TWENTY-FIRST ANNUAL REPORT

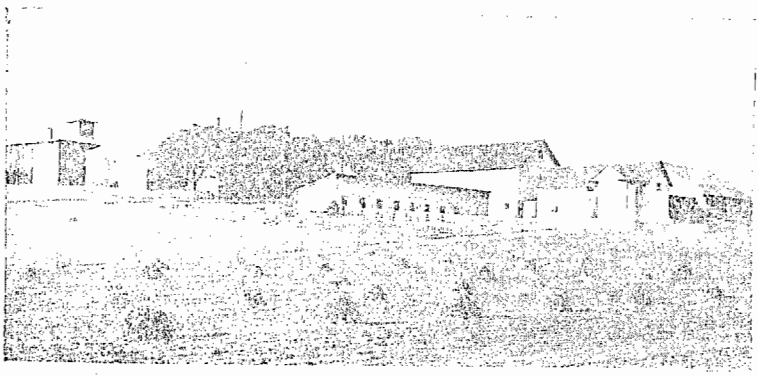
OF THE

Agricultural Experiment Station

OF THE

UNIVERSITY OF TENNESSEE

FOR 1908



VIEW ON THE STATION FARM

KNOXVILLE
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1909

The Agricultural Experiment Station

OF THE UNIVERSITY OF TENNESSEE

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The Station has facilities for analyzing fertilizers and cattle foods; for testing milk and dairy products; for examining seeds with reference to their purity or germinating power; for identifying insects, grasses and weeds; and for investigating insect enemies and diseases of fruit trees, grains and other useful plants.

Packages by express, to receive attention, should be prepaid.

All communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION,
Knoxville, Tennessee.

☞The Experiment Station building, containing the offices and laboratories, and the plant house and part of the Horticultural Department, are located on the University campus, 15 minutes walk from the Custom House in Knoxville. The experiment farm, the barns, stables, dairy building, etc., are located one mile west of the University, on the Kingston Pike. The fruit farm is adjacent to the Industrial School and is easily reached by the Lonsdale car line. Farmers are cordially invited to visit the buildings and experimental grounds.

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

LETTER OF TRANSMITTAL

KNOXVILLE, TENN., January 1, 1909.

To His Excellency, Malcolm R. Patterson, Governor of Tennessee:

SIR:—I beg to transmit herewith, on behalf of the Board of Trustees of the University of Tennessee, the report of the operations of the Agricultural Experiment Station for the year 1908, including an account of its work and a classified statement of its expenditures. This report is submitted in accordance with the requirements of the law that the Board of Trustees should annually submit such a report to the Governor of the State.

The work of the Experiment Station is expanding year by year, and the interest and confidence of the farmers of the State are most gratifying to the Station staff and to the Board of Trustees of the University. During the year the laboratories and offices of the Station have been moved into a new and commodious building, and the opportunity for better work is thus measurably increased.

In compliance with legislative enactment, a Station has been established in West Tennessee at Jackson. A farm of nearly two hundred acres, about a mile from the business center, was donated by Madison County as a site for this Station.

The farm is unusually well adapted for experiment station work, and it is believed the agricultural interests of West Tennessee will be greatly promoted by the work done there.

Cooperative experiments with the farmers of Middle Tennessee have been continued, and it is hoped this work will be liberally supported by the State, since it affords the largest opportunity for the solution of local agricultural problems.

The director of the Station, Prof. H. A. Morgan, and his staff have continued to cooperate with the State Commissioner of Agriculture in farmers' institutes throughout the State, and Commissioner Thompson has been most helpful in aiding the work of the Station in all possible ways.

Very respectfully,

BROWN AYRES,

President.



THE UNIVERSITY FROM SOUTH OF THE TENNESSEE RIVER; MORRILL HALL ON THE LEFT

TWENTY-FIRST ANNUAL REPORT OF THE AGRICULTURAL EXPERIMENT STATION OF THE UNIVERSITY OF TENNESSEE FOR 1908

REPORT OF THE DIRECTOR

To President Brown Ayres:

New building

The year 1908 was marked by the opening, in the early summer, of the new Morrill Hall, which was erected through State appropriation. The Experiment Station now has its headquarters in this commodious building.

Changes in the staff

The following changes occurred in the working staff of the Station during the year:

Mr. James N. Price, Dairyman, resigned July 1 to go into commercial dairying at his home in Missouri. At the same time Mr. F. C. Quereau, Animal Husbandman, was appointed Animal Husbandman and Dairyman, and Mr. F. H. Denniss, a graduate of the Ontario Agricultural College, was appointed Assistant Dairyman.

Mr. J. E. Hite, for two years Assistant in Charge of Cooperative Experiments in Middle Tennessee, resigned to take a special course in animal husbandry at the Illinois Agricultural College.

Experimental work

Work inaugurated in preceding years has been continued this year, and in addition there have been instituted, under the Hatch and Adams Funds, experiments relating to soil humus and fertility; immunity to diseases in red clover and other legumes; and the cattle tick (*Margaropus annulatus,*) and the peach-tree borer (*Sanninoidae exitiosa* (Say), with special reference to life-history and habits and remedial measures. Much progress has been made in the introduction and development of new varieties of plants and in the bringing about of conditions suitable for the general profitable production of alfalfa and alsike clover and winter legumes of much value as feed and for the protection and betterment of the soils of the State.

Rotation experiment

Extensive experiments have been conducted in connection with various rotations, under different systems of fertilization and culture, of all varieties of farm crops, with special reference to the peculiarities and types of soil; the comparative values of crops, or combinations of crops, under single, double, and even treble cropping systems; and the relation of such work to various lines of live stock production and development.

Fruit and truck

In cooperation with the State Department of Agriculture, Prof. C. A. Keffer, horticulturist of the Station, has studied the fruit and truck interests in the various divisions of the State. This work was begun in 1906. The fruit and truck counties of the Middle division were studied in 1907, and in 1908 the commercial areas of East Tennessee, as well as those of particular climatic promise in the production of fruit, were specially considered. The plan was to call together in various parts of each county persons engaged in fruit and truck production and those interested in the subject. As a rule demonstrations in the management of trees, plants, and soils were given at some adjacent orchard or truck farm. These demonstrations increased the interest of the growers in the studies undertaken and invariably resulted in active cooperation. Professor Keffer's reports have been published in the Biennial Reports of the Commissioner of Agriculture.

Cultivation of alfalfa

Under three of the most adverse conditions possible in the seeding of alfalfa, the Station in 1906 began an experiment with this crop. After applications of lime, acid phosphate, and manure, the seed was sown (1) in the spring, (2) with a heavy nurse crop, and (3) in ground on which a large amount of crab-grass and other grasses and weeds had been allowed to go to seed. From experimental and practical effort in this State spring seeding of alfalfa, the use of a nurse crop, and crab-grass and weed competition are not recommended. Many of the failures with alfalfa, even after applications of lime, phosphate, vegetable matter, and inoculated soil, have been due to one or more of these conditions. Intelligent fertilization, two years in clean-culture crops, and at least two months fallowing preparatory to seeding alfalfa in August or September, usually bring success in this State. The wide range of interpretation as to what these requirements mean makes it well-nigh impossible to get uniform preparatory alfalfa conditions; and hence the experiment with cultivation after seeding for the mulching of the plants and the ridding of the ground of grass and weeds. Each year since the seeding, double discing and double harrowing were given the ground after each cutting except the first cutting the first year, when only the 60-tooth harrow was used. In addition to the cultivation stated above, winter discing and harrowing to control chickweed were given. The result of this work has been a gradual increase in stand of alfalfa and the eradication of grass and weeds with five cuttings each year during the last two seasons.

Grass experiments

The value of meadow and pasture grasses for all sections of the State is being better understood and appreciated. Experiments with grasses have been undertaken with reference to the preparation of land, the application of lime and fertilizers, varieties and mixtures, rates and times of seeding, selections of promising strains, the management of meadows and pastures, and the place of meadows and pastures in economical rotations. The purpose of these experiments is to accumulate

definite information regarding the life and habits of grasses under varying practical conditions.

Investigational work

Under the Adams congressional appropriations, investigations in the subjects of soil humus, soil biology, "clover sickness" (attack of *Colletotrichum trifolii*), the peach borer, and the cattle tick have been continued. These investigations require a great deal of study, time, and technical apparatus, but during the year much progress has been made in orienting the projects, installing essential apparatus, and making initial determinations.

State cooperative experiments

The results of the two years' cooperative work in the Middle division of the State have been compiled for publication. The cooperative work, as was to be expected, indicates that very different methods of fertilization, systems of cropping, and farm management should be used on the varying soil areas. Lime has been found generally effective. Phosphate and lime on the Barrens and the Rim are fundamental in any system of farming for these areas. Fertilizers as compounded and distributed commercially have proved ineffective on the phosphate basin soils, but larger amounts of potash and nitrogen than are usually applied in mixed fertilizers have given very marked results on certain crops.

In the cooperative work some time has been given to demonstrations and extension. Much of the practical information accumulated by the Station in the past can be more thoroughly understood and applied by the farmers through demonstrations than in any other way. It is only by State appropriations that extension effort is possible.

In cooperation with the State Department of Agriculture some tests have been made in the production and efficacy of the hog cholera serum as devised by the Bureau of Animal Industry, U. S. Department of Agriculture, and the results thus far have proved very gratifying.

Horticultural and nursery inspections and demonstrations have been made in all parts of the State, with the result that the care and management of orchards, with special reference to the control of insects and fungi, have improved, and the possibility of economical and commercial production of fruit is no longer doubted.

The Station has also engaged in a preliminary study of sheep and lamb raising, particularly in Middle Tennessee. Data upon the source of breeding ewes, the sires used, and the management of the flocks have been collected and compiled, and will be reported in bulletin form and in the report of the cooperative work.

Experiments in cooperation with U. S. Dept. of Agr.

For a number of years cotton and cereal studies have been in progress at this Station in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture. The cotton breeding and selection has been conducted by Prof. S. M. Bain and the cereal work by Prof. C. A. Mooers. The Trice cotton distributed last year and the selections of Poole and Fulcaster wheat and

Culberson oats are illustrations of some of the results of this cooperation. Later, bulletins will be published embracing data on the more important experiments.

Mr. S. E. Barnes, working under a cooperative agreement between this Station and the Dairy Division of the Bureau of Animal Industry, has done very great service to the dairy interests of Tennessee. His herd record tests; assistance to dairymen in the management of their herds and dairy products; and advice on the construction of silos, rational feeding of dairy animals, and dairy farming have given to this important industry just the help needed and at a most opportune time.

In Montgomery and Robertson Counties the Bureau of Entomology of the U. S. Department of Agriculture has been engaged in tobacco insect investigations, and the Station has been represented in the work by Mr. D. C. Parman. Through the courtesy of Dr. L. O. Howard, Chief of the Bureau of Entomology, Mr. A. C. Morgan has prepared a report upon these tobacco insect investigations for publication in the report of the cooperative work in Middle Tennessee.

West Tennessee Experiment Station located

The Commission appointed under Senate Bill No. 82, Acts of Tennessee, 1907, selected a location for the West Tennessee Station about one mile west of the city of Jackson, in Madison County, and arranged the transfer of three adjoining pieces of property for the Station farm. These properties, comprising in all about 175 acres of land, are admirably suited for experimental and demonstrational work. The immediate location, stretching between two main thoroughfares—the Brownsville and Poplar Corners Pikes—is of easy approach to local and visiting farmers. The soils upon these areas are sufficiently diversified to be representative of the soil areas of this division of the State. The worn-out condition of many of the fields offers ample opportunity for experiments in economical soil improvement for the various phases of agricultural activity for which West Tennessee is so well adapted both by climate and geographical location.

Since a large share of West Tennessee's agricultural interest is cotton, the Station will have a rare opportunity to suggest and encourage other profitable lines of agricultural effort before the arrival of the Mexican cotton boll weevil, which at its present rate of dispersion will reach the outlying western counties about 1912 or 1913.

The substantial gift by Madison County to the State of the properties selected by the Commission illustrates the present interest in agricultural investigation and development throughout Tennessee.

Respectfully submitted, HARCOURT A. MORGAN, *Director.*

REPORT OF THE BOTANIST

Introduction

The Botanical Department of the Experiment Station at present comprises (1) investigations into certain lines of bacteriology, especially bacteriology of the soil, in charge of Mr. Mulvania; (2) general investigations in botany, especially plant diseases, in charge of the botanist

and the assistant botanist and mycologist, Mr. Essary; (3) cotton breeding investigations, in cooperation with the United States Department of Agriculture, in charge of the botanist, assisted by Mr. A. T. Anders.

The laboratories in which this work is conducted are located on the second floor of the new Morrill Hall, into which they were moved in June, 1908. Much time during the year has been spent in arranging and improving the general equipment of these laboratories. The facilities for investigation in the new quarters are a very great improvement over former conditions.

Soil bacteriology

The experiments in the important field of soil bacteriology have been directed largely toward the designing and perfecting of apparatus for special purposes. Mr. Mulvania has had constructed, after specifications, a large autoclave and other pieces for culture under controllable conditions. He has also continued the experiments on the nitrogen assimilation of the soy bean, and related problems.

Plant diseases

The main efforts of the botanist and the assistant botanist, Mr. Essary, have been in the direction of propagating the resistant strain of clover referred to in the last report, and of a study of the life-history of the fungus causing the disease. The propagation of the clover seed has progressed very satisfactorily. From little over half a peck of the seed harvested in 1907 there is now on hand about four bushels of the seed, and at least this much more may reasonably be expected as the second season's crop from the same sowing to be harvested in 1909.

The last season's experiments have been especially gratifying in that they still further indicate the successful solution of the clover problem as it applies to Tennessee. The value of this single line of experiments to the agriculture of the State is indicated in an estimate made recently by the botanist showing by a most conservative calculation that the practical solution of the clover question will save about $3,000,000 annually to the farmers of the State. Some progress has been made in the study of the life-history of the clover fungus.

No definite lines of work are aimed toward a complete survey of the various plant diseases occuring in the State each year. It is believed that with the limited force of investigators on the Station staff more permanent good can be accomplished by directing effort toward the solution of definite important problems than by merely recording the occurrence of certain diseases in our territory. Yet, by correspondence and incidental observation in the field while prosecuting special lines of investigation, many valuable data accumulate as to the occurrence of diseases. These facts are carefully compiled and filed for future reference.

Some attention has been given to tomato diseases in Gibson and Maury Counties, and to cantaloupe rust in Lawrence County.

Weeds and seeds

Mr. Essary has given some attention to the weeds occuring in the State. He has gathered a number of notes for use in a future publication on the

weeds of Tennessee. He also has given considerable attention to the testing of seeds sent in by farmers from various sections. The facilities of the Station for testing seeds are now taxed to the utmost limit, and it is earnestly hoped that a law may soon be enacted, not only protecting the farmer against fraudulent adulteration or misnaming of commercial seed, and against admixtures therein of injurious weed seeds, but also providing funds and efficient equipment for inspecting such seed. This law should operate in a manner analogous to the present law relating to fertilizers.

Cooperative cotton breeding experiments

By arrangement with the Bureau of Plant Industry of the United States Department of Agriculture, the botanist devotes half his time to cotton breeding experiments. The breeding plots have been continued the past year on the farm of Mr. W. N. McFadden, in Fayette County. After four years of selection a new and improved variety of cotton has been produced and distributed by congressional seed distribution. The variety came out of the stock found in Chester County, and was distributed under the name "Trice." The especial points in favor of this variety are its adaptation to a large portion of the cotton-raising section of Tennessee, its early maturity, and its productiveness, along with medium-large bolls.

Farmers' Institutes

In addition to the general lines of experimentation above outlined, the botanist has devoted some time to addressing the farmers' institutes under the auspices of the State Department of Agriculture. Advantage has been taken of this opportunity to lay before the farmers of the State the results of the clover experiments above outlined.

Need of a greenhouse

A very urgent need of this Department of the Experiment Station is a greenhouse constructed along modern lines. It at present has no facilities of this kind. Important lines of experiments are retarded and even prevented for lack of such a structure. It is sincerely hoped that legislative appropriation may be made and devoted to this important end.

Respectfully submitted, SAMUEL M. BAIN, *Botanist.*

REPORT OF THE CHEMIST AND AGRONOMIST

AGRONOMY

Field experiments

The various lines of experimental work with varieties of field crops, rotations, green manuring, etc., outlined in the reports of 1906 and 1907 have been continued with very satisfactory results. One bulletin, No. 82, on "The Soy Bean: A Comparison with the Cowpea," was published in December. This bulletin gives highly important practical data in regard to both varieties of soy beans and their peculiarities. With the aid of the data published, combinations of varieties for a succession of crops from early until late in the season may be determined; and the time of maturity for some of the most important varieties when planted

at any given date can be predicted with reasonable accuracy—something that could not be done previous to this publication. Also the results show that the soy bean supplements the cowpea crop by being able (1) to mature earlier than any of the varieties of cowpeas, (2) to produce good yields of grain when sown several weeks later than is possible for the cowpeas, (3) to yield seed containing about one and one-half times as much protein and ten times as much oil as the cowpea. Some features of the soy bean as a farm crop are to receive special attention in the near future; in particular, methods of harvesting and best stage for cutting.

A bulletin on corn, with special reference to soil adaptability, and also distance-in-planting, is in course of preparation. Certain varieties have been definitely determined to be especially well adapted to rich lands and others to poor lands; also some varieties are found to stand much thicker rates of planting than others.

Middle Tennessee cooperative experiments

The cooperative experiments in Middle Tennessee have proved of direct practical value to the farmers, both by demonstrating the soil needs and by giving information as to the amounts of fertilizers that may be used with most profit for a number of crops. This is the first time that such a series of any consequence has been carried out in that section of the State. The results are also valuable in connection with the soil investigation work being done in the chemical labratory. The close agreement between the conclusions from the chemical soil analyses and the results of the field experiments is highly gratifying. Central Basin soils which by chemical analysis were indicated to be well supplied with the mineral elements of plant food, phosphoric acid, lime, and potash, were found by field experiments to respond little or not at all to fertilizers valuable for these elements. The nitrogen supplies, however, were not always found to be ample, and this was likewise indicated by the laboratory determinations. The field experiments with the limestone soils of the Rim agreed with the chemical analyses in showing the need of phosphoric acid, nitrogen, and humus; the supplies of lime and potash being fairly good. The Barrens of the Rim were found to be in need of all the elements of plant food, the chemical analyses and the field experiments agreeing in this respect. The same can be said of the soils of the Cumberland Plateau, with the exception of potash, which does not seem to be especially needed, as demonstrated by the field experiments; but a poor supply is indicated by the chemical analyses. Perhaps the sandy nature of the soil, which allows the plant roots to penetrate it readily, accounts for this apparent discrepancy. The soils of Middle Tennessee have generally been found to be of good texture and suited to the production of a great variety of crops. They are also retentive of fertilizers and manures applied, so that even the poorest soils possess the fundamentally important characters necessary to successful improvement.

CHEMISTRY

Work in laboratories has continued about as indicated in previous

reports. An investigation of the composition of the soy bean plant at various stages of growth has been begun, with results which on account of the exceptional interest shown by the farmers throughout the State will merit publication at an early date.

The cooperative experiments have furnished valuable material for laboratory work.

The following 's a resume' of the year's analytical work, but does not include important investigation work which can not be tabulated in this way.

Soils:	Complete analyses	8
	Humus and ash estimations	112
	Nitrogen estimations	228
	Complete physical analyses	48
Ash analyses		23
Fertilizer inspection samples		264
Miscellaneous manures and fertilizers		23
Feeds, etc.		30
Limestones: Total carbonates		16
Mineral waters		5

REPORT OF ANIMAL HUSBANDMAN AND DAIRYMAN

EXPERIMENTS IN BEEF FEEDING

Importance of live stock on the farm

Nothing else has militated so much against the rational relation of live stock to average farm operations in the State as the disregard of the fertility removed from the farm when corn or other crops are so'd direct instead of being fed. In other words, for the sake of the soils and their future productiveness it has been altogether too common a practice for the producer to calculate the value of his crop on the market price. A more logical basis of estimate is the market price less the fertility sold in each pound, bushel, or ton. Yet under any system of direct marketing of crops we lose sight of the possibility of getting a better price if the crops were fed to live stock on the farm; the value of the utilization of roughage, much of which is unsalable; the accumulation of the elements of plant food and vegetable matter in manure; a more judicious and profitable rotation of crops; and an increasing crop yield at a much less cost per acre. Realizing the somewhat unconscious effect which market values as ordinarily interpreted are having upon the general agriculture of the State, the Station undertook a series of experiments with the following objects in view:

1. To establish a correct relationship between farm and market values.

2. To show the relationship between the maintenance of soil fertility and stock husbandry.

3. To find and test the crop or crops that would most economically produce finished animal products.

4. To learn something of the rate of improvement that could be

brought about in the fertility of soils by stock farming as against "mine" farming, or continuous cropping and sale of crops from the farm; in other words, the rate of improvement in worn-out farms by proper methods.

Influence of market values

The influence of market values in Tennessee is well illustrated in the case of the corn crop. Over fifty per cent of the total crop production of the State is corn, notwithstanding the fact that other crops are available that are less taxing upon the land, of a higher feeding value, and better adapted to a more judicious system of rotation. As a silage crop on well-fertilized fields corn has a very definite place in Tennessee, but the soil fertility under average conditions does not warrant so large an acerage planted to this crop. Statistics given in the reports of the U. S. Department of Agriculture indicate that Tennessee stands from ninth to eleventh in acreage and from thirty-first to thirty-third in yield per acre. Facts like this may have but one meaning, and that is that estimates of profits in the past have been made on an erronous basis.

Feeding experiment

Three acres were carefully measured off on the Experiment Station farm. This area was subdivided into three one-acre plots. These plots were planted to corn, cowpeas and soy beans, respectively. The products of these plots were harvested and fed, respectively, to three lots of steers, each lot containing four steers, as long as the products of the respective acres lasted; the object being to find how long the product of a single acre would feed four steers when planted to the crops indicated, and the amount of gain that could be produced from each of the feeds. Careful records were kept of the cost of production in all of its details, in order that some idea of farm values might be arrived at. As this experiment will be carried on for a number of years on the same area, analyses of the soils were made each year and an effort will be made to learn something of the rate of increase in soil fertility secured by proper rotations, feeding products to stock and returning the manure to the areas upon which the crops were grown.

Conclusions

The following conclusions have been reached from two years experiments:

1. Soy beans are the best forage crop that has been tested on the Station. The products from the acre of soy beans have fed longer, with greater gains, than either corn or cowpeas. Cowpeas stand next to soy beans and corn comes last.

2. By the return of manure from the feeding of crops there has been a marked increase in the productiveness of the soil, the feeding capacity for four steers per acre having been increased in the case of soy beans from 80 days in 1905-6 to 100 days in 1908-09.

3. Careful records most forcefully emphasize the value of the new idea of farm values rather than market values as a basis for the making of estimates in the farming business. A crop may be marketed in Tennessee by judicious feeding to live stock at a figure not greatly

below current market quotations, and this without giving a great deal of consideration to the value of the manure and increased soil fertility.

Other feeding experiments

Other experiments have been carried on during the past four years with various forms of roughage in connection with beef and dairy feeding. The results will be published in bulletin form as soon as the data can be compiled.

EXPERIMENTS IN DAIRY FEEDING

Effect of prices on dairy production

During the last few years the prices of cotton-seed meal, wheat bran, and other feeding stuffs have increased at least 25 per cent; averaging as they have from $25 to $30 per ton. Such prices have greatly increased the cost of producing milk and butter. Because of its high feeding and fertilizing value cotton-seed meal has been more popular than any other of the high-priced protein concentrates. It has been fed in excessive quantities, making an extremely one-sided ration, which has worked in too many cases infinite injury to the dairy herds.

There is but one way out of the difficulty, and that is for the Tennessee farmer to produce the bulk of his feed on the farm. In fact the purchase of feed of any kind by the farmer is decidedly against sound economic principles.

Market prices of feeding stuffs

Feed bought on the market costs from $25 to $30 for concentrates and $16 to $20 for roughage. The records of the Station prove that corn-and-cob meal may be produced at a farm value of from $8 to $12 per ton; soy-bean meal at from $16 to $20; corn silage at $2; corn stover and soy-bean straw at $3; and cowpea and soy-bean hay at $7. An ideal ration can be produced with these feeds at about one-half what it would cost to purchase a ration of equal value.

Soy bean against other feeds

The soy bean having given the largest yield per acre, both in roughage and grain, of all the farm crops tested by the Station, it was determined to test the feeding value of this crop with the Station herd and demonstrate the economy of home-grown rations in connection with other feeds. In the planning of this experiment two objects were kept in view; first, to compare the soy bean with other standard protein feeds, and second, to compare the cost of producing milk and butter with home-grown and with purchased rations of approximately the same feeding value.

The feeds used were corn-and-cob meal, cotton-seed meal, and a commercial dairy feed. Corn silage was the basis of all rations, every cow getting corn silage through the entire experiment. The other feeds were so combined that soy-bean straw was fed against corn stover; soy-bean hay against alfalfa hay; and soy-bean meal against cotton-seed meal. The cost per ton of the home-grown feeds was estimated in terms of farm values, as follows: Corn stover $3; corn-and-cob meal

$8; soy-bean straw $3; and soy-bean meal $17. The purchased feeds were charged as follows: Cotton-seed meal and the commercial dairy feed each at $25 per ton; and the alfalfa hay at $20 per ton.

The cows were selected and divided into three groups, and each group was divided into two lots of four cows each. The rations were fed in 30-day periods. There were two rations to each group of cows. The rations and the lots were alternated each period. This gave comparative results from the same ration with the same and with different cows.

Conclusions

The conclusions reached in this experiment are as follows:

1. Soy-bean straw will give better results than corn stover, and can be produced at about the same cost.

2. A ton of soy-bean hay produced at a cost of about $7, has a higher feeding value than a ton of alfalfa hay, which at present prices will cost from $18 to $20 per ton.

3. Cotton-seed meal and soy-bean meal have about the same feeding value, pound for pound.

4. A well-balanced ration can be produced on the farm at much less cost than it can be purchased on the market.

5. The growing of feeds on the farm gives a wider variety and will remove the tendency to feed cotton-seed meal excessively, which makes the ration so narrow that it is injurious to the health of the herd and does not give the best yields of milk and butter.

Respectfully submitted,

F. C. QUEREAU, *Animal Husbandman and Dairyman.*

REPORT OF THE FIELD EXPERT IN DAIRYING

The work along the lines of herd improvement; economic feeding; and the building of barns, silos, and dairy houses has made excellent progress. We are gaining the confidence of the people, and they are becoming interested enough to take active part in the work.

Visits to farmers and dairymen

As many as two hundred visits have been made to farmers throughout the State, who have been advised with reference to improvement in buildings, herd selection, crop rotations, etc., the last-mentioned subject being of great importance in the production of home-grown feeds. Regular visits have been made to eight or ten dairymen, some of whom finished the year's work, while others began only a few months ago. These people have all taken great interest in the work, and evidently much good has been done in a general way.

Silos, barns, etc.

During the past year the writer built six silos complete, and influenced the building of six others; gave advice and assistance in the construction of three barns, and remodeled four others; helped to construct two dairy houses and remodeled three others; influenced nine dairy farmers to invest in pure-bred dairy bulls; spoke at eight dairymen's

meetings; operated working dairies at three fairs in the State; and influenced the organization of three county dairy associations.

Dairy Association

The Tennessee Diary Association is now on a firm footing, having about seventy-five good members, and is creating considerable interest. It has published one annual report, and has induced 125 dairymen to subscribe for dairy papers.

The dairy farmers are showing great interest in this work, and are giving hearty cooperation.

Respectfully submitted. S. E. BARNES, *Field Expert in Dairying.*

REPORT OF THE VETERINARIAN

During the past year the work in veterinary science has been somewhat broadened, owing to a slight increase in its financial support.

Hog cholera serum

We have taken up the question of the production of hog cholera immunizing serum on a small scale. The serum which we have produced proved to be potent and we were able successfully to immunize hogs against cholera by vaccinating with the serum, which we have made at the Station. We have used the serum in several outbreaks of hog cholera, and have been successful in checking the spread of the disease. As already indicated, we have been doing this work to the extent that our means would permit, but it is sufficient to demonstrate that susceptible hogs can be successfully immunized against cholera, and that we can make a reliable serum at the Station. The annual loss in the State of Tennessee from hog cholera is close to $50,000. It is therefore to be hoped that an appropriation will be made by the State so that hog cholera vaccine can be produced on a large scale, for general distribution to the swine breeders of Tennessee at a moderate cost.

Prevalent diseases

The infectious and parasitic diseases brought to our attention as being most prevalent among live stock in Tennessee at present are the following: Tuberculosis, hog cholera, blackleg, actinomycosis (lumpy jaw), chronic bacterial dysentery, Southern cattle fever, hemorrhagic septicemia, mycotic stomatitis, glanders, hook worm, and stomach worm. However, as compared with many other states, with the exception of Southern cattle fever, hog cholera, and stomach worm of sheep, these animal plagues are not so very prevalent in Tennessee. Again, many conditions appear which we are compelled to pass unnoticed because of the limitation of our means and facilities.

Correspondence

The correspondence with citizens throughout the State seeking advice and information on animal diseases and live stock questions in general is becoming larger each year.

Need of support

This year more than ever before it has been apparent that our present means and facilities are wholly inadequate. When we compare this Department with similar departments in nearly every other state in

the Union, we must admit we are by circumstances forced almost to a standstill so far as doing advanced work is concerned. We are therefore compelled to emphisize the need of increased support in justice to the Department and the live stock interests of the State of Tennessee.

Respectfully submitted, M. JACOB, *Veterinarian.*

REPORT OF THE ENTOMOLOGIST

The usefulness of the Department of Entomology has broadened in many lines. The nursery inspection and field work is in charge of Mr. C. M. Bentley, and the experimental work is carried on mainly by Mr. E. C. Cotton.

NURSERY INSPECTION AND FIELD WORK

Nursery inspection

The nursery inspection has grown to be a large undertaking, and the services of two men have been required for the greater part of three months during the summer. At present there are 247 nurseries, located in 50 different counties of the State.

Woolly aphis

In connection with the nursery inspection an article has been published in the Fourth Annual Report of the Tennessee State Board of Entomology on the woolly aphis, one of the worst pests upon apple stock. The life-history of this form has been simply given, with the best-known methods for control.

Brown-tail moth

Foreign importations of nursery stock coming into Tennessee last February from France were found to be infested with winter nests of the destructive brown-tail moth. Consequently all these shipments into the State were inspected. Many nests were taken and strictest precautionary measures were carried out. Had this foreign pest become established in Tennessee the extensive fruit and timber interests would have suffered serious loss. It is hoped that every trace of this insect has been eradicated. However, careful examinations will be made throughout the State this summer in connection with the regular nursery inspection.

"Seventeen-year locust"

For the past four years observations have been made of the Periodical Cicada, commonly known as the "seventeen-year locust." The results, with life-history and Cicada maps, have been published in the Fourth Annual Report of the Tennessee State Board of Entomology. The occurrence of the different broods has been established for the various counties of the State. Practical application of our knowledge of the Cicada is given attention in relation to orchard planting and pruning and the lessening of the injury to nurserymen.

Apiary

The work in the experimental apiary has continued, and valuable observations have been made in a comparison of the German bee with the various strains of the Italian bees. Experiments with single and double-

walled hives, the location of the hive, and different manipulations of swarms have furnished data used in correspondence and publication in bee journals.

Cotton boll weevil

The cotton boll weevil has not been found in Tennessee; yet its dispersion from the infested centers of Texas and Louisiana is rapidly advancing toward the cotton section of this State, and it is probable that this insect will reach here within the next three years. To check this invasion, it would be necessary for an inspector to examine all cotton shipped into the State from the weevil-infested sections.

EXPERIMENTAL ENTOMOLOGY

The greater part of the time of Assistant Entomologist E. C. Cotton has been given to a continuation of the investigations of the life-history of the North American fever tick and the peach tree borer and methods for their control.

North American fever tick

As last year, the fever tick project has claimed the larger share of his energies because of the intense biologic interest in the study and the important economic results which we expect to obtain from it. Early in the past year the indoor series of longevity tests of the seed ticks was discontinued because the conditions in the laboratory are so different from those obtaining in the field, where the eradication must be applied, as to render these results of very little value.

The outdoor series has been continued and much additional valuable information obtained. However, in order to draw unquestionable general conclusions it will be necessary to continue this part of the work for at least another year. The necessity for this continuation is not due to lack of definiteness or conclusiveness in the results already obtained, but entirely to the fact that the lengths of the various life periods of the ticks are largely dependent upon the weather, and as the climatic conditions of no two seasons are exactly alike the conclusions drawn from one year's results will not necessarily apply in the next.

Inasmuch as but little definite investigation has ever been undertaken to determine positively if any of the species of ticks other than the fever tick are capable of transmitting the protozoan parasite which causes the "Texas" fever and because of its great importance in eradication work, we have during the latter part of the year taken up this line of investigation. Seed ticks of the Gulf Coast tick (*Amblyomma maculatum*) and the Dog tick (*Dermacentor variabilis*) were secured and reared to maturity upon a bull which did not have the "Texas" fever. Although these ticks had hatched from eggs laid by a female tick which had become engorged upon the blood of a fever-infected animal, they did not produce the fever in our experimental animal—indicating that if these two species are pathogenic at all they acquire the power later than the egg stage. This phase of the investigation will be continued and the tests extended to several other species.

We are enabled to do this work through the hearty cooperation of

Mr. W. D. Hunter, In Charge of Southern Field Crop Insect and Tick Investigations, of the United States Bureau of Entomology.

Peach tree borer

The field observations and the rearing under controlled conditions of the peach tree borer, were continued through this year. No new results were obtained, the observations merely confirming previous results. Tests of preventive measures were started from which we hope to get some definite results. For a continuation of this work an experimental orchard was planted out in the fall.

Miscellaneous work

From time to time during the year our attention has been called to local outbreaks of destructive insects, and many of these minor problems have been investigated, and some time has been devoted to life-history work along these lines.

NEED OF FINANCIAL SUPPORT

The principal need of the Department of Entomology is for adequate financial support for (1) the inspection of the orchards of the State for San Jose scale, the new peach scale, and peach yellows; (2) the carrying on of cooperative experiments in orchard spraying with insecticides and fungicides; and (3) life-history study of prevalent injurious insects, for which it would be necessary to have an insectary where breeding cages could be kept under proper conditions.

Respectfully submitted, H. A. MORGAN, *Entomologist.*

REPORT OF THE HORTICULTURIST

Orchard Investigation

In cooperation with the State Department of Agriculture, the months of October, November and December of the year 1908 were devoted to an investigation of the present condition of the orchards of East Tennessee. Particular attention was paid to the mountain counties, as these are better adapted to fruit culture than the valley counties. A report embodying the results of the investigation was submitted to the Commissioner of Agriculture. During the course of this work 24 meetings were held in orcards, to which the farmers of the neighborhoods were invited. Demonstrations of orchard pruning, with discussions of the various phases of orchard management, were given at the meetings, and the interest exhibited warrants a continuation of such work. The average attendance for the entire series was 21.

Experimental work

The experimental work of the year included experiments with fertilizers for cantaloupes, tillage and cover-crop experiments in orchards, and spraying for peach rot.

Cantaloupes

The cantaloupes were a failure, owing to unfavorable weather. Re-seeding was necessary, and a drought in May prevented growth. The whole year was excessively dry, the rainfall for the cantaloupe season being 5½ inches below the mean rainfall for the corresponding period at this place.

Orchard tillage

The orchards were given clean tillage until July. This required harrowing with a disc harrow three times and with a spike-tooth harrow five times. The result of this heavy working was to keep the soil in perfect condition; but in a commercial orchard this high tillage would not be profitable in Tennessee—first, because of the cost, and second, because with our heavy rainfall during the spring and early summer—when the principal growth is made by the trees—there is a sufficient amount of available moisture in the soil without the need of so much tillage. In other words, the conservation of moisture can be sufficiently secured without excessive tillage in Tennessee.

Cover crops

The work with cover crops demonstrated the importance of satisfactory soil-moisture conditions in securing a stand. Crimson clover sown the third week in August gave an excellent stand. By October the soil was entirely covered with a rich growth of clover, and the cover thus made afforded ample protection against washing. In another plat sown the second week in September, no stand was secured from the same lot of seed. Seasonable rains enabled the first sowing to sprout, while dry weather prevented the sprouting of the second sowing. Vetch, alsike clover, and vetch and oats suffered equally with crimson clover. Rye, planted with the first planting of clover, made a perfect stand. As September droughts are common here, the earlier planting is much the safer.

San Jose scale

San Jose scale increased with remarkable rapidity on Burbank plums in the Station orchard. The orchard was well sprayed in February, 1908, and but few live scale were seen on the trees before blooming; but the fruit of these trees was badly infested by the time it was ripe. The scale made but little headway in the adjoining rows of trees, which were of Bevay and Yellow Egg varieties.

Orchard fertilizing

Experiments in orchard fertilizing were begun in cooperation with Messers. Walter Bell, of Mont Eagle, Grundy County, and I. C. Murphy, of Columbia, Maury County. It is hoped this line of work may be extended during the coming year.

Seedling apples

Cions of over 200 seedling apples, selected by Mr. J. J. Reasor from orchards in Sumner and adjoining counties, were root-grafted successfully, and an orchard of these choice seedlings will be planted at the Station this year, and they will be top-grafted in trees of bearing age for a comparison of their merits with standard commercial varieties. During the last few months Mr. Reasor has collected over 50 additional varieties, which will be grafted. It is reasonable to expect from these Tennessee seedlings apples well adapted to local conditions.

Respectfully submitted, CHARLES A. KEFFER, *Horticulturist.*

REPORT OF THE LIBRARIAN

The following is a statement of the number of books and periodical publications belonging to the agricultural library:

Bound volumes	3,845
Accessions during 1908	119
Purchased	22
Obtained by exchange and gift	94
Bound by the Station	3
Volumes complete, ready for binding	100
Journals subscribed for	22
Agricultural papers received in exchange for bulletins	112

There are on file a large number of bulletins, reports and circulars of the U. S. Department of Agriculture and other experiment stations and of miscellaneous pamphlets.

The library in the new Agricultural Building is equipped with five oak book stacks sufficient to accomodate about 5,000 books. They are used for the filing of bulletins and other pamphlets, as well as for books, and are almost filled.

The library is in charge of Miss Ruby Franklin, who also assists in general office work.

The bulletin mailing list is distributed as follows:

MAILING LIST

U. S. Dept. of Agr. and experiment stations	2,047
Tennessee newspapers	171
Exchanges	159
Individuals in Tennessee	10,673
Other states	650
Foreign, not including foreign exchanges	43
	13,743

Respectfully submitted,

F. H. BROOME, *Librarian.*

BULLETINS OF THE TENNESSEE EXPERIMENT STATION AVAILABLE FOR DISTRIBUTION

REGULAR BULLETINS

1888. Vol. I, No. 2. The Experiment Station: Building and Laboratories. Germination of Seed Corn. Analyses of Commercial Fertilizers.

No. 3. Weeds of the Farm.

1889. Vol. II, No. 1. Notes on Fertilizers and Fertilizing Materials.

No. 4. Grasses of Mountain Meadows and Deer Parks. Chemical Composition and Tests of Varieties of Strawberries.

1891. Vol. IV, No. 3. The True Bugs, or Heteroptera, of Tennessee.

No. 5. A Chemical Study of the Cotton Plant.

1892. Vol. V, No. 1. Fruit Trees and Experiments with Vegetables.

No. 4. Experiments with Fruit Trees and Vegetables.

1897. Vol. X, No. 2. Pot Culture of Lettuce.

No. 3. The Soils of Tennessee.

No. 4. Scale Insects: San Jose and Other Species.

1898. Vol. XI, No. 2, 3 and 4. Grasses and Forage Plants of the South.

1902. Vol. XV, No. 2. The Action of Copper on Leaves.

1905. Vol. XVIII, No. 1. Texas Fever Cattle Tick: Pasture Methods of Eradication.

No. 3. I. Alsike Clover; II. Ill Effects Sometimes Produced on Horses and Mules Pastured Exclusively upon Alsike.

No. 4. The Control of Insects, Fungi and Other Pests.

1906. No. 75. Selection for Disease-resistant Clover: A Preliminary Report.

No. 76. The San Jose and Other Injurious Scale Insects of Tennessee with Methods for Their Control.

No. 78. The Soils of Tennessee: Their Chemical Composition and Fertilizer Requirements.

1908. No. 79. The Relation of Steer Feeding to Farm Economics.

No. 80. Home-grown Rations in Economical Production of Milk and Butter.

No. 81. Tick Eradication: The Life-history and Habits of the North American Fever Tick with Special Reference to Eradication.

No. 82. The Soy Bean: A Comparison with the Cowpea.

SPECIAL BULLETINS

1889. B. Analyses of Commercial Fertilizers.

1890. C. Treatment of Certain Fungous Diseases of Plants.

E. The Cotton Worm. The Hessian Fly.

PRESS BULLETINS

1900. No. 14. Grades on Country Roads.

No. 19. Formulas for Spraying Mixtures.

1906. No. 20. Cattle Tick Extermination: Feed-lot and Pasture Rotation Methods.

1907. No. 21. Preparation of Land for Alfalfa.

No. 22. Importance of Testing and Keeping Records of Dairy Cows.

1908. No. 23. How to Save the Soy-bean Crop.

TREASURER'S REPORT

HATCH FUND

JULY 1, 1907 TO JUNE 30, 1908.

The Agricultural Experiment Station of the University of Tennessee

IN ACCOUNT WITH THE UNITED STATES

		Dr.	Cr.
To unexpended balance on hand July 1st		$ 18.34	
To United States Treasury Draft	July 8, 1907	3750.00	
" " " " "	October 10, 1907	3750.00	
" " " " "	January 11, 1908	3750.00	
	April 6, 1908	3750.00	
By Salaries			$8,580.00
Labor			2,408.76
Publications			498.81
Postage and Stationery			312.14
Freight and Express			97.50
Heat, Light and Water			371.58
Chemical Supplies			179.08
Seeds, Plants and Sundry Supplies			183.47
Fertilizers			39.81
Feeding Stuffs			1,361.64
Library			198.42
Tools, Implements and Machinery			7.60
Furniture and Fixtures			244.75
Scientific Apparatus			51.20
Traveling Expenses			75.80
Contingent Expenses			15.00
Building and Repairs			374.44
Balance			18.34
Totals		$15,018.34	$15,018.34

This is to certify, that, as the authorized Auditing Committee of the Board of Trustees of the University of Tennessee, we have examined the accounts of the Treasurer of the Agricultural Experiment Station for the fiscal year ending June 30, 1908, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than $374.44 was expended for building and repairs; and that there is $18.34 cash balance.

C. DEADERICK,
WM. RULE,
Auditing Committee.

We hereby certify that C. Deaderick and Wm. Rule are the authorized Auditing Committee of the Board of Trustees of the University of Tennessee.

BROWN AYRES, *President.*
WM. RULE, *Secretary.*

STATE OF TENNESSEE, COUNTY OF KNOX:

Before me, Thos. D. Morris, a Notary Public in and for said State and County, personally appeared the foregoing signers, personally known to me to be trustees and officers of the University of Tennessee, who made oath, in due form of law, that the above statements are true to the best of their knowledge, information and belief.

Witness my hand and official seal at office in Knoxville, Tennessee, this 21st day of November, 1908.

THOS. D. MORRIS,
Notary Public.

TREASURER'S REPORT

ADAMS FUND

JULY 1, 1907 TO JUNE 30, 1908.

The Agricultural Experiment Station of the University of Tennessee

IN ACCOUNT WITH THE UNITED STATES

		Dr.	*Cr*
To United States Treasury Draft	July 8, 1907	$2250.00	
" " " " "	Oct. 10, 1907	2250.00	
" " " " "	Jan. 10, 1908	2250.00	
" " " " "	Apr. 9, 1908	2250.00	
By Salaries			$6,020 00
Labor			680.16
Postage and Stationery			13.90
Freight and Express			201.72
Heat, Light and Water			90.84
Chemical Supplies			190.34
Seeds, Plants and Sundry Supplies			221 62
Library			245.14
Tools, Implements and Machinery			25.87
Furniture and Fixtures			43.22
Scientific Apparatus			1,037.72
Traveling Expenses			167.71
Building and Repairs			61.76
Balance			
Totals		$9,000.00	$9,000.00

This is to certify, that, as the authorized Auditing Committee of the Board of Trustees of the University of Tennessee, we have examined the accounts of the Treasurer of the Agricultural Experiment Station for the fiscal year ending June 30, 1908, and find them correct; that the above is a true balance sheet corresponding with said accounts; that the said accounts show no more than $61.76 was expended for building and repairs, and that there is no cash balance.

C. DEADERICK,
WM. RULE,
Auditing Committee.

We hereby certify that C. Deaderick and Wm. Rule are the authorized Auditing Committee of the Board of Trustees of the University of Tennessee.

BROWN AYRES, *President.*
WM. RULE, *Secretary.*

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