days later. The results show that the yield in pounds was increased, as well as the size of the fruit, and the number of fruits gathered. Spraying was stopped before many of the blossoms opened. Larger plots will be used the coming season, and other sprays will be tried, and the plants studied for fruit-shedding due to the sprays.

In spraying for leaf-spot control it is essential that the whole plant be well covered—both sides of the leaves, and the stems; for much of the damage is done to the stems.

Red Clover

A large number of selections of red clover seed, principally of the anthracnose-resistant variety, with common seed for checks, were planted in rows, in order that the action of the anthracnose on the plants might be studied, and also the inheritance of any resistance that might be found. Some of the resistant seed was from seed sent for a number of years to the West, where anthracnose does not appear. The object was to determine if the seed lost its resistance when grown out of contact with the disease. As the experiment has been running only one season, no definite results can yet be given. Larger plantings are to be made the coming season, and the disease organisms will be sprayed on each selection, and the resistant and non-resistant strains will be noted. Crosses will be made, and self-pollinated seed will be collected for future studies.

Sweet Corn

A number of crosses of sweet corn with field corn were made in 1928, and the first crop was planted in 1929. The first generation of crosses showed some very promising results. Ears of each cross were self-pollinated, and the selfs will be planted in 1930. Sweet- and field-corn strains will be selected for further study from the segregates taking place in the F_2 generation of the year 1930.

For a number of years, selfed lines of most of our common corn varieties have been grown. Many crosses of pure lines have been made, and some excellent cross varieties have been obtained. Many double crosses have been made for test in the coming years.

ANIMAL HUSBANDRY

M. JACOB

Beef Cattle Feeding Experiment

In the fall of 1927 a beef cattle feeding experiment was begun at the Knoxville Station, comparing normal silage with grainless silage in the feeding of steers for fattening. In this experiment two silos are being used; one filled with corn from which the ears have been re-

moved, and the other, of equal capacity, with corn from which the ears have not been removed. The two kinds of silage are fed in equal amounts, with cottonseed meal, to steers averaging approximately 800 pounds in weight at the beginning of the feeding period.

This experiment is now in its second year, and will be continued at least another year, when we hope to be able to draw definite conclusions regarding the comparative merits of these two common feeding practices.

Soft Pork Feeding Experiment

Corn and Soybeans Ground, Self-Fed, in Dry Lot

The experiment with soft pork feeding was conducted at the Knoxville Station, in cooperation with the U. S. Bureau of Animal Industry. It was started January 25, 1929, and terminated May 19—a period of 115 days. There were included 24 purebred Duroc-Jersey pigs, divided into 3 groups of 8 pigs each, and designated as lots I, II, and III.

Lot I was self-fed on a ground mixture consisting of 12 parts by weight of shelled corn and 1 part by weight of soybeans, and mineral mixture.

Lot II was self-fed on a ground mixture consisting of 9 parts by weight of shelled corn and 1 part by weight of soybeans, and mineral mixture.

Lot III was self-fed on shelled corn, tankage, and mineral mixture.

The soybeans fed to lots I and II were of the Mammoth Yellow variety. Mineral mixture fed to all groups was made up as follows:

Powdered limestone	10 parts
Acid phosphate (16%)	10 parts
Sodium chloride	1 part

Two check pigs, also Duroc-Jerseys, were shipped to Beltsville for carcass test at the beginning of the experiment. One of these pigs, weighing 110 pounds, killed soft, and the other, weighing 202 pounds, killed hard. The first one killed soft probably because of immaturity.

At the end of the experiment, all 3 groups were shipped to Beltsville for carcass test. The results were as follows:

Lot I (corn and soybeans, 12:1) ..	$\left\{ \begin{array}{l} 5 \text{ medium soft} \\ 3 \text{ medium hard} \end{array} \right\}$	Avg. *R.I.=1.4604
Lot II (corn and soybeans, 9:1) ..	$\left\{ \begin{array}{l} 1 \text{ soft} \\ 3 \text{ medium soft} \\ 4 \text{ medium hard} \end{array} \right\}$	Avg. R.I.=1.4604
Lot III (corn and tankage)	$\left\{ \begin{array}{l} 7 \text{ hard} \\ 1 \text{ died from injury} \end{array} \right\}$	Avg. R.I.=1.4594

*Refractive index.

The feeding results are given in table 4.

TABLE 4—*Weights of pigs, with rate and cost of gains*

	Lot I Corn and soybeans (12:1) Mineral mixture	Lot II Corn and soybeans (9:1) Mineral mixture	Lot III Corn and tankage Mineral mixture
Average number of days in experiment..	115	115	115
Number of pigs in each lot.....	8	8	8
Average initial weight of pigs—pounds..	111.1	111.7	111.5
Average final weight of pigs—pounds.....	211.56	214.88	298
Average gain per pig—pounds.....	100.46	103.18	186.5
Average daily gain per pig—pounds.....	.87	.89	1.62
Average cost per 100-pounds gain.....	\$12.87	\$12.01	\$ 9.47

TABLE 5—*Cost of feedstuffs, and feed requirements*

Feed	Average market price	Pounds of feed per 100-pounds gain		
		Lot I	Lot II	Lot III
Corn.....	\$1.12 per bushel	557.92	506.12	430.8
Tankage.....	\$73.00 per ton			23.1
Mineral mixture..	1c per pound	.036	.02	.18
Soybeans.....	\$2.00 per bushel	50.27	56.19	.....
Total concentrates per 100-pounds gain..		608.22	562.33	454.08

Swine Feeding Experiment

The Experiment Station is frequently called upon to give information regarding the merits of various commercial livestock feeds. It is impossible to undertake feeding trials with all such feeds that are now being offered; hence, this work has been limited to a few that are extensively used in the feeding of swine.

For a number of years the University of Tennessee has advocated the feeding of corn supplemented with milk, high-grade tankage, or fishmeal, either on pasture or in dry lots, as the most economical ration for fattening hogs. It has therefore been the practice to make comparisons with one of the above combinations. During the summer and fall of 1929, a feeding experiment was undertaken comparing fishmeal with American Milling Company (AMCO) 40% Hog Meal as a supplement to corn for fattening hogs on pasture. Tables 6 and 7 give detailed information on the experiment, but the results should not be accepted as conclusive, as it covers only one feeding trial.

TABLE 6—Weight of pigs, with rate and cost of gains

	Lot I	Lot II
	Corn, fishmeal Mineral mixture (self-fed, free choice)	Corn, AMCO 40% Hog Meal Mineral mixture (self-fed, free choice)
Number of days in experiment.....	91	91
Number of pigs in each lot.....	19	19
Average initial weight of pigs—pounds..	56.9	56.9
Average final weight of pigs—pounds....	204.1	196.7
Average gain per pig—pounds.....	147.2	139.8
Average daily gain per pig—pounds.....	1.615	1.537
Cost per 100-pounds gain.....	\$6.66	\$8.60

TABLE 7—Cost of feed, and feed requirements

Feed	Price	Pounds of feed per 10-pounds gain	
		Lot I	Lot II
Corn.....	\$ 1.35 per bu.	245.1	275.7
Fishmeal.....	82.00 per ton	18.2	
AMCO 40% Hog Meal..	74.00 per ton		52.7
Mineral mixture ^a	1 cent per lb.	.68	.65
Total concentrates per 100 pounds gain		263.98 lbs.	329.05 lbs.

^aMineral mixture: Powdered limestone 10 parts, acid phosphate (16%) 10 parts, salt 1 part.

Lamb Castration Experiment

The experiment with lamb castration was conducted at both the Knoxville and Columbia Stations. The object was to determine the comparative influence on rate of gain in ram lambs castrated with the emasculatome (Burdizzo's European castrating forcep), a comparatively new method, and with the knife, recognized as the old method. A total of 93 lambs were used in the experiment, of which 45 were castrated with the emasculatome and 48 with the knife—both groups being docked by means of the knife. The lambs were dropped during the months of January and February, and marketed as early spring lambs, after reaching the required weights during May and June. The individual lambs were weighed when born, at the time of the operation, and on the day when shipped to market. All weights were taken on the Station farms, and the lambs were docked and castrated when from 10 to 14 days old. The lambs were similarly handled, following their mothers on winter pasture, with free access to grain fed in creeps.

TABLE 8—*Comparison of two methods of of castration*

Location	Knife		Emasculatome	
	No. lambs	Avg. daily gain	No. lambs	Avg. daily gain
		Pounds		Pounds
Knoxville.....	18	.508	14	.498
Columbia.....	30	.482	31	.492
Total.....	48		45	
Average daily gain.....		.495		.495

The results obtained indicate that one method of castration has no advantage over the other in rate of gain of early spring lambs. The fact cannot be overlooked, however, that the danger of tetanus infection is lessened to some extent by the emasculatome method of castration, even though no losses were sustained in this experiment.

AGRICULTURAL ECONOMICS

C. E. ALLRED

Decidedly better progress was made during the past two calendar years on the economic and social research projects being carried on by the Agricultural Economics Department than during any previous period. This was possible because of an increase in the staff. Previous to 1928 the Department had only one-half the time of a scientific worker plus some assistance from a graduate student.

The field of this Department embraces work in rural economics and rural sociology, and studies are being carried on in both of these divisions, some members of the staff being especially trained in each. The projects are carefully coordinated in a way that greatly increases efficiency.

Cotton Grade, Staple Length, and Price

This project was begun August 1, 1928, in cooperation with the Division of Cotton Marketing of the U. S. Department of Agriculture, which is carrying on similar projects in the principal cotton states. This Station is supplying one-half the services of a man who gathers the field data as outlined by the Department of Agriculture and aids in writing up a report on each year's work.

The object of this study is to determine (1) the quality of cotton grown in the various counties of the State, relative to grade, staple length, and character; (2) the extent to which producers are paid, on a

basis of quality; and (3) the extent to which central market values are reflected in the local markets.

The need for a study of this kind has long been recognized. There has not always been a close relationship between (1) the quality and staple length and the price paid to the producer, and (2) central market prices and local market prices. There has been a lack of definite and reliable information based on a thorough analysis of actual conditions.

During the first year, data on grade and staple length were obtained from 35 cotton gins, distributed among all of the principal cotton-producing counties of the State. In addition, price data were secured from 5 price-study points. The results of the first year's work, with the exception of that based on the price data, have been written up in a preliminary, unpublished report. The second year's field work is in progress. This year, in cooperation with the Bemis Bag Company, in Madison County, 3000 additional cotton samples are being obtained. The consumer's demand is also being studied in cooperation with this Company. Our field representative will spend some time at the close of the field work in writing up the results of the second year's work.

Farm Taxation and County Government

From 1918 to 1928 the per capita county tax in this State increased from \$4.63 to \$9.97. In many counties approximately 80 per cent of the tax burden is borne by the farmers. The average "labor income" of farmers in many counties is very low. For instance, in Overton County, which is representative of a considerable number of Tennessee counties, the average "labor income" of 50 representative farmers in 1925 was \$—104. Largely because of low incomes and greatly increased taxes, there has come a cry for tax relief. Efficient county government is essential to tax relief, as the major portion of all direct taxes in rural areas is expended under the supervision of local government officials.

It is the purpose of this project, (1) to ascertain the equality in the distribution of taxes as indicated by the equality in property assessment, real and personal; (2) to determine the adequacy and efficiency of local governmental services and organizations; and (3) to formulate a county tax program based on the findings.

This project was begun July 1, 1927. The equivalent of 16 weeks of field work has been done. Two preliminary reports have been prepared, one covering the work done in 1927, and the other covering the work done in 1927 and 1928. A third report is now being prepared. It is a consolidation of the results of the 3-year period.

Cooperative Organizations in Tennessee

The work thus far done on this project falls into the four phases mentioned below.

Inventory of rural cooperative organization.—This project was begun July 1, 1927, in cooperation with the College of Agriculture and the Division of Agricultural Extension. The first objective of the study is to gather information on the various cooperative organizations that have existed, or now exist, in the State, as to their location, age, and success or failure. This information is used as a background for further research on rural cooperation in the State.

Information has been secured on approximately 7000 cooperative organizations, which include organizations in each of 3 groups—economic, social, and socio-economic. The data about each organization have been typed on 5" x 8" duplicate cards. These cards are filed in two sections, (1) by counties and (2) by type of organization. Additional data are being secured from time to time, such as (1) more complete information on the organizations that have been indexed, and (2) the names of additional organizations.

Area study of rural cooperative organizations.—During the fiscal year 1928-29 an intensive study was made of the rural cooperative organizations in Overton County. The object was to determine the history and the present status of such organizations—economic, social, and socio-economic; the data to be used in formulating a program of rural cooperation that will be applicable to this and similar counties in the State.

This intensive study of the organizations in selected areas will throw light on the types of organizations that are succeeding, the factors contributing to their success, and the services which the organizations are rendering their constituencies. An analysis of the factors of success or failure of a given type of cooperative organization will enable this Station to render a real service to the members of such organizations. By means of an intensive study of individual organizations, it is expected that we shall be able to determine fundamental principles and laws that are applicable to rural organizations in general. The field data on this phase of the project have been gathered and analyzed, and have been written up in a 588-page unpublished report.

Cooperative marketing of strawberries.—This phase of the project was begun July 1, 1929. The cooperating agencies are, (1) the College of Agriculture, which is furnishing part time of a research assistant; (2) the Agricultural Extension Service and the Federal Bureau of Agricultural Economics, which have made available survey data collected recently in the commercial strawberry areas of the State.

The object is to determine (1) the status of the cooperative marketing organizations, as to their state of activity, services rendered, method of operation, and the success or failure factors; (2) the adequacy of the various marketing agencies, and their methods of marketing; (3) costs in marketing; (4) the causes for the general depression of the industry; (5) the possibilities for handling surpluses by processing and other methods.

A preliminary survey of strawberry cooperative organizations indicates that approximately one-half of those organized have now become inactive. From all reports it appears that some of those that are now active are in a declining condition. The price of strawberries has been decreasing within the past 4 years. Since 1926 the price per quart has decreased from 18 cents to a low level of 8 cents in 1929. There has been a general decline in price in the other commercial-producing states, but the decrease in Tennessee has been the most serious, placing this State lowest among all second-early-producing states in price received per quart.

A preliminary report on this project is now being prepared. The field work has not yet been completed. Much of the literature relating to the strawberry industry, however, has been assembled and studied. The survey data furnished through the cooperation of the Agricultural Extension Service and the Federal Bureau of Agricultural Economics have been analyzed. Data on various phases of the project, which were available from the Census report, reports of the U. S. Department of Agriculture, and various state experiment stations, also have been assembled.

Cooperative marketing of sweet potatoes.—This is another phase of the project on cooperation. The study was begun October 1, 1929. Its purpose is very similar to that of the work on strawberries, being as follows: To determine (1) the status of cooperative marketing organizations, as to their state of activity, services being rendered, method of organization and operation, and the factors in their success or failure; (2) the marketing methods and practices of the various sweet potato marketing agencies; (3) ways of alleviating the periodic and severe fluctuations in prices characteristic of this crop in recent years.

Sweet potatoes are an important farm crop in certain areas in the State. In 1927 this crop ranked highest of all truck crops in carlot shipments, with 2729 cars shipped. In 1921 to 1925, inclusive, it ranked second only to Irish potatoes in production in the United States. It is climatically adapted to this State, and in many counties a fair yield can be produced on relatively infertile soil with the use of some fertilizer. It is the marketing phase that presents the most serious problems. Over one-half of the sweet potato cooperative marketing organizations have failed in recent years.

Effect of Industrial Development on Rural Life in Tennessee

Tennessee, having many advantages for manufacturing, has had a relatively rapid increase in industrial development during the past decade. Recently several small towns have enjoyed a rapid growth, due largely to this cause. With the coming of these industries the economic and social life of the rural people in the newly created industrial areas is undergoing, and will continue to undergo, significant changes. It is the purpose of this project to determine in what ways

industrial development in a region is helpful to the rural people and in what ways it is harmful to them.

The Division of Farm Population and Rural Life, of the U. S. Department of Agriculture, is cooperating with the Agricultural Experiment Station—the latter bearing the larger part of the cost of the project. Since July 1, 1925, the date the project was begun, the field data have been gathered and analyzed. Three preliminary reports have been prepared, including the recent bulletin entitled "The effect of industrial development on rural life in Sullivan County." A final report is being prepared by two members of the staff. This report will be a consolidation of the previous reports, together with field data not incorporated in them.

CHEMISTRY

W. H. MACINTIRE

Biochemistry

The biochemical studies that relate to the home economics problems of food and nutrition have been continued by Dr. Margaret B. MacDonald. As supplemental to her findings that led to the perfection of a method for removing the garlic flavor and odor from milk, work relative to certain physiological phases of the problem is being conducted in cooperation with Dr. M. Jacob, Head of the Department of Veterinary Science and Animal Husbandry. Another phase of this work, that of vitamin factors, is being investigated in cooperation with the Home Economics Department of the College of Agriculture.

The prevalence of bitterweed (*Helenium tenuifolium*) is a serious problem to dairymen, especially in West Tennessee. The bitter principle of this plant has been studied. It was found that the bitter substance is water-soluble, and that it can be removed from the cream by the washing of freshly separated cream with untainted skim milk, or with water. On this basis a method was devised to permit utilization of the cream from milk produced by cows that have fed upon this noxious weed. This method was demonstrated to a large class of special dairy manufacturing students, and is described in Station Circular No. 26, "The removal of the bitter flavor from 'bitterweed' cream," by Margaret B. MacDonald and Adelaide Glaser.

"Bios," its nature, origin, and function, is also being studied further.

General Chemistry

Fluorine compounds have been the subject of further study by the Associate Chemist, Mr. G. A. Shuey, who is endeavoring to perfect an apparatus and a technic for the determination of fluorine. Some new combinations of fluorine have been made, and these will be sub-

jected to tests to determine their toxicity and adaptability as insecticides and possible fungicides.

A new project being worked upon by Mr. Shuey is "The utilization of the sweet potato." His efforts are being directed toward the development of possible products and by-products from this crop. In the initial stages of this investigation special attention is being given to the technic and chemistry of the production of vinegar.

Mr. Shuey has also rendered assistance to the other Station departments in such of their problems as involve chemical considerations.

Soil Chemistry

Soil chemistry studies have been continued under the immediate supervision of the Associate Soil Chemist, Mr. W. M. Shaw. The longevity of the investigations relative to the activities of various forms of lime and magnesium makes the lysimeter studies on this subject of particular interest and cumulative value. This is especially true because of the fact that comparisons between soil only and soil plus subsoil afford opportunity to determine the downward migration and fixation of liming materials. An adjunct study concerning one phase of the problem—the variant properties and activities of different forms of magnesia—has been completed. The results of this 4-year study will soon be offered in print. They confirm previous findings relative to the protective, or buffering, effect that added magnesia exerts upon the soil's supplies of calcium and potassium. New light was also thrown upon the distinct characteristics exhibited by specific alkaline forms of magnesia.

Two parallel laboratory studies relative to the disintegration of limestone and dolomite were completed. The results of one study were embodied in a paper that has been accepted for publication in the Journal of the American Society of Agronomy. It was shown that different dolomites disintegrated in a manner that was determined by the CaCO_3 content above that required for a CaCO_3 - MgCO_3 ratio of 1:1, and that all dolomites ultimately enter the soil system in this ratio. In the other paper, which has been accepted for publication in the same journal, it was shown that the disintegration of limestone and dolomite occurs more extensively in the April-September period than in the October-March period.

Sulphur conservation, as influenced by lime and magnesia, is a project that has been studied during the past 12 years. The lysimeter phase of this study was terminated at the end of the 12-year period. Valuable data have been obtained relative to the part that lime and magnesia play in the conservation of the sulphur that is derived from the organic soil occurrences of this element, as well as that derived from rainfall. The influence of liming materials upon the oxidation of elemental sulphur and pyrite was included in this study, and data of scientific interest are available for early publication.

The 4-year lysimeter study of the influence exerted by green manure upon the outgo of calcium and magnesium from limestone and dolomite additions of different degrees of fineness was terminated. The data of this project have been of special interest in showing the influence of lime additions upon clover-derived potash. The findings are now in proof for an early issue of *Soil Science*. This study has also shown that certain fractions of the added liming materials do not enter into base exchange combinations. The data were given in a paper entitled "The relation between the absorbed and the exchangeable calcium and magnesium content of a soil four years after additions," by W. H. MacIntire and K. B. Sanders, *Soil Science*, Vol. 28: pp. 289-304.

A joint chemistry-agronomy project of nitrogen conservation that is based upon the inoculation of a Tennessee soil by two soils from Colorado is still under way.

Progress was also made in the investigation that deals with the cumulative effects produced by full and fractional annual additions of 4 liming materials. Thirty-one tanks are being used in this study, which is being duplicated at the Virginia Agricultural Experiment Station.

New projects.—The fixation of the potash of different manurial salts by liming materials and the causative factors are being studied in a number of tanks that have received potash additions in combination with different radicals. The reactions between acid phosphate and limestone and dolomite before and after incorporation in the soil are also being studied, in part by means of lysimeters.

A new phase of the joint chemistry-agronomy project was inaugurated in the rearranged pioneer lysimeter equipment wherein a 28-unit series is being used to obtain extensive checks prior to the use of concentrated nitrogenous fertilizers on each of 2 distinct soil types of this State.

A new joint project called for the placement of 3 types of lysimeter tanks, and involves a comparison of the Russian type of lysimeter with the built-up and the filled-in lysimeter, the two types that have been in general use.

Miscellaneous

The Associate Chemist, Mr. Shucy, has been reappointed as Associate Referee in charge of the development of methods for fluorine determinations by the A. O. A. C.

The Associate Soil Chemist, Mr. Shaw, has been continued by the A. O. A. C. as its Associate Referee for liming materials. The Chemist is serving the same organization as General Referee for soils and liming materials. The Chemist was also designated by the A. O. A. C. as its representative on the Board of Governors of the Crop Protection Institute.

ENTOMOLOGY

S. MARCOVITCH

Insecticidal Properties of Cryolite and Barium Fluosilicate

The demand for an arsenical substitute has arisen from various sources, such as the truck- and apple-growers, who are harassed by the residue problem. More recently muck soils and cranberry bogs where arsenicals have been in use have been found to become unproductive, due to the decomposition of the insoluble arsenates.

The results of the experimental work conducted with a view to finding a stomach poison that will take the place of arsenic, and yet be safe on foliage, toxic to insects, and comparatively non-poisonous to human beings, indicate that at the present time cryolite and barium fluosilicate offer the most promise. These materials have a lower solubility than sodium fluosilicate, and are therefore safer on foliage. Toxicity tests showed barium fluosilicate to be more toxic than cryolite to adult insects. Both materials gave excellent control of the Mexican bean beetle when used as a spray at the rate of 1 pound to 50 gallons of water. These compounds were also effective when used as a dust at the rate of 6 pounds to the acre, and were safe on bean foliage. At the rate of 30 pounds or more to the acre, burning of foliage may occur if conditions of temperature and moisture are favorable to it. Five weekly dustings on tobacco (6 pounds to the acre) produced no foliage injury with either material and controlled the hornworms and flea beetles. In order to increase the adhesiveness, fish oil was employed at the rate of 25 per cent of the weight of the insecticide.

In our work a light-bodied synthetic commercial cryolite was used. While barium fluosilicate has no use aside from that as an insecticide, an effort will be made by the manufacturers to supply the demand that may arise. A more detailed report will be found in Station Bulletin No. 140, entitled "Cryolite and barium fluosilicate: their use as insecticides."

Cutworms

The study of the biology and control of cutworms was started in the summer of 1927, and has been continued since that time. Particular attention has been paid to the seasonal abundance of cutworm moths and the weather records. It is believed that through a study of the seasonal abundance in connection with the climatic conditions it may be possible to predict outbreaks of cutworms.

The collection of cutworm moths now contains over 174 species, with more than 100 species of related moths.

The control studies have consisted of comparative experiments with arsenicals and fluorine compounds in poison baits. Sodium

fluosilicate was found to be more toxic than any arsenical tested. Due to the low cost of sodium fluosilicate, and its distastefulness to stock and fowls, it should prove to be an excellent poison for cutworms.

Woolly Aphis

The work on the control of the woolly aphis is still in progress. Data were accumulated on various soil insecticides, such as tobacco, paradichlorobenzene, and carbon disulphide emulsion. The last material appears most promising, and will control the aphis when used in the dilution of 1-200 at the rate of $1\frac{1}{2}$ pints per square foot of soil. Such a treatment is rather expensive, and may not be practicable for the nurserymen. In a newly set orchard, however, carbon disulphide emulsion could be used economically.

During hot, dry weather the aphis often disappears from the roots. The aphis population fluctuates considerably, and appears to be influenced by weather conditions. A study is also in progress of the effects of temperature and moisture on the reproductive capacity of the woolly aphis. More information on this subject should enable us to determine the best time to apply soil insecticides.

Insect Pests of the Year

Hundreds of letters are received by the Station Entomologist each year making inquiry as to methods for combating insect pests. The following insects were especially abundant and caused a vast amount of destruction:

Termites.—Many inquiries were received from different parts of the State in regard to termites, or white ants, causing damage to buildings. The Agricultural Building, at the University farm, was infested last summer, and much damage was done to the moldings at the entrance.

Bagworm.—This pest was unusually abundant on red cedars, many of which were completely defoliated. A few apple orchards also suffered from its depredations.

Pickle worm.—The melon crop suffered severe losses from the pickle worm, which bores into the fruit of the different cucurbits. This pest is of sufficient importance to warrant an extended study, and it is hoped that some preliminary information can be obtained next summer.

Bean beetle.—The bean beetle is as destructive as in 1923, and where beans were not sprayed or dusted they were almost completely destroyed. In many cases, beans protected by insecticides showed a gain of 300 per cent in yield.

Oriental peach moth.—This newly established pest reached alarming proportions last summer, and as much as 50 per cent loss was suffered. It was especially serious in those sections where apple and peach are planted together. For the protection of the fruit interests

of the State, a study of this pest will be undertaken the coming summer, so far as funds and personnel will permit.

HORTICULTURE

J. A. McCLINTOCK

Fire Blight

Several varieties of pears obtained in past years from the Office of Foreign Seed and Plant Introduction, U. S. Department of Agriculture, bloomed for the first time in our test blocks in the spring of 1929. Those that were susceptible blighted severely. Two varieties that had shown marked resistance set good crops of fruit. One variety produced large, well-shaped fruits, while the other produced fruits too small for market use. Neither of these varieties was of sufficiently high quality to justify introduction as a dessert pear. The fruits of these two varieties further emphasize the fact that blight-resistance is associated with low quality in the Asiatic pears, and that improvement must come through crossing and selection to combine the blight-resistance of the Asiatic types with the quality of the European and American varieties. Such crosses are being made at the Knoxville Station, both in the orchard and in the greenhouse. The greenhouse has proved more satisfactory because at the season of the year when resistant varieties of pears are in bloom weather conditions out-of-doors are often unfavorable. Frost may destroy the fruits after crosses have been made. By dwarfing the various pears on quince stocks it is possible to grow them in large pots and transfer them to the greenhouse as needed, and later take them back out-of-doors, when danger of frost is past. Several hundred dwarfed pear trees of many varieties are growing in pots for use in making crosses. With the limited greenhouse space available at present, only a portion of these potted trees can be used. This limits the number of crosses that can be made in one season under controlled conditions. Doubling of the available greenhouse space would greatly aid the breeding work for fire-blight control.

Pear seedlings produced from crosses in previous seasons made good growth in the nursery during 1928 and 1929. These will be ready to test for blight-resistance in 1930.

The 6-year-old pear trees moved in the spring of 1929 suffered a severe shock, and may require several years to regain their normal habits of growth and blossoming.

Root Stocks

In the test of pear root stocks, *Pyrus calleryana* and *Pyrus betulae-folia* continue to be most suitable under Tennessee nursery conditions. In addition to their greater blight-resistance, these two species have

marked resistance to leaf spot. Seedlings of *Pyrus serotina*, *Pyrus ussuriensis*, and French, Bartlett, and Winter Nellis pears, growing in adjoining nursery rows, are practically defoliated by midsummer; while the two resistant varieties retain their leaves and remain in good condition to bud throughout the growing season. A paper on this subject was presented to the American Society for Horticultural Science under the title, "Importance of leafspot in the selection of pear varieties used as stocks for budding." A second paper presenting the results of propagation experiments with pears and other nursery stock was presented to the same Society under the title "New wraps for buds and grafts." These two papers are available as separates.

At the winter meeting of the Tennessee Nurserymen's Association the results of pear-blight studies were presented in a paper entitled "A progress report on pear root stocks as to blight, leafspot and cold resistance."

In a paper entitled "New points on fire-blight control," presented at the meeting of the Tennessee State Horticultural Society, the results of experiments on fire-blight control were summarized. These experiments indicate that while a small percentage of blight bacteria overwinter in apple cankers, a much larger percentage overwinter in pear cankers. It has been found that comparatively few insects are present at the time primary infection occurs in early spring. It is probable, therefore, that insects are not so important as had been suspected in primary spread of bacteria from cankers. The relation of hold-over cankers to new blossom and twig infections indicates that rain falling on the cankers is responsible for the early spread of the overwintered bacteria. These data suggest the importance of cutting out all blighted twigs, limbs, and cankers during the dormant season. The above-mentioned paper will be published in full in the Proceedings of the Society.

Experiments with various apple root stocks indicate that some species are more resistant to blight than the French crab, which is extensively used at the present time. These experiments are being continued in order that additional data may be secured on the adaptability of the new stocks to nursery conditions in Tennessee. In connection with these studies of apple stocks, data were obtained relative to apple blotch on stored seedlings. These data were accepted for publication in "Phytopathology," in a paper entitled "The Longevity of *Phyllostica solitaria* E. & E. on apple seedlings held in cold storage."

Root Knot

Studies on nematode-resistant stocks, which have been in progress for some time, have established the fact that the varieties of peaches grown commercially in Tennessee can not be successfully propagated on resistant plum stocks such as are produced by clonal strains of the

Marianna plum. Where peaches propagated on such clonal stocks have continued to live and grow, it has been found that they have become established on peach roots sent out from above the union with the plum stocks. Tests conducted during 1928-29 indicate that Marianna seedling stocks have several advantages over those grown from cuttings; hence, further study of the seedling stocks is being made to determine their nematode-resistance and adaptability as root stocks. A progress report on this phase of the experiment was presented to the American Society for Horticultural Science.

Testing Soils for Nematode Content

Experiments conducted in commercial nurseries in 1928-29 indicate the practicability of testing soil for the presence of root-knot nematodes by growing lettuce or other thick-growing susceptible plants that can be dug and examined for the presence of nematodes, before the land is used for nursery stock. Such tests, in addition to locating nematodes, have disclosed the fact that flood waters of certain streams are an important factor in the spread of root-knot nematodes. This phase of the root-knot problem is to be studied further to determine if flood lands are generally infested by this parasite. Such information will serve as a basis for recommendations regarding control measures in land along streams.

The results of tests with rose stocks indicate that none of the stocks in common use by nurserymen are immune to root-knot nematodes. A marked difference in the vigor of the various stocks has been noted during the progress of this experiment. The results to date have been submitted for publication in the American Rose Society Annual, under the title "Rose understocks in Tennessee."

In the search for nematode-resistant stocks, various cherries are being tested. In these studies it has developed that American-grown Mahaleb and Mazzard pits give better germination than imported pits, and produce equally good stocks the first year from seed. The results of these tests were presented to the Tennessee State Nurserymen's Association at its summer meeting under the title, "Can good cherry root stocks be raised in Tennessee?"

For several years past, seed of native Mazzard cherries collected in Virginia have been included in the cherry-stock tests. The resulting seedlings have proved as vigorous as French Mazzard and Mahaleb. They are more resistant to leaf spot than the French Mazzard. The possibilities of these American Mazzard seedlings as root stocks were presented to the American Society for Horticultural Science in a paper entitled "American Mazzard cherry seedlings as root stocks for cultivated cherries."

Strawberries

Shipping tests conducted during 1929 indicate that some of the new Aroma seedlings produced at the Knoxville Station hold up much

better in transit than Aroma berries shipped under the same conditions; i. e., by freight in refrigerator cars, and by express without ice. One of the best of these new seedlings compares favorably with Klondyke and ripens at the same time. The plants are erect and hold their berries above the ground. The berries are large and retain their size throughout the picking season much better than the Klondyke variety. If this select seedling does as well in the test plots established at the substations in Middle and West Tennessee as it has done at the Knoxville Station it will be worthy of introduction as a new variety.

In addition to the original Aroma seedlings, we now have a large number of second-generation seedlings obtained by crossing the best of the first-generation selections. Some of these were transferred to the field in 1929 and will fruit in 1930. Others have been held in flats and pots and will be set in the field in 1930.

Besides the new seedlings developed at the Knoxville Station, we are testing new seedlings which the U. S. Department of Agriculture and the New York State Experiment Station have sent out as worthy of trial. Included in this test is the Blakemore, which the Department of Agriculture introduced. Records on the fruiting of these varieties will be obtained in 1930.

Bush Fruits

The variety test with blackberries was discontinued after the harvesting of the 1929 crop. No variety was found that gave as good yields of early-maturing fruit as the Early Harvest. Data on blackberry diseases and their control were also obtained in the course of this test.

The Van Fleet continues to lead all other varieties of raspberries in vigor of plant and yield of fruit. In size, shape, and color, however, the Van Fleet fruits are inferior to those of several of the less prolific varieties. To overcome this objection, a number of crosses were made in the summer of 1929; the pollen from large-fruited varieties being used on the Van Fleet. As the result of these crosses we now have several thousand seedlings in flats and pots. These will be set in the field in the spring of 1930.

Tests made during the summer of 1929 indicated that the fruit of Van Fleet has sufficient acid and pectin to make a good grade of jelly without the addition of commercial sources of pectin. With the large yields of fruit produced by Van Fleet, its adaptability for jelly-making offers a much wider use for this variety. A discussion of the results of tests to date on the Van Fleet raspberry has recently been written for publication as a Station circular.

Dewberries

In tests with dewberries the Lucretia continues to lead in yield. While the Young variety is a more vigorous grower and produces

better-quality fruit, it has consistently proved itself to be a poor yielder at the Knoxville Station, regardless of cultural method. The Oregon Evergreen is a fairly vigorous grower and a fair yielder. This variety could be used to prolong the fruiting season, as it matures considerably later than Young and Lucretia.

Peaches

Troubles in the nursery and in the orchard have been the source of much loss to peach growers; and studies have been made with a view to finding a solution for these troubles. The nursery interests of Tennessee have been greatly disturbed over reports that the phony peach disease, which is very destructive in Georgia, has been found in Tennessee orchards. The results of findings along this line were presented to the Southern Nurserymen's Association, at Birmingham, Alabama, in September, under the title, "The relation of phony peach and other troubles to the sale of southern nursery stock."

Studies on the sources of overwintering brown rot indicated that mummies on the trees are by far the most important source of infection. Under favorable conditions, as in 1929, such overwintered mummies cause a large percentage of blossom blight. That brown rot limb cankers probably do not overwinter the causal fungus, is indicated by careful studies made during the winter and spring of 1929. Under favorable conditions mummies on the ground produce the apothecia and perfect spores of the brown rot fungus. This stage appears, however, to be of less importance than the mummies on the trees. The results of these studies were incorporated in two papers published in the *American Fruit Grower*, under the titles "Brown rot blossom blight of the peach" and "The brown rot situation in 1929."

Garden Crops

Sweet Potatoes.—In the variety tests of sweet potatoes the Nancy Hall continues to stand out as the quality variety best suited for early market. The Bunch Porto Rico still compares favorably with the vining type of Porto Rico in yield, and is much more easily handled from the cultural standpoint.

Irish Potatoes.—The studies on sources of certified Irish potato seed have been discontinued. A circular on "The value of certified Irish potato seed" was published in December. Search is being continued for a fall-crop variety adapted to Tennessee conditions.

Cabbage.—The results of tests with yellows-resistant cabbage have been published as a circular by the Agricultural Extension Service. Work along this line has been discontinued for the present.

Rhubarb.—Several thousand seedling rhubarb plants were grown in 1929 at the Knoxville and Jackson Stations from seed saved in 1928 from plants that have continued to grow in soil badly infested with crown rot. Part of the seedlings have been set back in diseased soil at.

the Knoxville Station, and the balance set at substations or distributed to interested growers.

Canner Crops

Tomato tests at Clarksville, Knoxville, and Jackson indicate that the varieties of the Baltimore group are among the highest yielders under Tennessee conditions. The Marglobe is one of the most promising of the new varieties in land where wilt is serious. Staking gave a better yield and a larger percentage of No. 1 fruits in all varieties tested.

Bean tests at the Mericourt Station, Clarksville, indicated that the best planting date for the spring crop is about April 15, and for the fall crop about August 1. Yield tests of Giant Stringless Greenpod indicated that strains showing the highest percentage of germination in the laboratory give the best field stand and highest yield. Western-grown seed continue to give the best results as regards freedom from disease.

Tests with several strains of Alaska peas showed from 5 to 15 per cent of off-types, which reach the harvesting stage too early or too late to make a good pack if included with the balance of the crop at the time it is harvested. Results of these 1928-29 tests were presented at the State Cannery meeting in Nashville.

A list was compiled, with cultural notes, of vegetable varieties in common use by truckers and market gardeners in Tennessee, supplemented by varieties that have proved desirable in tests at the experiment stations.

Pyrethrum

For the past two years *Pyrethrum cinerariaefolium* has been tested at the Knoxville Station to determine if this plant can be grown profitably as a commercial crop in Tennessee. The results thus far have been such that the Crop Protection Institute has decided to aid in the continuance of this work in other sections of the State.

PLANT PATHOLOGY

C. D. SHERBAKOFF

The studies of plant diseases have been continued under the same projects mentioned in last year's report, with an additional project on the new wilt of cotton caused by the fungus *Verticillium*.

Wheat Root Rot and Head Blight (Scab)

The work with wheat root rot and scab during the past year consisted primarily in the making of single-plant selections from wheat samples collected all over the State, especially in East Tennessee, during the summer of 1928. The selections have been planted in in-

dividual rows for further comparison of their relative resistance to root rot and scab. The selections made several years previous continue to compare favorably with our best standard varieties of wheat, and at present are included in a fairly extensive field-plot comparison with one of our best standard varieties. From these selections it is hoped to obtain wheats that will be highly resistant to root rot and scab, high-yielding, and of the best quality. At present some of the selections appear to possess these characters to a promising degree.

Wilts Caused by *Fusaria*

Besides the general studies of *Fusaria* causing wilt of economic crops, special attention was given during the year to cotton wilt, with particular reference to occurrence, damage, and control of the disease. Use of proper fertilizers, including a sufficient amount of potash, in otherwise well-balanced fertilizer, and proper crop rotation, seem to be important factors in reducing the damage. Cotton crops on the lighter soils seem to be subject to the wilt, and whenever the disease becomes well established on such soils, the use of resistant varieties is the only safe method of disease-control.

Crown Gall

The experiments on the effect of soil acidity upon the development of crown gall in the nursery apple trees were continued, and the data obtained show that generally on the more acid soils there is decidedly less crown gall. The determinations of the soil acidity, in the form of hydrogen-ion concentrations, were made by the Department of Chemistry.

Tobacco Angular Leaf Spot

The experiments with the angular leaf spot were conducted along the same lines as previously. Due, however, to the fact that there was practically neither wildfire nor angular leaf spot in the other parts of the fields where the experiments were conducted, no data in regard to the effect of the measures against the disease could be obtained.

Apple Black Rot and Scab

The work with black rot and scab shows that even during the seasons when the diseases are more severe on the foliage and on the fruit, they are readily controlled if the recommended spray schedule is properly followed and the fungicides are applied in a thorough manner. Certain modifications of the standard spray materials have been tested, and some of them, so far, give good promise of being efficient, convenient, and harmless to foliage.

Verticillium Wilt of Cotton

In 1927 *Verticillium* wilt of cotton was found in the fields for the first time. Since then it has become known as a common trouble on the bottom land along the Mississippi River. During the past year

62 varieties of cotton were tested for their resistance in a field naturally severely contaminated with the fungus, and in the Station greenhouse in artificially inoculated soil. Only 2 of the varieties, Sea Island and Pima, appear to be practically immune from the disease. All the short-staple varieties seem to be affected by it. The degree of susceptibility could not be definitely determined because of the small size of the plots and the relatively small number of replications. The experiment will be repeated the coming season on a sufficiently large scale to determine this factor.

MIDDLE TENNESSEE COOPERATIVE EXPERIMENTS

Beginning with the year 1907, the Station has received \$5,000.00 annually for cooperative experiments in Middle Tennessee. This fund has proved exceptionally useful. Field experiments have been conducted in over half the counties of this division of the State to determine the special needs of the more important soil types. In 1928 was completed the tenth year of such a series on a typical Cumberland Plateau soil near Crossville. The results, which were published in bulletin form in November, 1929, are of practical value in furnishing data for the rational use of fertilizers in this section. The trials included a comparison of different phosphates under both limed and unlimed conditions; also rate-of-application experiments. Without experiments of this nature, fertilizer and liming recommendations would be mere guesswork. In addition to soil studies, varietal trials of various farm crops have been made on different kinds of soil, and have helped to establish the reliability of important recommendations for this large division of the State.

For a number of years a part of this fund was used in carrying on field experiments with dark tobacco. This work was done cooperatively with the Office of Tobacco and Plant Nutrition Investigations of the U. S. Department of Agriculture. The results have enabled the Station to make well-founded recommendations with regard to fertilizers for this important crop; also as to the effects of liming, and of various preceding crops, on the yield and quality of the tobacco. Material is on hand for another bulletin on this subject. More recently this fund has been used in the study of tobacco diseases, under the direction of the Department of Plant Pathology, and in the study of tobacco barn ventilation, by Mr. Roy H. Milton, of the Agricultural Extension Service.

At Murfreesboro, field experiments have been continued for a number of years in cooperation with the Middle Tennessee State Teachers College. In 1929 the work was limited to studies of cotton varieties and the testing of new strains under the direction of the Department of Botany.

This fund has been used in orchard spraying experiments, in farm management, and other studies that come under the head of "agricultural economics." With its aid, a few years ago a soil sur-

vey of Rutherford County was made. The fund finds use in the meeting of special demands by various agricultural interests. Recently a request has come for much needed work in connection with strawberry growing in the Portland area, which has suffered much from both disease and insect troubles. It is the plan to give special attention to this area during the coming year.

WEST TENNESSEE EXPERIMENT STATION

BEN P. HAZLEWOOD, Superintendent

Fam Crops

(Under the direction C. A. Mooers)

The season of the past year was favorable for good crops at the West Tennessee Station, and highly satisfactory results were obtained in the experimental work of all kinds. The prominence of the cotton crop in this part of the State has caused the Station to pay special attention to selection and improvement of varieties; also to methods of culture and the use of fertilizers. Under the direction of Mr. S. H. Essary, the breeding and selection work was greatly increased. The importance of nitrogenous fertilizers in cotton culture has grown during recent years because of the lowered cost of fertilizer nitrogen, and the subject received special attention during the past season.

The need of more nitrogen by the soils of West Tennessee is very great, and striking results can be obtained from high-grade mineral forms, such as nitrate of soda and ammonium sulphate, particularly in the case of highly responsive crops. For example, in the 1929 experiments with sweet potatoes on poor land the yield on the unfertilized plots was 100 bushels per acre, but with the aid of 100 pounds of nitrate of soda alone the yield was increased to 200 bushels. In connection with the sweet potato crop, mention may be made of the fact that no other large section of the State has appeared so well adapted to this crop—both soil and seasonal conditions being favorable.

Another crop that is especially adapted to West Tennessee is lespedeza. Records have been kept of the results of varietal trials at the West Tennessee Station for several years. The data show the superior value of the Station selection known as "No. 76" over any other variety. The yield of seed was also good. Tables 9 and 10 give the yields obtained to date.

TABLE 9—*Lespedeza seed yields at the West Tennessee Station*

Variety	Yields per acre in bushels of 25 pounds				
	1926	1927	1928	1929	Average
No. 76.....	13.15	2.13	9.20	6.40	7.22
Kobe	16.00	2.60	7.00	6.80	8.10
Korean	12.00	5.73	5.60	6.00	7.33
Common	5.82	4.40	7.60	8.00	6.46
Mississippi* .....	.....	5.07	6.40	8.00	6.49

*The common variety grown in Mississippi.

TABLE 10—*Lespedeza hay yields at the West Tennessee Station*

Variety	Yields per acre in tons			Average
	1927	1928	1929	
No. 76	1.68	3.93	4.72	3.44
Kobe	1.81	2.96	3.76	2.82
Korean	1.73	2.03	3.09	2.28
Common	1.23	2.53	4.14	2.63
Mississippi	1.36	2.92	3.74	2.68

Experiments to determine the effects of various legumes on the corn crop following them have been continued for several years. The results show the superior value of alfalfa and sweet clover as soil-improvers. It is planned to publish the experimental findings in bulletin form at an early date.

Much other experimental work with field crops is being done at the West Tennessee Station, including varietal trials of corn, soybeans, lespedeza, oats, wheat, and clovers and grasses. The best-yielding varieties of corn found up to the present time are Neal Paymaster, Jellicorse, and Jarvis Golden Prolific. The Jellicorse variety is probably best suited to rich land, where it yields nearly as well as Neal Paymaster and produces a sounder ear. Mention may be made of the growing popularity of Jarvis Golden Prolific for use on average uplands.

Horticulture

(Under the direction of J. A. McClintock)

Fruits

Apples.—Tests with young Yellow Transparent apples indicated that primary infections of fire blight take place largely through the blossoms, and that old pear trees in the vicinity of the apple trees are an important source of the bacteria for blossom infection of Transparent apples. The destruction of the old blighted pear trees would go far toward controlling blight in early apple orchards in West Tennessee.

A small percentage of cankers on apple trees overwinter the

blight bacteria. As the cankers that harbor the bacteria can not be distinguished from the others during the fall and winter, it is advised that all cankers be removed or treated to eliminate these sources from which overwintered bacteria spread, by means of rain, to the new growth of the apple trees during the spring.

Pears.—The test planting of pears indicates that blight-resistant varieties make as satisfactory growth at the West Tennessee Station as they do at the Knoxville Station; while susceptible varieties are killed in a single season when infected with blight.

Peaches.—The Station orchard has produced satisfactory crops during the past two years. This demonstrates that from the earliest varieties, like Mayflower, on through the season to Elberta and Hale, all produce crops as good, and with as much regularity, as the same varieties of the same age at higher elevations, in East Tennessee.

Plums.—At present, plums are not planted commercially in Tennessee, but the good yields obtained at the West Tennessee Station, taken with data collected in Middle and East Tennessee, indicate that plums can be successfully grown throughout the State. Tests are being conducted at the Jackson Station to determine varieties suitable for home and commercial plantings in West Tennessee.

Fruit-tree seed and stock production.—Plantings of European stock varieties of apples, cherries, plums and quinces established in 1923 are now producing crops of fruit. Seed from these when properly handled give better germination than imported seed of the same varieties. These tests indicate that American nurserymen would be justified in establishing orchards of select trees for seed production. Tests on seedling root-stock production are being continued with a view to getting further data on the best methods of growing stocks suitable for nursery use.

Grapes.—Tests are being continued to determine which varieties are adapted to West Tennessee conditions. The results to date indicate that the standard varieties produce well enough to be profitably planted for home use and local markets.

Bush Fruits

Raspberries.—As an early-crop variety, the St. Regis red raspberry has given satisfactory yields. In vigor and yield, however, the Van Fleet has proved superior to all other varieties tested. In the first bearing year the Van Fleet averaged slightly more than 8 pints of fruit per plant.

Blackberries.—Early Harvest continues to be the most satisfactory blackberry. This variety produces good crops, which ripen in advance of wild blackberries, with which later cultivated varieties have to compete.

Dewberries.—Lucretia continues to give the best yields, and is desirable for both home and commercial planting in West Tennessee.

Strawberries.—New varieties of strawberries developed at the Knoxville Station are being tested in comparison with the standard varieties raised in West Tennessee. In vigor of plant-growth, and disease-resistance, one of the Knoxville seedlings appears to be superior to all others in the test plots. New varieties of strawberries developed by the U. S. Department of Agriculture are also being tested. These have made satisfactory plant growth to date. Fertilizer tests have continued.

Truck Crops

Tomatoes.—Tests with tomato varieties for use as green wraps indicate that the Tennessee Beauty is outstanding in yield and wilt-resistance. Select seed of this variety is being produced by the Jackson Station for distribution in West Tennessee.

Experiments with tomatoes have been carried out for a number of years. They include varietal trials, selection for disease-resistance, and fertilizer experiments. In 1929 a thorough test was made of the effects of nitrating on the quality of tomatoes for shipping purposes. Various amounts of nitrate, up to 400 pounds per acre, were used in comparison with both unnitrated plots and those receiving an application of ordinary complete commercial fertilizer. Shipments of fruit grown under the various conditions were sent to both Humboldt and New York, where they were held for examination and report. The results, which are given in table 11, showed little relationship between fertilizer treatment and quality, but were favorable to the heavy nitrating rather than otherwise. The trials are to be continued the coming year.

Tests with canner varieties indicate that proper attention to the use of wilt-resistant varieties will result in yields that will make it profitable to grow tomatoes for canning purposes in West Tennessee. Marglobe proved to be one of the best varieties in this test.

Cabbage.—Tests with cabbage varieties indicate that home-grown plants are freer from disease than plants shipped in from states farther south. The data collected from tests with yellows-resistant varieties have been incorporated with similar data from the Knoxville Station in Extension Circular No. 19.

Sweet potatoes.—The Nancy Hall continues to lead in variety tests of sweet potatoes. Close spacing of plants appears to give higher yields of all varieties tested. The bunch strain of Porto Rico still compares favorably in yield with the vining strain, and the bunch type is less difficult to cultivate and harvest. Field tests indicate that crop rotations of 2 to 3 years are not long enough to rid soil of the black rot fungus.

Irish potatoes.—Certified seed of all early-crop varieties continue to produce yields enough larger than commercial seed of the same varieties to justify the purchase of certified seed even at a considerably higher price. Delay in the harvesting of spring-crop Irish potatoes

in the test plots has resulted in serious losses of tubers, due to infection by the soil-infesting fungus *Sclerotium rolfsii*. This fungus has not been observed attacking the fall-crop Irish potatoes.

Asparagus.—Tests with select Washington asparagus indicate that plants of this variety are entirely free from rust, and well adapted to both home and commercial production in West Tennessee. Tests are being conducted to determine the best planting distance for commercial production.

TABLE 11—Effects of nitrate of soda on yield and quality of tomatoes—results for 1929, calculated to acre basis

Plot	Fertilizer	Yield	Rating as graded at Humboldt	Report from New York		
				Ripe and firm		Ripe and soft
		Bu.		Date July	No.	No.
1	200 lbs acid phosphate.....	140	6	2	2	0
	50 lbs muriate of potash			6	12	0
				8	11	1
2	200 lbs acid phosphate.....	272	4	2	6	0
	50 lbs muriate of potash			6	12	0
	100 lbs nitrate of soda.....			8	11	1
3	200 lbs acid phosphate.....	348	Poorest of lot	2	4	0
	50 lbs muriate of potash			6	11	1
	200 lbs nitrate of soda.....			8	11	1
4	200 lbs acid phosphate.....	388	1	2	4	0
	50 lbs muriate of potash			6	11	0
	300 lbs nitrate of soda.....			8	12	0
5	200 lbs acid phosphate.....	436	3	2	4	0
	50 lbs muriate of potash			6	12	0
	400 lbs nitrate of soda.....			8	12	0
6	800 lbs 9-3-6.....	336	5	2	3	0
				6	9	1
				8	10	0
7	340 lbs 4-11-6.....	436	2	2	1	0
				6	9	1
				8	11	1
8	Rich land F 10 tons.....	490	3	2	2	0
	340 lbs 4-11-6.....			6	10	0
				8	12	0

Rhubarb.—Seed from select crown-rot-resistant plants growing in test plots at the Knoxville Station produced new seedlings large enough to transplant to permanent location at the end of one season's growth at the West Tennessee Station. Additional seedlings grown for one season at the Knoxville Station have been set in the West Tennessee Station plot to enlarge the number of crowns from which to select for crown-rot-resistance and improved horticultural type.

Livestock

(Under the direction of M. Jacob)

Dairy Herd

The establishing of a dairy herd at the West Tennessee Experiment Station was begun in 1927. According to the project, the foundation for this herd was to consist of carefully selected cattle, preferably out of West Tennessee, and to include 6 purebred Jersey females, an equal number of grade Jersey cows, and a purebred Jersey bull. The herd will be enlarged out of its own production until 20 cows in milk are included.

The object in establishing this herd is as follows:

1. To demonstrate improved dairy methods.
2. To demonstrate herd improvement.
3. To assist in the improvement of dairy cattle in West Tennessee.
4. To undertake experimental work on special dairy problems.
5. To study the possibilities of dairying under West Tennessee conditions.

Cows retained in the herd must meet Register of Merit requirements, or the equivalent, in production. Considering the small number of females that have had to be eliminated, there is promise that a herd of the required number will develop within a comparatively short time. The project also embodies the control of abortion disease. All cattle purchased and added to the herd were required to give a negative reaction to the agglutination test for Bang abortion disease infection. Hence, there has been a breeding efficiency of practically 100 per cent since the herd was established. The cattle will be retested at regular intervals, and the herd carefully guarded against infection, in the hope of demonstrating that a breeding herd can be established and maintained free from this disease.

Sheep

A purebred Hampshire flock of sheep was established, consisting of 9 ewes and 1 ram. This should be the means of encouraging and assisting the sheep industry in this section of the State, which, like Eastern and Middle Tennessee, has some possibilities in the production of lambs for the early spring market.

On account of limited area, and the number of other kinds of livestock on the farm, it will not be possible to maintain a large flock at the West Tennessee Station. The flock will be of sufficient size, however, to afford opportunity for the study of some of the problems in breeding, feeding, and management.

Swine

A small breeding herd of swine is being maintained, including Berkshire and Duroc-Jersey breeds. The offspring have been disposed of up to this time for breeding purposes. It is proposed to enlarge the herd so as to make possible the production of enough pigs each year to meet the needs of experimental work, especially along feeding lines. So far, the objective has been the production of breeding pigs to meet present-day type requirements. In this, the results have been satisfactory, especially with Berkshires, for which there has been a good demand.

Work Stock

The Station policy of raising its own work stock is still in effect. At present, 4 registered Percheron mares, 1 Percheron stallion, 1 jack, and 8 mules of different ages are included. In addition to meeting the work requirements of the farm, it has been possible to sell at least one pair of mules each year. The merit of producing mules out of big mares with quality is being established, and has justified its recommendation to the farmers of the State. The solution of the work-stock problem must be met sooner or later, and a demonstration such as is being carried out at the West Tennessee Station should have a wholesome influence.

MIDDLE TENNESSEE EXPERIMENT STATION

L. R. NEEL, Superintendent

At the Middle Tennessee Experiment Station, the year 1929 was spent mainly in getting the plant in better condition as to fences, the water system, roofs and other equipment, and in carrying on the experiments previously started. These included the cost of calf production, methods of finishing farm-raised calves for market, a study of breeds of sheep, the effects of castration and docking, completion of soybean pasture test with hogs, extensive pasture work with cattle, and the plot work with pasture, hay, and grain crops. Considerable attention was given to the improving of the farm pastures.

A new series of hog-pasture plots was started, including alfalfa, a set of 2 sweet clover plots, red clover, lespedeza, bluegrass and white clover, Sudan grass, and dry lot for check. These $\frac{1}{4}$ -acre lots are to be pastured as they get ready, with enough pigs to make use of the pasture while receiving a $2\frac{1}{2}$ per cent ration of corn. The hogs

are also to get a mineral mixture ad libitum and a limited ration of tankage. This will be a rather long experiment.

An experiment was started to determine the effect of grain ration on beef cattle being finished on pasture in the early summer. Five groups of cattle were placed on as many pastures. Four of them were given the following daily rations per head: (1) 5 pounds of crushed corn-and-cob meal, (2) 5 pounds of crushed corn-and-cob meal and hay in rack, (3) 4 pounds of crushed corn-and-cob meal and 1 pound of cottonseed meal, (4) 10 pounds of crushed corn-and-cob meal. A check group was given no grain. This test is to be run for a term of years.

A nitrogen experiment with corn was started. Three sets of plots were put out on which nitrogen fertilizers of the different kinds were used at two rates of application. Good, medium, and worn types of soil were used. This test is to be repeated several times.

A Jersey cow, U. T. Hardison's Gift, belonging to the Middle Tennessee Experiment Station, completed her test in the late winter with a record of 768.94 pounds of butterfat in 365 days, becoming the best cow of the year in Tennessee and the third highest cow in Tennessee's history.

A swimming pool was made for the 4-H club boys and girls by the erection of a concrete dam in the creek that passes through the farm. This, with the large club building erected the year before, made the Experiment Station a much more attractive place for the farm children, and resulted in a record crowd at the annual camp in July. The number of farmers and of farm children visiting the Middle Tennessee Experiment Station continued to grow throughout the year, as did the number of inquiries coming to the office by mail and telephone.

Horticulture

(Under the direction of J. A. McClintock)

Considerable variation in the susceptibility of apple varieties to fire blight is evident from records taken at the Columbia Station orchard. These records confirm those obtained at the Knoxville Station to the effect that the Star variety is so susceptible to blight that it is not suitable for planting as an early variety in Tennessee.

The new growth of top-budded trees indicates that budding is better than grafting as a method of working over the tops of 3- to 6-year-old trees to convert them into desirable varieties.

Pears.—A number of varieties of both resistant and susceptible pears are making good growth from top buds inserted into scaffold limbs of young, well-established blight-resistant stocks. This method may prove satisfactory in producing quality pears for home use in Middle Tennessee.

MERICOURT EXPERIMENT STATION

The plot work was increased at the Mericourt Experiment Station during 1929. This was possible for the following reasons: The stumps and bushes were removed, the wild onions were pretty well eradicated, and more of the funds were available for experimental work, since the buildings, fencing, and equipment were largely completed the previous year.

The eradication of the wild onions is in itself interesting. On all of the higher, well-drained parts of the farm, where the program of late fall and March plowing could be followed, the eradication is complete. The only places where the onions have not been eradicated are where the program was not followed, due to wet weather or interference of crops.

The first camp at Mericourt of the Montgomery County boys and girls' clubs was held July 24-27, with 125 boys and girls in attendance.

Sweet corn.—In the fertility plots, where 400 pounds per acre of acid phosphate was used as a check, increased yields were obtained by the addition of 2 tons of ground limestone per acre, as well as by the addition of 75 pounds of muriate of potash. Increases were obtained by the addition of different amounts of nitrate of soda, from 50 to 300 pounds per acre.

Nitrophoska.—Comparisons between complete fertilizer (900 pounds per acre, 10-5-5) and Nitrophoska (300 pounds per acre, 30-15-15), with and without ground limestone, used on a number of different vegetable crops, showed best results obtained where ground limestone and Nitrophoska were mixed together in the proportion of 2 parts of ground limestone and 1 part of Nitrophoska. The lowest yields were obtained where Nitrophoska was used alone.

Apple orchard.—Good growth was made on most of the plots of the fertilizer experiments. The trees that were planted in the spring of 1927 showed marked differences in growth as the result of different fertilizer applications. Nitrate of soda produced the most noticeable effect in height and caliper measurements, as well as in leaf color and thrifty appearance. The trees lost their leaves on most plots during August or September, but where nitrate was applied they held their leaves until freezing weather in November.

Soybeans.—In the varietal trials, 57 varieties and new strains were grown.

Field corn.—Six varieties were included in the varietal and rate-of-planting trials. Hildreth, a yellow corn which has aroused local interest, and a new strain of Neal Paymaster, a hard starch type, were included in the test. Good yields were secured in spite of the excessive drought.

Tobacco.—The most striking thing shown in the tobacco plots was the increase in both quality and yield secured in the plots that followed lespedeza, as compared with those that followed other crops.

Sweet potatoes.—Seven varieties were included in the varietal trials. Fertilizer trials continued to show marked response to both phosphate and potash.

Horticulture

(Under the direction of J. A. McClintock)

Tomatoes.—Tests were made with cloth- versus glass-covered beds for tomato-growing. The results would not justify the added expense of glass. Various methods of transplanting in the hotbed and cold-frame did not give a sufficient increase in yield, from the canner's standpoint, to justify the extra labor involved in transplanting over that of setting direct from the bed to the field. The results with staked versus unstaked plants were much in favor of the staked plants, as shown in the total yield of tomato fruits of No. 1 grade suitable for canning. Figures are being obtained on the cost of staking to determine if this will be justified in growing tomatoes for canning purposes. Practically all of the tomatoes grown for shipping as green wraps are staked, and the loss from cull fruits is thus greatly reduced. This extra expense may, therefore, prove justifiable in the case of crops grown for canning purposes.

Beans.—Tests with beans confirm previous reports that western-grown seed is freer from diseases, and thus results in a larger crop of beans suitable for canning. Tests on dates of planting are being continued, to determine whether there are definite dates best suited to the planting of beans for spring and fall canning crops. We succeeded in controlling the bean beetle by following standard recommendations.

Bush Fruits

Raspberries.—The Van Fleet raspberry proved superior to St. Regis, King, and Latham, in vigor and yield. During the winter, Van Fleet plants appeared to suffer seriously from cold. This would indicate the need of caution in planting this variety in sections where low temperatures may occur from year to year.

Blackberries.—The Early Harvest blackberry when properly pruned produced better yields than the Missouri Mammoth, and the fruit was harvested before it had to compete with the wild berries that greatly reduced the market price.

Strawberries.—Plants of one of the new strawberry seedlings developed at the Knoxville Station withstood the winter at Clarksville better than plants of Klondyke and Aroma. This may prove an important factor in selecting varieties adapted to that section of the State.

Rhubarb.—Crowns produced from seed of crown-rot-resistant plants growing at the Knoxville Station are making satisfactory growth at the Mericourt Station.

LIBRARY

ELIZABETH CHEATHAM

The work of reorganization of the Station library is still going on, but the material is now in much more usable form. With the assistance of Miss Lucy Ogden, formerly of the Office of Experiment Stations Library, at Washington, the entire book collection has been thoroughly examined and all unsuitable material withdrawn or transferred to other departments. Inventory and recataloguing are still in process and should be completed during the coming year.

Shelves for the display of current periodicals and one new floor stack were added during the year, and the entire book collection was cleaned and shifted. The volumes in the Experiment Station library now number 8600, not including the College of Agriculture collection, which is in the same room and available for use by Station workers.

It is to be hoped that sufficient funds may now be available for supplying missing volumes and completing sets of scientific and technical periodicals. Much unbound and duplicate material remains to be checked, and this work will probably occupy the whole of the coming year.