PROGRESS

of

AGRICULTURAL RESEARCH

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74TH AND 75TH ANNUAL REPORTS

OF THE

TENNESSEE AGRICULTURAL EXPERIMENT STATION

THE UNIVERSITY OF TENNESSEE

KNOXVILLE

THE UNIVERSITY OF TENNESSEE
KNOXVILLE
OFFICE OF THE PRESIDENT

To His Excellency, Frank Clement
Governor of Tennessee

SIR:

I have the honor of transmitting, herewith, on behalf of the Board of Trustees of the University of Tennessee, a report on the work and expenditures of the Agricultural Experiment Station for the years 1961 and 1962.

The years covered by this report are those during which the nation's Land Grant Colleges and Universities celebrated the 100th anniversary of the signing of the Morrill Act, which provided for the establishment of this system of higher education. Particular attention is given to relating the work of the Station to this Centennial Celebration.

This report is submitted in accordance with the law requiring that such a report be submitted by the Agricultural Experiment Station to the Governor of the State.

Respectfully submitted,

Andrew D. Holt
President

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AGRICULTURAL KNOWLEDGE ABOUT TENNESSEE GROWS OVER 100-YEAR PERIOD

IN 1862, a young Sweetwater, Tennessee wife wrote to her soldier-husband at the Siege of Vicksburg that she was carrying on the farm work as best she could. She told how she cultivated the corn crop using the equipment and power of the day—herself, a crippled mare, and the double-shovel plow. She probably walked 115 miles planting, tending, and harvesting each acre of that corn.

In that same year, President Abraham Lincoln signed into law a bill creating a system of higher education called land-grant colleges and universities. The University of Tennessee is such a university.

This educational system was to change dramatically the face of agriculture in Tennessee and in the nation. Human power and horse power would be replaced by machine power. Low yields of poor-quality crops would disappear to be replaced by tripled yields of good-quality crops. Poor-quality livestock would be succeeded by animals bred to fit specific needs of the marketplace.

This law that President Lincoln signed was the Morrill Act. The colleges and universities that it made possible had a chief mandate to teach agriculture and the mechanic arts. Until that time, American colleges and universities had been training young men largely for four professions—law, clergy, medicine and teaching.

After the passage of the Morrill Act, sons of the nation's farmers could learn more about agriculture and how to apply existing knowledge in solving problems of farming. Most of the nation's population lived on farms and a large portion of the national effort was going to produce food and fiber.

Soon, however, the early professors of agriculture found that existing knowledge about agriculture was scant. They had to have facts to teach their agricultural students. Being curious and conscientious, they began to seek new facts.

Their first efforts, often carried on without funds or adequate facilities and in addition to their assigned tasks, were the beginning of agricultural research.

Tennessee can be proud that its leaders of those days recognized the value of this experimentation to find new facts. In 1882, research in agriculture was officially begun without aid of an endowment, making the Tennessee station one of the first five agricultural experiment stations in the United States. Early work at the Tennessee station dealt with field experiments with wheat and feeding experiments with animals.

Hatch Act Boosted Research

Interest in agricultural research grew quickly and in 1887, Congress passed the Hatch Act, creating a system of agricultural experiment stations in each state. The law stated:

"*That in order to aid in the acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agriculture, and to promote scientific investigation and experiments respecting the principles and applications of agricultural science*, there shall be established, under direction of the college or colleges or agricultural departments of colleges in State or Territory established, or which may hereafter be established, in accordance with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled 'an act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts' or any of the

supplements to the said act, *a department to be known and designated as an 'agricultural experiment station.'*"

Upon the passage of the Hatch Act by Congress, the Tennessee Agricultural Experiment Station was reorganized and the president of the University became the director of the station. Three other professors and the director formed the staff, which received an appropriation of $15,000 a year to conduct its work.

In April of the next year, 1888, the Station issued its first report. It is interesting to note what the report had to say about the Station:

"The Station is a bureau of information for farmers and every Tennessee citizen interested in developing our agricultural industries or resources has a right to apply for assistance . . . object of the station is the promotion of agricultural interests of Tennessee, by practical and scientific experimentation and investigation . . . the station will undertake work if results promise to promote the course of agricultural progress, to prove of interest to the public and be free for publication."

This early statement of purpose still holds true for the Agricultural Experiment Sation.

With the boost it received from the passage of the Hatch Act, the Station began to expand its work. In 1890 the 100-acre College of Agriculture farm was turned over to the Experiment Station for research purposes.

The State of Tennessee recognized the importance of agricultural research when the legislature made its first direct appropriation to the Station in 1903. Forty more acres of land were purchased.

Need Seen for Branch Stations

Early work was located at Knoxville near the University, but it began to become apparent that research was needed in the differing farming areas of the state. Interest in creating branch experiment stations developed and the West Tennessee Experiment Station at Jackson was established in 1907.

This action was followed by the setting up of additional branch stations and field stations until in 1962 there were 11 such research units located throughout the state.

The face of Tennessee has undergone many changes since those first agricultural professors began their "spare time" research work. Highways, cities, industrial complexes, recreational areas, and river developments have all had their effect on the lives of Tennessee farmers and their families. Not the least of the changes, however, have been those directly affecting the operation of Tennessee farms.

Huge financial investments in land, buildings and equipment, complicated marketing procedures, diverse disease and insect control methods, intricate farm machinery, interdependent soil and crop management practices—all are common features of today's agriculture.

The University of Tennessee Agricultural Experiment Station is seeking ways to apply the knowledge already available to solve some of these problems of Tennessee agriculture as it goes about its $500 million annual business.

But what will be problems of agriculture 10 years from now, 20 years from now, of 50 years from now?

Today's knowledge will probably not answer these questions of the future. The Tennessee Agricultural Experiment Station feels an obligation to look ahead and to use its resources to seek new knowledge, perhaps unneeded today, but vital to tomorrow.

Material Contained in this Report

In the following pages, examples are presented illustrating progress in agricultural research at the University of Tennessee Agricultural Experiment Station as it seeks today, as in 1888, to be "a bureau of information for farmers and every Tennessee citizen interested in developing our agricultural industries or resources . . . through the promotion of agricultural interests of Tennessee, by practical and scientific investigation and experimentation."

In addition to these reports are listings of the following information:

(1) Research projects active as of December 31, 1962;

(2) Research projects terminated during the calendar year 1961;

(3) Research projects terminated during the calendar year 1962;

(4) Bulletins, articles, and reports prepared by Experiment Station staff members and published during the calendar years 1961 and 1962.

In addition, this report contains the financial statements for the Agricultural Experiment Station covering the periods July 1, 1960 to June 30, 1961 and July 1, 1961 to June 30, 1962. Also included is a list of the Experiment Station personnel for the two calendar years, 1960 and 1961.

CENTENNIAL PLOTS

THE University of Tennessee took part in the celebration of the centennial of the signing of the Morrill Act in a number of ways. One of these activities was carried out by the Agricultural Experiment Station.

In order to focus attention on the progress made in the production of food, feed and fiber crops over the past 100 years, the Station set up some "live" field exhibits.

These exhibits were labeled "Centennial Plots" and were set up at Knoxville, Greeneville, Springfield, and Jackson in 1961 and continued through 1962. Station staff members worked out an extensive program using corn, small grain, hay, pasture, strawberries, tobacco, cotton, and soybeans to show the results from crop production practices of 100 years ago, 50 years ago, and today. The plots were demonstrational in nature, although yield records were kept on each for informal comparisons.

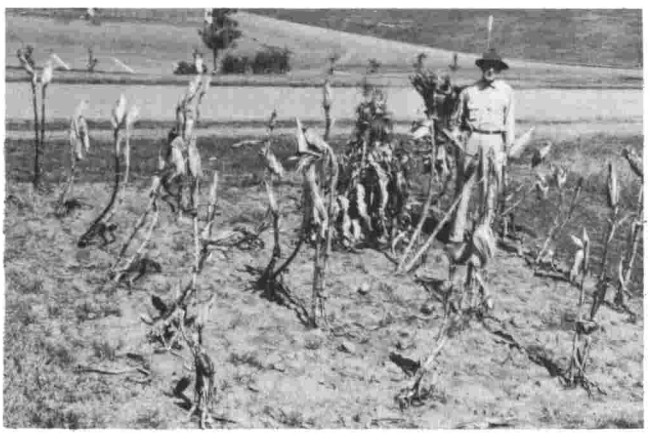
At Main Station

At Knoxville, the plots showed progress in the production of corn, small grain, hay, pasture and strawberries, emphasizing changes in varieties, fertilization, cultivation and harvesting practices.

On corn, for instance, when 1861 practices were followed, yield was 30 bushels per acre. The farmer probably walked 115 miles in producing 1 acre.

With 1911 practices, yield was about 35 bushels per acre. The farmer probably walked 35 miles to produce 1 acre at that time.

With 1961 methods, yield was about 148 bushels per acre. The farmer did not walk any to produce this acre.



CORN PRODUCTION—1861

Land Preparation: "Bull-tongue" or single-stock plow. Two ways

Variety: Ordinary crib corn.

Fertilizer: None

Spacing & Population: 4 ft. x 4 ft. check-row with 2 plants/hill—5,445 per A.

Planting Method: Furrow two ways and hand drop.

Cultivation: "Bull-tongue" two ways & "hill-up" with hoe.

Harvesting Method: Hand strip fodder and top. Snap ears by hand.

Yield: 30 bu. per A.

Miles Walked Per Acre:	115.5
Miles Walked Per Bu.:	3.85
Cost Per Bu.:	$0.48
Man Hours Per Bu.:	5.04

CORN PRODUCTION—1961

Land Preparation: Two-bottom tractor plow.

Variety: Dixie 29 (Tenn. hybrid)

Fertilizer: 500 lbs. 6-12-12 per A., 300 lbs. ammonium nitrate per A.

Spacing and Population: 10 in. in 3½ ft. rows—15,682 plants per A.

Planting Method: Two-row planter with fertilizer attachment.

Cultivation: None—pre-emergence herbicide.

Harvesting Method: Corn picker.

Yield: 147.8 bu. per A.

Miles Walked Per Acre:	None
Miles Walked Per Bu.:	None
Cost Per Bu.:	$0.245
Man Hours Per Bu.:	.046 or 2.72 minutes

At the Tobacco Experiment Station at Greeneville, in East Tennessee, Lockwood tobacco, a pre-World War I variety used for chewing and pipe smoking, was grown side by side with Burley 21, a modern cigarette variety. Lockwood was fertilized with only 150 pounds per acre of 16% "acid" phosphate fertilizer while Burley 21 was fertilized with an adequate, balanced fertilization program and treated with approved insecticides.

At Greeneville

At the Tobacco Experiment Station at Greeneville, the plots showed changes in production of corn and burley tobacco. The corn plots here, as at other locations, showed what can be accomplished by using an adapted hybrid, fertilizing it properly, and spacing the plants closer together to take advantage of the greater yield potential of the hybrid at high fertility levels.

The burley tobacco plots showed progress made in breeding for resistance to such diseases as black root rot, mosaic, wildfire and black shank.

At Springfield

The Centennial Plots at the Highland Rim Experiment Station at Springfield were the most complete of all. The crop comparisons here included both dark-fired and burley tobaccos, corn, wheat, oats, alfalfa, red clover and other hay and pasture mixtures.

In the demonstration of the dark-fired tobacco in 1961, the Madole variety fertilized the old way—400 pounds of cottonseed meal, 300 pounds of 16% phosphate and 100 pounds of sulfate of potash—with plants spaced 3½ feet apart in rows also spaced 3½ feet apart, produced 1,610 pounds of leaf with a gross value of $660 per acre.

The same variety with plants spaced 2½ feet apart in 3½ foot rows, fertilized at a rate of 120-90-180 N-P_2O_5-K_2O pounds per acre produced 2,430 pounds of leaf with a gross value of $1,020 per acre.

One of the most striking demonstrations at Springfield was the one with corn. In 1961, the old open pollinated variety Hickory King, unfertilized and with plants spaced far apart, produced 66.2 bushels per acre. A plot of the hybrid Dixie 29 planted along side with plants spaced much closer together and fertilized according to soil test produced 130 bushels per acre. Additional proof that this was no happenstance was provided in 1962 when the Hickory King plot produced 42 bushels per acre and the Dixie 29 plot, 101 bushels.

CORN ON CENTENNIAL PLOTS 10-12-61
H.R.E.S., SPRINGFIELD, TENNESSEE

Plot 23 (left)
Hickory King ..... 66.2 bu./acre

Plot 24 (right)
Dixie 29 ..... 130.5 bu./acre

Difference in yield due to variety, plant population, and fertilization.

This corn demonstration plot at the West Tennessee Experiment Station was part of the Land Grant College Centennial Demonstration conducted in 1962. Those who attended the West Tennessee Farmers and Homemakers Institutes at Jackson saw the corn in the background that was grown with modern corn production techniques: proper spacing of corn plants resulting from the right planting rate, modern chemical weed control, and proper fertilization. The elaborate Centennial demonstration at Jackson also included cotton and soybeans.

At West Tennessee

The Centennial Plots at the West Tennessee Experiment Station at Jackson involved comparisons with corn, cotton and soybeans. With corn the comparisons were among Hickory King and Neal's Paymaster—open-pollinated varieties of 50 to 100 years ago—and Dixie 29, a modern hybrid. Spacing of plants, fertilization, and cultivation practices were those followed at these three periods of time.

For example, weeds and grasses were controlled with a turning plow on the two "old" corn varieties while a chemical was used for weed control on the modern hybrid. Despite later unfavorable moisture conditions, this plot produced 82 bushels of corn per acre, compared with yields of 48 bushels for Hickory King and 53 bushels for Neal's Paymaster.

The cotton demonstration showed the improvements that have been made in variety, fertilization, and cultivation. The variety of 100 years ago was a tall, late, leafy variety of the Acala type; the variety of 50 years ago was Half and Half, while Stardel was used to represent the varieties of today.

In the soybean demonstration, the old Mammoth Yellow variety was compared with modern varieties, Ogden and Hood.

These demonstrations were labeled with appropriate signs and they were visited by a large number of people, individually and in groups. At each of the summer field days held at the four locations, wagon tours stopped at the Centennial Plots and a staff member explained their significance and the significance of the land-grant system. Field days in both 1961 and 1962 made use of these plots.

Centennial Address Featured

In addition to the Centennial plots, 1961 field days at the Spring Hill, Greeneville, Crossville, and Springfield stations featured an address by Dr. Webster Pendergrass, Dean of the College of Agriculture. Dean Pendergrass explained the land-grant system and how it has contributed to the development of the nation's agriculture through teaching, research, and extension activities.

At the 1961 Knoxville station field day, called the East Tennessee Farmers' Convention, a major portion of the morning program was given over to a panel discussion of "100 Years With the Land-Grant Colleges."

During this session, individuals who had been associated with Tennessee agriculture over the last 50 years told about problems facing Tennessee farmers in the production of corn and hay and how they had sought to solve these problems. Based on this historical setting, current Experiment Station and Extension staff members reported what is known today about the production of these crops.

The Centennial Plots at the four locations, plus the special emphasis on several summer field day programs, enabled the Agricultural Experiment Station to bring the Land-Grant Centennial to the attention of a large number of farmers, agricultural industry representatives, and the general public during 1961 and 1962.

BUDGETS, PROJECTS AND PUBLICATIONS

1961

The United States Appropriations under the Hatch Act Amended and Non-Federal Funds

Receipts	1960-61 Hatch	Non-Federal Funds
From United States Treasurer	$891,980.00	
From Other Sources		$1,286,779.61
Personal Services	$802,297.14	$ 505,004.27
Travel	16,177.72	31,073.96
Equipment	21,701.80	127,591.72
Lands and Structures		119,690.87
Personnel Benefits		113,687.44
Supplies and Materials	43,358.75	244,178.54
All Other Expenses (Contractual)	8,444.59	145,552.81
Total Expenditures	$891,980.00	$1,286,779.61

1962

The United States Appropriations under the Hatch Act Amended and Non-Federal Funds

Receipts	1961-62 Hatch	Non-Federal Funds
From United States Treasurer	$971,494.00	
From Other Sources		$1,531,917.18
Personal Services	$858,371.81	$ 618,519.14
Travel	4,874.02	44,176.02
Equipment	55,293.81	132,071.56
Lands and Structures		75,080.23
Personnel Benefits		128,981.89
Supplies and Materials	35,992.48	314,246.09
All Other Expenses (Contractual)	16,961.88	218,842.25
Total Expenditures	$971,494.00	$1,531,917.18

Projects

As of December 31, 1961, there were 124 Hatch projects and 18 active State projects. As of December 31, 1962, there were 115 active Hatch projects and 22 active State projects.

There were 9 active U-T—AEC projects both years.

During 1961, 18 projects were terminated while 16 projects were terminated in 1962. Reports on these projects have either been published or are being prepared for publication.

Hatch projects are supported in part with Federal-Grant funds made available by Congress to the Agricultural Experiment Stations of the country under the Hatch Act Amended. State projects are supported entirely by University funds.

Many of the projects involving studies of soils, crops, and livestock may include experimental work at one or more of the sub-stations as well as at the Main Station in Knoxville.

The headquarters of the Tennessee Agricultural Experiment Station is located on the agricultural campus of the University of Tennessee at Knoxville. The UT-AEC Agricultural Research Laboratory is located some 20 miles distant at Oak Ridge, Tennessee. In addition, there are six branch stations and five field stations which represent soil and climatic conditions in the major regions of Tennessee. These research centers are shown on the map on the back cover.

Publications

A total of 138 technical, semi-technical and popular articles were prepared by staff members and published in 1961. In 1962, 147 such articles were prepared and published.

In addition to various professional, technical and popular type publications, published reports on research of the Tennessee Agricultural Experiment Station appear as Station Bulletins and as articles in Tennessee Farm and Home Science. There were 14 Station Bulletins published during 1961 and 25 articles appeared in four issues of Farm and Home Science. During 1962, 26 Station Bulletins were published and 41 research articles appeared in Farm and Home Science.

For copies of the Bulletins, write the Editor, Agricultural Experiment Station, Knoxville. Copies of articles published in various journals and periodicals may sometimes be obtained by writing directly to the author.

DEPARTMENTAL RESEARCH ACTIVITIES

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

FARMERS have made many adjustments to meet changing farm operating conditions over the past 100 years. Capital requirements per farm have increased as one man has been able to handle more land and other materials and as machine power and equipment have been substituted for horse-drawn equipment.

As capital investments have increased, so has the amount of credit farmers use in order to continue farming in the most profitable way. In fact, for the farmer who uses credit, correct knowledge about loans, interest rates and credit sources is just as much a part of farm management today as the correct practices used in producing crops and livestock.

A survey of 500 farmers in the state by the Department of Agricultural Economics showed that farmers in Tennessee lack dependable knowledge concerning the names, locations and ownership of existing credit sources as well as the types of loans and interest rates for each.

Factors found associated with increased knowledge of farm credit by farmers were: higher formal education; the farther west the residence (in moving across the state by the three grand divisions), the greater volume of sales from the farm; and increasing age of the farmer.

Factors found having little relation to the knowledge were tenure, type of farm (crops or livestock), and extent of off-farm income.

Furthermore, higher knowledge ratings were found for: borrowers as compared to non-borrowers; farmers who had been lenders as compared to non-lenders; and farmers who had given consideration recently to using more credit as compared to those who had not.

The study also revealed some of the areas of credit information where farmers needed more knowledge in order to make the most advantageous management decisions. Included were information on interest rates being paid, sources of lower interest rates than they were paying and how to calculate interest rates.

About two-fifths of the farmers surveyed were currently users of credit, while over two-fifths had not obtained a loan for any purpose during the past 3 years. Considering all farmers, there was an average outstanding indebtedness of $823. Those farmers with current loans had an average loan of $1,905.

The various major credit sources held the following percentage of outstanding credit: commercial banks, 34.9%; individuals, 25.2%; Federal Land Bank, 19.7%; Farmers Home Administration, 7.2%; Production Credit Association, 5.6%; and insurance companies, 4.4%.

The knowledge of farmers borrowing from the Federal Land Bank, Farmers Home Administration, Production Credit Association and insurance companies was substantially higher than the average score of all farmers.

Factors found associated with the amount of credit used were: more knowledge about credit sources—more borrowed; greater volume of sales from the farm—more borrowed; in comparing the owner-operator to the tenant and sharecropper—less borrowed; in comparing borrowing experience of farmers by residence from West to Middle to East Tennessee—the less borrowed; and the older the farmer—the less borrowed.

Factors having little effect on amount borrowed were formal education, percent of farm income from crop sales, and percent of income from off-farm work.

Proj. No.	Research Project Titles
4	Farmers' Capital Needs and Problems of Capital Acquisition.
5	Farming Adjustments in Tennessee with Emphasis on Economics of Conservation Farming; cooperative with the U. S. Department of Agriculture.
6	Impact of Industrialization Upon Tennessee Agriculture.
12	Type and Breed as Factors Influencing Beef Carcasss Characteristics and Consumer Acceptance; cooperative with the Animal Husbandry-Veterinary Science Department and the U. S. Department of Agriculture.
16	Marketing and Utilizing Low-Quality Hardwoods.
22	An Economic Study of Feed and Forage Production and Use on Beef and Dairy Farms in Specified Areas of Tennessee.
23	Buying Policies and Other Practices in the Tennessee Vegetable Industry; cooperative with the Horticulture Department (contributing to Regional Proj. SM-8).
156	Fluid Milk Supplies, Prices, and Movement in the Lower Mississippi River Valley Marketing Area (contributing to Regional Proj. SM-10).
159	Level-of-Living Adjustment of Rural Households in Tennessee (contributing to Regional Proj. S-44).
175	Analysis of Movement of Livestock (Slaughter Hogs, Cattle and Calves) and Meat (Pork, Beef, and Veal) in Tennessee (contributing to Regional Proj. SM-23).
179	An Economic Appraisal of Farming Adjustment Opportunities in Selected Areas of Tennessee to meet Changing Conditions; cooperative with TVA and the U. S. Department of Agriculture (contributing to Regional Proj. S-42).
189	Market Potential for Frozen Broilers in Tennessee; cooperative with the U. S. Department of Agriculture (contributing to Regional Proj. SM-15).
190	Vertical Integration in the Marketing of Livestock in Tennessee.
191	Alternative Cotton Marketing Practices and Systems for Increased Efficiency in Channels of Trade (contributing to Regional Proj. SM-24).
192	Transportation of Grain and Grain Products in Tennessee (contributing to Regional Proj. SM-11).
195	Changing Patterns of Milk and Milk Product Consumption in Tennessee.
196	Capital Formation and Growth of Farm Supply Firms in Tennessee.
197	Demand for Floricultural Products.
205	An Economic Appraisal of Agricultural Credit Used By Tennessee Farmers.
206	Cost-Return Ratios in Farming in Tennessee.
State 11	Changes in the Attitudes, Knowledge, and Practices of Farmers Participating in a UT-TVA Trial-Acre Program; cooperative with TVA.
State 15	Impact of Mechanization on Costs and Returns in Cotton Production; cooperative with the Agricultural Engineering, Agronomy, and Entomology Departments.
State 19	Impact of the Interstate Highway System on Movement of Farm Products Important to Tennessee Agriculture.

Projects Concluded in 1961

11	Economics of Marketing Milk in Tennessee; cooperative with the U. S. Department of Agriculture.
13	A Study of the Marketing Methods of the Horticultural Specialty Industry in Tennessee; cooperative with the Horticulture Department (contributing to Regional Proj. SM-12).
17	A Study of Comparative Prices Paid Producers for Milk of Manufacturing Grade in Tennessee and the Midwest; cooperative with the U. S. Department of Agriculture.
19	Financial Management and Related Problems Affecting the Success of Tennessee Cooperatives.
24	Expansion of Demand for Horticultural Specialties; cooperative with the Horticulture Department.

Projects Concluded in 1962

Proj. No.	Research Project Titles
4	Farmers' Capital Needs and Problems of Capital Acquisition.
5	Farming Adjustments in Tennessee with Emphasis on Economics of Conservation Farming; cooperative with the U. S. Department of Agriculture.
22	An Economic Study of Feed and Forage Production and Use on Beef and Dairy Farms in Specified Areas of Tennessee.
189	Market Potential for Frozen Broilers in Tennessee; cooperative with the U. S. Department of Agriculture (contributing to Regional Proj. S-42).
190	Vertical Integration in the Marketing of Livestock in Tennessee.

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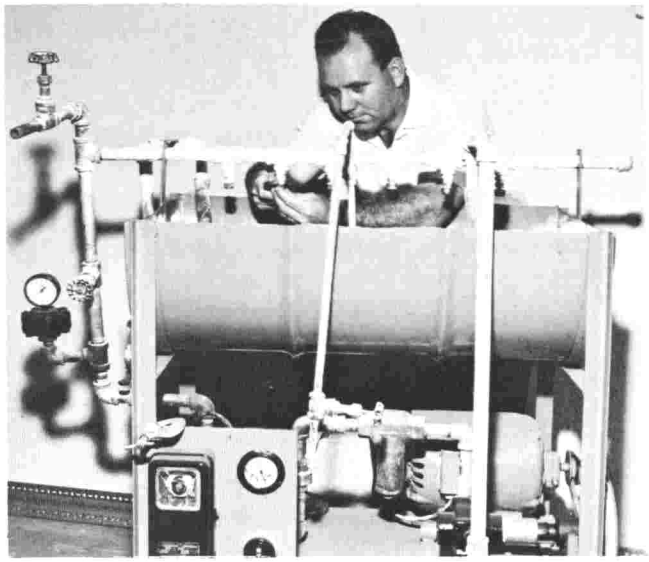
AGRICULTURAL ENGINEERING

HIGH production per man with labor-saving cost-cutting equipment has brought about a better way for all. Mechanization has helped bring this about in the past 100 years, both in the factory and on the farm. The modern-day farmer can no longer afford to use his labor for a machine's—if the machine can do the job. Man can only produce about 1/8-horsepower—worth only about 3 cents a day—when compared with the cost of electric power.

Electricity and machines can perform most of the jobs around the farmstead on the modern farm: pump the water, milk the cows, feed the livestock, move the grain or other products, perform the household chores, and do hundreds of other jobs. In 1862, men and women performed each and every one of these same jobs by the brawn of their muscles and the sweat of their brows.

In the same period, the average farm worker would use only 1 or 2 horses or mules in the field at one time. Their speed was 2 or 2½ miles per hour. Today's farmer, to be average, must drive a 50 to 60 horsepower tractor and travel at speeds up to 15 miles per hour, depending upon the job he is performing. Controlling weeds, cutting hay, or picking cotton: the present-day farmer can do all by machine.



Wear Tests on Sprayer Nozzles: A laboratory model of an agricultural field sprayer was used to study the abrasive effects of wettable powder herbicides on sprayer nozzle tips. Results proved the value of using hardened stainless steel as compared with the usual soft brass for spray tips.

Even with each farmer now producing enough food and fiber for himself and 25 other people, farm mechanization has not been completed. Agricultural engineers are at work to

reduce labor and power requirements even more.

The constant introduction of new herbicides requires that agricultural engineers adapt machinery to apply them. Developing improved weed control equipment is one aim of current research work in the Department of Agricultural Engineering. Abrasive herbicides are being studied in order to determine the best materials for nozzles, pumps, and other critical sprayer parts.

Brass has been the agricultural sprayer metal for many years. However, if a farmer expects a reasonable amount of service from his sprayer while using abrasive materials, he must use sprayer parts of stainless steel, nylon, or some other appropriate material. These and other materials are being tested.

New granular weed and insect killers pose other problems in machinery design. These pesticides must be applied at the correct rate and right place. Application at too low a rate will give poor control, while too high a rate will cause the farmer unneeded expense. Agricultural engineers are working to develop machines that will give satisfactory results in these and other respects.

What machinery did the Tennessee farmer have 100 years ago for controlling weeds and insects? Mostly the hoe; chemicals were scarce and used only in limited amounts, if at all.

Today's farming methods, without improvement, will not satisfy tomorrow's needs. The farmer today would be just as amazed to see how his descendants will be farming 100 years from now as his 1862 ancestors would be if they visited him today.

Proj. No.		Research Project Titles
Hatch	26	Food Processing Machinery Development.
Hatch	32	Chemical Weed Control; cooperative with the Agronomy and Horticulture Departments.
Hatch	172	Housing for Chicks; cooperative with the Poultry Department.
Hatch	202	Electrical Properties of Cotton Fiber; cooperative with the Physics Department.
Hatch	204	Factors Affecting Water Yields from Small Watersheds in Tennessee; cooperative with the Agronomy, Geology, and UT-AEC Departments, TVA, and Soil Conservation Service (contributing to Regional Proj. S-53).
State	7	Electric Treatment of Plant Materials; cooperative with the Agronomy, Food Technology, Home Economics Research—Nutrition, and Textiles and Clothing Departments, and the U. S. Department of Agriculture.
State	15	Impact of Mechanization on Costs and Returns in Cotton Production; cooperative with the Agricultural Economics and Rural Sociology, Agronomy, and Entomology Departments.
State	22	Effect of Structural Characteristics of Vertical Silos and Silo Equipment on Maintenance Costs, Silage Quality, and Milk Production; cooperative with the Dairy Department and the National Silo Association.
State	25	Land Forming for Drainage and Furrow Irrigation; cooperative with the Soil Conservation Service.

Projects Concluded in 1961

Proj. No.		Research Project Titles
State	6	Mechanical Handling of Silage.
Hatch	27	Drying and Handling Forage Crops for Hay and Silage.

Projects Concluded in 1962

Proj. No.		Research Project Titles
Hatch	169	Storage and Management of Water for Irrigation.

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AGRONOMY

DURING the past 100 years, there have been many crop production changes in Tennessee. The oat crop is a good example for illustration.

Acreage of oats harvested for grain has had several ups and downs in the past 100 years in Tennessee. Acreage reached a high of 590,000 acres in 1889, then dropped to a low point of 77,000 acres in 1935 as automobiles replaced carriage horses. But the development of new improved varieties brought about an expansion in acreage—to a peak of 248,000 acres harvested in 1956.

Oat grain yields held steady to the late 1930's and then climbed about 50%. Better management practices and improved varieties of fall-sown oats have been largely responsible for the higher yields of recent years. About 80% of the Tennessee oat acreage is now sown in the fall, compared to about 20% 40 years ago.

Before 1900, the predominant oat varieties in Tennessee were Red Rustproof and Burt types. Fulghum, a pure line selection from Red Rustproof, came into the picture about 1900 and gradually replaced the older varieties. It had fairly stiff straw and was earlier and taller than Red Rustproof, but lacked winterhardiness.

In the early 1900's University of Tennessee scientists began an oat improvement program which dealt mainly with pure line selections and variety testing. As the trend shifted from spring to fall seeding, the oat breeders saw the need to develop winterhardy varieties. In 1930, several hundred head selections were made from the Fulghum variety from which three promising winterhardy ones were released as Tennex, Fulwin, and Forkedeer. Forkedeer replaced Fulghum and is still a popular variety with Tennessee growers.

With the coming of combine harvesting, oat breeders selected for more lodging resistance. LeConte, of hybrid origin, was released in 1949. It has very good straw strength and is almost as winterhardy as Forkedeer.

The Blount variety was released in 1960. It has short, stiff straw, a high yielding potential and good winterhardiness. Blount performs especially well on productive soils and under conditions of high fertilization, and is becoming widely accepted by Tennessee growers.

The development of oat varieties with superior forage and grazing qualities is now being emphasized in oat breeding work in the Department of Agronomy. Such varieties should be winterhardy and have intermediate to upright habit of growth to provide additional forage for grazing. Also, they should have resistance to crown rust to reduce the hazards of rust infection in the fall of the year. A high level of rust resistance from wild species, *Avena strigosa*, is currently being transferred to some of our adapted varieties.

Develop Oat Varieties: **LeConte (at left) and Blount are two oat varieties developed and released by the University of Tennessee Agricultural Experiment Station in the last 15 years. Both have good straw strength and possess good winter-hardiness. Blount performs especially well on productive soils and under conditions of high fertilization.**

Proj. No.	Research Project Titles
Hatch 28	Moisture Sorption Characteristics of the Major Soils of Tennessee and the Relation of Moisture Tensions to Plant Growth and Fertilizer Utilization; cooperative with TVA and the U. S. Department of Agriculture (contributing to Regional Proj. S-24).
Hatch 32	Chemical Weed Control; cooperative with the Agricultural Engineering and Horticulture Departments.

Hatch 33 Evaluation of the Performance of Varieties of Field Crops.

Hatch 34 Corn Improvement; cooperative with the Entomology Department and the U. S. Department of Agriculture.

Hatch 37 Production of Burley Tobacco; cooperative with the U. S. Department of Agriculture.

Hatch 38 The Comparative Value and Relative Efficiency of Various Phosphate Fertilizers Under Different Soil and Cropping Conditions; cooperative with TVA.

Hatch 39 Improvement of Cultivated Grasses.

Hatch 42 Potassium Fertilization of Farm Crops on Different Soil Series in Tennessee.

Hatch 45 Movement and Persistence of Herbicides in the Soil (contributing to Regional Proj. S-18).

Hatch 47 Establishment and Maintenance of Turf.

Hatch 48 Soil Survey of Tennessee to Help Determine Crop Adaptations and Management Requirements; cooperative with TVA and the U. S. Department of Agriculture.

Hatch 49 Determination of Residues from Certain Pesticides When Applied for the Normal and Experimental Control of Insects and Diseases of Fruits and Forage Crops in Tennessee; cooperative with the Entomology Department (contributing to Regional Proj. S-22).

Hatch 51 Root Development of Farm Crops as Related to the Physical and Chemical Characteristics of the Soil; cooperative with TVA.

Hatch 55 The Influence of Chemical, Physical, and Mineralogical Properties of Soils on Nutrient Availability and Plant Growth; cooperative with the U. S. Department of Agriculture (contributing to Regional Proj. S-14).

Hatch 56 Trace Elements in Tennessee Agricultural Crops.

Hatch 75 Breeding and Genetics of Crimson Clover.

Hatch 77 Breeding and Genetics of Lespedezas.

Hatch 78 Use of Ionizing Radiation in Crop Improvement; coop. with the UT-AEC Agric. Res. Lab.

Hatch 79 Production and Improvement of Cotton Varieties Suitable to Tennessee Conditions; cooperative with the U. S. Department of Agriculture.

Hatch 80 Oat Breeding.

Hatch 81 Barley Breeding.

Hatch 136 Breeding for Improvement in Wheat Varieties to include resistance to Disease, Hessian Fly, and Changes in Morphological Characters; cooperative with the Entomology and Plant Pathology Departments and the U. S. Department of Agriculture.

Hatch 163 Culture of Dark Tobacco.

Hatch 164 Nitrogen Fertilization of Farm Crops.

Hatch 183 Crop Response to Liming.

Hatch 184 Effects of Environmental Factors on Ladino Clover and Orchardgrass Persistence (contributing to Regional Proj. S-47).

Hatch 186 Forage Crops Management: Establishment, Persistence, and Productivity.

Hatch 208 Breeding for Improvement in Small Grains (wheat, oats, barley and rye); cooperative with the Entomology and Plant Pathology Departments and the U. S. Department of Agriculture.

State 7 Electric Treatment of Plant Materials; cooperative with the Agricultural Engineering, Food Technology, Home Economics Research—Nutrition and Textiles and Clothing Departments, and the U. S. Department of Agriculture.

State 9 Land Reclamation.

State 13 Changes in Attitudes, Knowledge, and Practices of Farmers Participating in a UT-TVA Trial-Acre Program; cooperative with TVA.

State 15 Impact of Mechanization on Costs and Returns in Cotton Production; cooperative with the Agricultural Economics and Rural Sociology, Agricultural Engineering, and Entomology Departments.

State 57 Evaluation of New Plants; cooperative with the Horticulture Department.

Projects Concluded in 1962

Proj. No.	Research Project Titles
Hatch 51	Root Development of Farm Crops as Related to the Physical and Chemical Characteristics of the Soil; cooperative with TVA.
Hatch 80	Oat Breeding.
Hatch 81	Barley Breeding.
Hatch 136	Breeding for Improvement in Wheat Varieties to Include Resistance to Disease, Hessian Fly, and Changes in Morphological Characters; cooperative with Entomology and Plant Pathology Departments and the U. S. Department of Agriculture.
State 13	Changes in Attitudes, Knowledge, and Practices of Farmers Participating in a UT-TVA Trial-Acre Program; cooperative with TVA.

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ANIMAL HUSBANDRY-VETERINARY SCIENCE

LIVESTOCK production 100 years ago in Tennessee was much less efficient than today.

Emphasis now is on "producability," "cutability," and "eatability"—on a fast-gaining, early-maturing meat animal that yields a handyweight carcass with maximum consumer acceptability. Roughages—grass, pasture, hay and silage—and other home-grown feeds play a major part in the growing and finishing of this modern meat animal.

Scientists in the Department of Animal Husbandry-Veterinary Science are looking for ways to make more efficient use of forages through meat animals. Improved breeding, better rations, and more efficient feeding methods offer ways of increasing the efficiency of forage use.

Research projects dealing with forage use

sometimes have two parts—first, feeding trials and then digestion trials, using artificial rumens, to further pinpoint the value of a forage. For instance, liquids from a steer's stomach were used in a waterbath apparatus to learn why feeding alfalfa to beef steers resulted in 10% to 16% faster gains with less feed than did feeding orchardgrass hay. The laboratory and metabolism tests showed that the alfalfa hay contained more digestible protein than did the orchardgrass hay. They further revealed that the good alfalfa hay supported more microbial action in the rumen, thus enabling the animal to use the alfalfa more efficiently than the orchardgrass.

Other tests have been made to learn more about the factors affecting the activity of these rumen bacteria. In one such test, it was learned that dicalcium phosphates increased bacterial activity—and breakdown of the feed in the rumen—more than did some defluorinated phosphates.

Feedlot experiments with beef cattle have pointed out the importance of silages for economical and profitable production of beef cattle in Tennessee. Further information from research about silage and other roughages should assist beef cattle producers to continue the development of their enterprises.

Proj. No.	Research Project Titles
Hatch 12	Type and Breed as Factors Influencing Beef Carcass Characteristics and Consumer Acceptance; cooperative with the Department of Agricultural Economics and Rural Sociology and the U. S. Department of Agriculture.
Hatch 50	The Effects of Certain Atmospheric Effluents Upon the Growth and Composition of Plants, and Upon Animal Life, at Locales in East and Central Tennessee.
Hatch 52	The Evaluation of Different Pasture Species in Various Combinations and at Varying Rates of Nitrogen Fertilization as Reflected in Beef Cattle Gains and Forage Yields.
Hatch 58	Studies of Endocrine Relationships in Farm Animals—Swine.
Hatch 60	Studies of Endocrine Relationships in Farm Animals—Beef Cattle.
Hatch 61	The Improvement of the Producing Ability of Beef Cattle; cooperative with the U. S. Department of Agriculture (contributing to Regional Proj. S-10).

Paper By-Product for Bedding: **Straw, hay, and shavings were compared with barkwool as bedding material for livestock in one research project. Barkwool is a by-product of pulpwood that is used in the papermaking industry.**

Hatch 63	Mineral Metabolism in Animals: I. Absorption, Distribution, and Physiological Behavior of Calcium and Phosphorus in Farm Animals; cooperative with the UT-AEC Agric. Res. Lab.
Hatch 65	The Detection of Animals Heterozygous for Recessive Bovine Dwarfism; cooperative with the U. S. Department of Agriculture.
Hatch 66	The Effects of Radiation on Reproductive Physiology in Farm Animals; cooperative with the UT-AEC Agric. Res. Lab.
Hatch 67	Ripening of Beef from Cattle Produced Under Different Feeding Methods as Related to B-Vitamin Content; cooperative with Home Economics.
Hatch 68	Carcass Value Investigations with Beef.
Hatch 69	Expanded Study and Evaluation of Diagnostic Measures in *Vibrio Fetus* Infection of Cattle and Sheep (contributing to Regional Proj. S-30).
Hatch 70	Evaluation of the Adaptability of Existing Breeds and Commercial Types of Sheep for the Production of Early Milk Fat Lambs (contributing to Regional Proj. S-29).
Hatch 71	Factors Affecting Feed Utilization by Ruminants.
Hatch 72	Evaluation of Roughages for Beef Cattle.
Hatch 73	The Improvement of the Producing Ability of Swine Through Performance Testing and Breeding Methods.

Hatch	74	Evaluation of Control Measures Against Anaplasmosis; cooperative with the U. S. Department of Agriculture and Tenn. Department of Agriculture.
Hatch	176	Performance of Growing-Finishing Swine on Concrete and Pasture.
State	2	Swine Testing
State	3	Effects of Fluorine Levels of Soil and Water on Grazing Cattle Under Different Systems of Management.
State	20	Evaluation of Methods of Producing Beef.

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DAIRY

PRODUCTION of milk has always been important to the Tennessee farmer and his family. One hundred years ago, he may have kept a few cows to provide his family with milk and dairy products. But today, dairying is a multi-million dollar enterprise, both in investment and in production.

Research at the University of Tennessee is aimed at helping the dairyman make wiser and more profitable management decisions than he could have made 100 years ago before land-grant college research was established. An example of this research in the Department of Dairy follows.

The main objective in growing dairy heifers is to develop high-producing cows. For many decades, it has been suspected that a heifer's growth period could affect her milk production potential, but it was hard to prove because nearly every cow has a different inherent ability to produce milk.

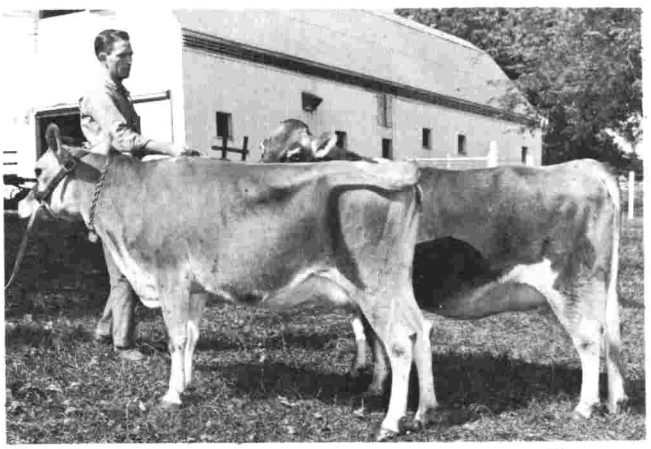
By using identical twins, the inherited lactation potential could be kept equal. Then the production of heifers grown at different rates would show the effect of growth rate.

Such growth studies have been completed by the dairy department, using identical twin dairy heifers.

In the first study, one heifer of each pair of twins was allowed to eat all of the grain she wanted before first calving. These heifers grew fast and fat. However, during their first lactation period, they produced only 85% as much as their leaner mates that had been raised on good roughage feeds. Both were fed adequately and alike in the lactation period.

The study showed that heifers could be fed too well for development of lactation potential. Also, at the end of the second lactation most of the early fattened heifers had poorly-developed udders.

In a second study, one of each pair of twin heifers was again fed normally on good hay alone after 10 to 12 months of age and her mate was restricted in hay intake to about two-thirds



Use Identical Twins in Dairy Experiments: **This pair of identical twin Jerseys at first calving is typical of seven pairs used to compare fast fattening growth with leaner "normal growth." They differed 237 pounds in weight, but the leaner heifers outmilked the fat ones.**

that of normal. The underfed animals weighed only 78% as much as their mates at calving time. Two of the eight underfed heifers were lost from the experiment due to calving difficulties.

The research showed that underfeeding during growth depressed lactation. The average yield of six such twins has been 87% that of the normals. The value of the milk difference would more than pay for the extra roughage needed for normal growth.

These experiments indicate that there is an optimum, moderate rate of growth for the development of good milking ability.

Proj. No.	Research Project Titles
Hatch 88	Feeding Thyroidally Active Materials to Dairy Cows.
Hatch 89	The Effects of Processing and Handling Upon the Livability and Fertility of Bull Spermatozoa.
Hatch 92	Development of Strains of Purebred Jerseys Especially Adapted for High Milk Production Under Maximum Grazing and Forage Conditions; cooperative with U.S. Department of Agriculture (contributing to Regional Project S-49).

Hatch	93	Effect of Variations in Growth Rates and Feeding Practices During Growth of Dairy Heifers on Their Lactation Performance.
Hatch	150	Raising Dairy Calves.
Hatch	151	Importance of the Dry Period and Management of Dairy Cows During the Dry Period.
Hatch	161	Evaluation of Forages for Dairy Cattle.
Hatch	165	Quality and Shelf Life of Dairy Products in the Marketing Channels.
Hatch	198	Lactic Culture Evaluation.
Hatch	199	Absorption of Minerals in Relation to Gastrointestinal Tissue and Ingesta Characteristics in the Dairy Cow; cooperative with the UT-AEC Agric. Res. Lab.
Hatch	200	Effect of Processing Methods on Dairy Product Quality.
State	22	Effect of Structural Characteristics of Vertical Silos and Silo Equipment on Maintenance Costs, Silage Quality and Milk Production; cooperative with the Agricultural Engineering Department.
State	24	Feeding Levels During Lactation.

Projects Concluded in 1961

Proj. No.		Research Project Titles
Hatch	95	The Roles and Interrelationships of Sodium, Potassium, Calcium, and Phosphorus in Milk Secretion in the Dairy Cow; cooperative with the UT-AEC Agric. Res. Lab.
Hatch	180	Fission Product Distribution in Milk and Dairy Products; cooperative with the UT-AEC Agric. Res. Lab.

Projects Concluded in 1962

Proj. No.		Research Project Titles
State	6	Mechanical Handling of Silage; cooperative with the Agricultural Engineering and Animal Husbandry-Veterinary Science Departments.

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Effect of Growth Rate on Lactation. Feed Age 11(3):30-35, March, 1961.

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ENTOMOLOGY

INSECTS have pestered man since the beginning of time. However, the past 100 years has seen many advances in the constant battle to avoid personal nuisances and economic losses from insect pests.

About 100 years ago, or about the time President Lincoln signed the land-grant college act, the first great breakthrough in the insect battle took place. The Colorado potato beetle had spread eastward from the Rocky Mountains and was ravishing potatoes, a staple food crop. Probably a painter may have observed that where green house paint had been splattered on potato vines, the potato bugs were killed. Paris green, an arsenical compound used to color paint, began to be used to control insects attacking food plants. And so chemical insect control got its start.

The biggest breakthrough in insect control came in 1942 when a commercial firm announced the re-discovery of DDT. (World War II was the first major war in which more men died of firearms than of insect-borne diseases!) The introduction of phosphate and carbamate insectides has also helped keep man's chief earthly competitor under control. Much of today's work is studying how we can best use these wonder chemicals.

The alfalfa weevil, a relative newcomer in the state, did an estimated $1 million damage in Tennessee in 1962. Fall treatment with heptachlor impregnated on fertilizer has been found by the Department of Entomology to give effective control. This research is important to livestock producers as far west as Middle Tennessee, where the insect has been found recently.

Entomology research with control of cotton insects the past few years shows that insecticides need to be applied only eight times per season—if properly timed—and the cotton will make just about as a big a crop as with more frequent applications. Such knowledge can save cotton producers many dollars.

Study Control of Nursery Insects: Here is a peach tree borer in a section of a 2-year old peach tree. This insect is a serious pest in nurseries, and often damages over 50% of the trees.

Proj. No.	Research Project Titles
Hatch 34	Corn Improvement; cooperative with the Department of Agronomy and the U.S. Department of Agriculture.
Hatch 49	Determination of Residues from Certain Pesticides When Applied for Normal and Experimental Control of Insects and Diseases of Fruits and Forage Crops in Tennessee; cooperative with the Agronomy Department (contributing to Regional Proj. S-22).

Hatch	96	Biology and Control of Insects and Mites Attacking Forage Crops (contributing to Regional Proj. S-25).
Hatch	98	Life History, Ecology, and Control of Major Cotton Insects.
Hatch	136	Breeding for Improvement in Wheat Varieties to Include Resistance to Disease, Hessian Fly, and Changes in Morphological Characters; cooperative with the Botany and Plant Pathology Departments and the U.S. Department of Agriculture.
Hatch	203	Control of Insects Attacking Nursery Plants.
State	15	Impact of Mechanization on Costs and Returns in Cotton Production; cooperative with the Agricultural Economics and Rural Sociology, Agricultural Engineering, and Agronomy Departments.
State	21	Evaluation of New Insecticides.

Projects Concluded in 1961

Proj. No.	Research Project Titles
Hatch 97	A Study of the Life History, Ecology, and Control of Army Worms, *Pseudaletia Unipuncta,* and Related Species (contributing to Regional Proj. S-25).
Hatch 101	A Study of the Life History and Control of the Strawberry Leaf Roller, *Ancylis Comptana,* and Some Related Aspects of Strawberry Insect Control.

Projects Concluded in 1962

Proj. No.	Research Project Titles
Hatch 99	Studies on Soil Insecticides with Special Reference to the Control of the Elongate Flea Beetle, *Systena Elongata.*
Hatch 100	Evaluation of New Insecticides.

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Controlling Cotton Insects. Tenn. Farm & Home Sci. Rep. 38, June, 1961.

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FOOD TECHNOLOGY

A few of the more than 5,000-odd food items sold in a modern supermarket are fresh, but most of them are processed: canned, waxed, dried, frozen, bottled, pickled, packaged, wrapped, baked or changed in one way or another. Contrast this with the "cracker barrel" bulk handling in general stores of 50 to 100 years ago.

Freezing preservation of foods, a development of the past 30 years, showed phenomenal growth during and after World War II. Freezing, along with canning, was responsible for this remarkable change from fresh bulk handling of foods to the processed packaged product.

The following example illustrates how the Department of Food Technology has contributed to knowledge about frozen foods.

Bacteria known as enterococci occur commonly in the intestinal tract of man and animals. And bacteriologists commonly believe that they are found only there. Recently, sev-

eral investigators reported that they commonly occur in frozen foods, suggesting human pollution.

However, studies conducted at the University of Tennessee show that these organisms occur naturally on many plants, and that they can enter the food with the raw product. Thus, the human health significance of the enterococci, or group D streptococci, becomes questionable.

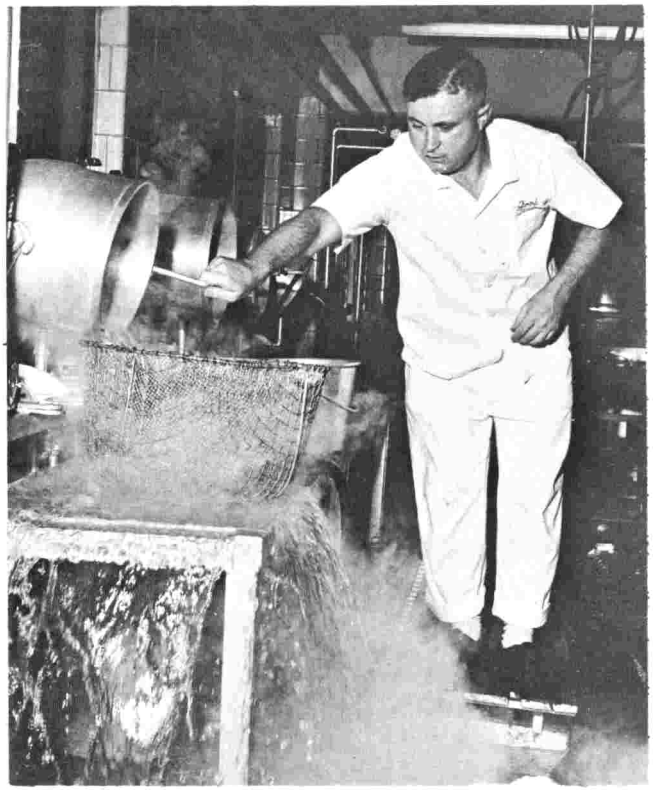
About 24% of the 2,850 separate samples of plants and soil examined were found to contain enterococci. These bacteria were found much less frequently on buds than on flowers. The enterococci were found on flowers in agricultural areas more often than on flowers in non-agricultural areas. Their occurrence in or on soils was correlated (71%) with their occurrence on plants growing on or next to the soil sampled. They were recovered from about 65% of the wild animals studied.

These distribution studies of the group D enterococci in nature are contributing to an understanding of their public health significance when found in frozen foods.

Proj. No.	Research Project Titles
Hatch 173	Group D Streptococci Isolated from Plants.
Hatch 177	Flavonoid Pigments and Their Degradation in Processed Fruit and Vegetable Products.
Hatch 193	Improving Firmness of Frozen Vegetables.
State 7	Electric Treatment of Plant Materials; cooperative with the Agricultural Engineering, Agronomy, and Home Economics Research—Nutrition, and Textiles and Clothing Departments, and the U. S. Dept. of Agriculture.
State 83	Preservation of Fruits and Vegetables by Freezing.

Projects Concluded in 1961

Hatch 83	Preserving of Fruits and Vegetables by Freezing.
Hatch 86	Quality of Frozen Green Snap Beans as Affected by Methods of Transportation, Processing, Duration and Temperature of Storage; cooperative with the Department of Bacteriology.



Conduct Water Blanching Studies: **Research work is conducted in the Food Technology Department's laboratory or pilot plant in order to learn the correct time and temperature for water blanching the following crops: Snap and lima beans, field peas, okra, and green peppers. The blanched vegetables are frozen and stored, then evaluated for quality.**

Projects Concluded in 1962

Proj. No.	Research Project Titles
Hatch 173	Group D Streptococci Isolated from Plants.

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McCarty, I. E., and W. E. Goble
Quality Grading of Strawberries. Tenn. Farm and Home Sci. Prog. Rep. 37, March, 1961.

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FORESTRY

THE 19th century Tennessee farmer usually looked upon the forest land as an obstacle to his progress. The trees had to be cut down to make way for farmsteads, for roads, for settlements.

Today, about one-half of Tennessee is still in woodland. But instead of an obstacle to progress, this woodland offers a great potential for future development. Forest products are of great importance to the state.

The Department of Forestry is concerned with studies that will help increase efficiency in the use of the woodland area. The effort to bring back the chestnut tree to the state's forests is an example of the work underway.

History books are rich in accounts of the flourishing stands of American chestnuts that once covered large areas of Tennessee. American chestnut was an important source of timber for construction purposes, a source of tannins and dyes, and supplied food for humans as well as wildlife.

After chestnut blight was introduced from abroad in 1904, native chestnut proved to be a very susceptible host and virtually all of the native chestnuts were killed by the blight. The loss has been great because no other tree has been found to replace the American chestnut. Asiatic chestnut trees have been planted, but produce no valuable timber and the nuts lack the delicate sweetness which oldtimers still remember.

It has been demonstrated in other species that variation exists among individual trees with regard to various characteristics, such as frost hardiness, time of flowering and disease resistance. One phase of the chestnut breeding program is to search out surviving individual chestnut trees in Tennessee and western North Carolina with the idea in mind that some blight-resistant trees may be found.

To date, 13 trees have been selected which appear to possess some degree of resistance. One of the larger trees selected is shown here. Scions from the selected trees will be grafted on Asiatic chestnut seedlings and exposed to further tests in order to better evaluate their resistance to the blight. When the grafted trees are flowering, crosses will be made and selection begun for resistant trees among the progeny.

Another phase of the chestnut breeding program is the irradiation of American chestnut seed in the hope of obtaining mutations which will give blight-resistance in the resulting trees.

Some 300 native chestnut trees, grown from seed irradiated in 1958, are outplanted at Oak Ridge. These trees are undergoing selection by being exposed to natural contact with the chestnut blight. Several thousand more seedlings are now ready to be outplanted and subjected to natural selection.

Research to Re-establish the American Chestnut: This surviving American chestnut was located by the Forestry Department. It is 63 inches in diameter. The dashed line indicates the extent of the live crown.

Proj. No.	Research Project Titles
Hatch 102	Forest Management.
Hatch 103	A Study of Tree Species Adapted to the Different Forest Regions of Tennessee.
Hatch 106	Forest Tree Breeding.
Hatch 107	Relationship of Soil and Other Site Factors to Forest Composition and Productivity.
Hatch 185	Forest Tree Genetics (contributing to Regional Proj. S-23).
Hatch 207	Forest Tree Fertilization.
State 8	Wood Preservation.
State 12	Fertilization of Shade Trees on Lawns; cooperative with the Horticulture Department.

Bulletins, Articles, and Reports—1961

Britt, R. T., J. A. Catlett, and Eyvind Thor
Marketing Christmas trees in the Knoxville area. Tenn. Farm and Home Sci. Prog. Rep. 39, p. 10, Sept., 1961.

Kring, J. S.
Summary of 1961 Post Inspection. 15th Annual Coordinated Wood Preservation Council, 1961.

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Thorbjornsen, Eyvind
Variation in Density and Fiber Length in Wood of Yellow Poplar. Tappi 44:192-195, 1961.

Thor, Eyvind
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American Chestnut Breeding Program at the University of Tennessee. Proc. 53rd Annual Meeting of Northern Nut Growers Assn., Aug., 1962.

Thor, Eyvind
Developing Trees with Better Pole Properties. Tennessee Valley Wood Pole Conf., pp. 3-11, Feb., 1962.

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Christmas Tree Production and Marketing in East Tennessee. Extension Circ. 598, March, 1962.

Thor, Eyvind, and S. J. Brown
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HOME ECONOMICS RESEARCH

PROCESSING from seed cotton to fabric 100 years ago was essentially the same as it is today. However, there were few—if any—mechanical devices for measuring fiber properties. It is doubtful that much attention was given to the blending of cottons, at least not scientifically.

Home economics scientists at the University of Tennessee are concerned about problems in the manufacturing and use of fabrics, just as they are concerned with questions dealing with child development, foods, home management, home equipment, family economics and nutrition. The work on cotton fabric processing is presented as one example of research in home economics.

Scientists have studied fiber properties and their effect on processing, yarn properties and fabric properties. But until recently it was difficult to do this kind of research with *selected* cotton types because of the expense involved in processing experimental fabrics in a commercial mill.

However, at the University of Tennessee, a miniature spinning, weaving, and finishing procedure for cotton has made it economically feasible to carry out these kinds of investigations with specially selected experimental cotton types. This could be helpful in evaluating new strains and varieties of cotton by providing information about the contribution of certain fiber properties to finished fabric performance.

Six cottons were processed by the U.S. Department of Agriculture Spinning Laboratory at Knoxville in cooperation with home economics researchers. Each cotton was spun and woven into plain weave fabric of muslin weight and bleached by a hydrogen peroxide process.

Reflectance tests were made to determine the increase in whiteness after bleaching. Results showed that the laboratory bleaching method produced a whiteness equal to that of commercial bleaching.

Breaking strength, elongation, tear strength and wrinkle recovery tests were made on the woven fabrics.

In these tests the six fabrics did not vary a great deal, indicating that physical differences which exist between cottons in the fiber state tend to diminish during the processing into fabric.

Child Development and Family Relations

Proj. No.	Research Project Titles
Hatch 158	Educational and Vocational Goals of Rural Youth in Tennessee (contributing to Regional Proj. S-48).

Bulletins, Articles, and Reports—1961

Holloway, Harold D.
Normative Data on the Children's Manifest Anxiety Scale at the Rural Third Grade Level. Child Dev. 32:129, 1961.

Weaving Experimental Fabrics: Amounts ranging from as little as 1 to 3 pounds of fiber from experimental strains and new varieties of cotton are now processed at the University of Tennessee. This is done in order to study properties of the fiber as related to its processing qualities and yarn and fabric characteristics. This research is made possible through specially-designed miniature spinning, weaving, and finishing machinery. The textiles research worker is weaving experimental cotton fabric on the loom.

Foods

Proj. No.	Research Project Titles
Hatch 67	Ripening of Beef from Cattle Produced Under Different Feeding Methods as Related to B-vitamin Content; cooperative with the Animal Husbandry-Veterinary Science Department.
Hatch 201	Effect of Preparation Procedures on Fatty Acids in Foods.

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Effect of Three Cooking Methods on Cesium-134 Content of Beef from Orally-Dosed Steers. Food Tech. 16:110, 1962.

Home Management, Equipment, and Family Economics

Proj. No.	Research Project Titles
Hatch 170	Decision-Making Factors in Consumer Buying of Dairy Products (contributing to Regional Proj. SM-13).

Projects Concluded in 1961

Proj. No.	Research Project Titles
Hatch 116	A Study of Procedures to Use with Washing Machines to Obtain Results Satisfactory to Families from the Standpoint of Cost and Soil Removal.

Nutrition

Proj. No.	Research Project Titles
Hatch 108	Measurement and Interpretation of Bone Density.
Hatch 110	Metabolism of Calcium, Phosphorus, and Magnesium in Preadolescent Children Fed Diets of Plant Origin (contributing to Regional Proj. S-28).
State 18	Mucopolysaccharides and Cellular Lipoproteins in Vitamin E Deficiency.

Bulletins, Articles, and Reports—1962

Mason, Rossie L., and Dorothy E. Williams
The Density of Some Bones of Cattle Fed Different Levels of Fluorine. Tenn. Farm and Home Sci. Prog. Rep. 44, Dec., 1962.

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Textiles and Clothing

Proj. No.	Research Project Titles
Hatch 113	The Effect of Selected Properties of Raw Cotton Upon Product Quality and Serviceability; cooperative with the U. S. Department of Agriculture (contributing to Regional Proj. SM-18).

Bulletins, Articles, and Reports—1961

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HORTICULTURE

FAMILIES have always tried to beautify the surroundings of their homes, even when the land was a wilderness. They combined beautification with the practical needs of privacy and protection through the use of trees and shrubs for hedges, screens, and windbreaks.

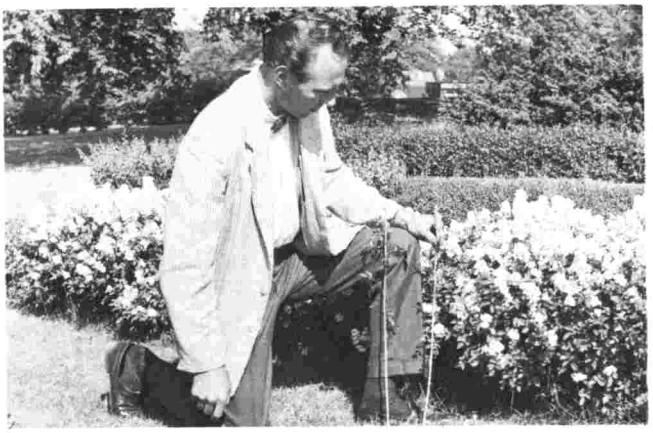
The need to use ornamental plants for privacy and protection is greater today with the exploding metropolitan housing developments. But lack of information on the selection and care of ornamentals has led to many failures and has discouraged home owners in the use of plants for functional purposes.

The Department of Horticulture is concerned with research on ornamental plants as well as fruits and vegetables. One project relates to the selection and care of plants for hedges, screens, and windbreaks. Preliminary results indicate that practices now commonly used for maintenance could be improved.

A new approach to pruning and maintaining the form of the plants was tried in this study. The plants were maintained in a shape somewhat like that of a pyramid but with a flat top line about one-half as wide as the base. During the growing season, the pruning height of the hedges was increased a few inches at each clipping to encourage development of new breaks and fresh foliage or flowering wood.

As a result of the study, a satisfactory pruning scheme has been developed for 22 species of shrubs. Although on the surface this system looks simple, actually it requires considerable care and timeliness.

When properly maintained, Abelia grandiflora proved to be one of the better hedge plants even though it is often considered to be inferior. Rose multiflora and Forsythia intermedia made beautiful hedges and bloomed profusely. Spiraea thunbergi made a fine textured hedge which grows 2 to 4 feet high and maintains a fresh green appearance all summer. Ligustrum japonicum outperformed any of the more common hedge privets. Some of the bush honeysuckles and privets thought of as good hedge plants were inferior in function and beauty or were difficult to maintain.



Research with Ornamental Plants: **The Horticulture Department tests many plant materials for value as hedge plants. This is Rosa multiflora maintained as a space divider. At this point it is 8 inches high and 8 inches wide. It is maintained as a hedge 1 foot in height except in its flowering season.**

Proj. No.	Research Project Titles
Hatch 23	Buying Policies and Other Practices in the Tennessee Vegetable Industry; cooperative with the Agricultural Economics and Rural Sociology Department (contributing to Regional Proj. SM-8).

Hatch 32 Chemical Weed Control; cooperative with the Agricultural Engineering and Agronomy Departments.

Hatch 117 Screening Pear Seedlings for Fireblight Resistance.

Hatch 118 A Comparative Study of Inheritance in the Cultivated Raspberry With Reference to Certain Diseases and to Fruiting Habits.

Hatch 119 Breeding and Selection of Blackberries, Including Dewberries.

Hatch 123 Mineral Nutrition of Vegetable Crops.

Hatch 125 Mineral Nutrition of Fruit Crops.

Hatch 126 Vegetable Variety Investigations.

Hatch 127 Fruit Variety Investigations.

Hatch 128 Propagation of Fruit and Ornamental Plants.

Hatch 154 Kind and Variety Investigations of Ornamentals.

Hatch 157 Management and Evaluation of Plants for Hedges, Screens, and Windbreaks.

Hatch 167 Breeding Tomatoes for Tennessee Markets With Emphasis on Earliness and Disease Resistance; cooperative with the Plant Pathology Department.

Hatch 174 Breeding Strawberries for Tennessee Markets with Emphasis on Climatic Adaptability and Disease Resistance; cooperative with the Plant Pathology Department.

Hatch 187 Storage and Handling of Evergreen Nursery Stock.

State 12 Fertilization of Shade Trees on Lawns; cooperative with the Forestry Department.

State 16 Development of Lima Beans Having Specific Seed Coat Colors.

State 17 Effect of Pruning Cut on Development of Shoots and Spurs of Apples.

State 57 Evaluation of New Plants; cooperative with the Agronomy Department.

Projects Concluded in 1961

Hatch 13 A Study of the Marketing Methods of the Horticultural Specialty Industry in Tennessee; cooperative with the Agricultural Economics and Rural Sociology Department (contributing to Regional Proj. SM-12).

Hatch 24 Expansion of Demand for Horticultural Specialties; cooperative with the Agricultural Economics and Rural Sociology Department.

Hatch 121 Inheritance in Garden Beans With Reference to Resistance to Mexican Bean Beetle and Other Insects, Nematodes, Diseases, Southern Adaptation, and Commercial Quality.

Projects Concluded in 1962

Hatch 118 A Comparative Study of Inheritance in the Cultivated Raspberry With Reference to Certain Diseases and to Fruiting Habits.

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Roever, W. E.
A Review Of The Work Of The Tennessee Agricultural Experiment Station In Horticulture For 1960. 55th Proc. of the Tenn. State Hort. Soc., 1961.

Swingle, H. D.
Sweet Potato Variety Study. Tenn. Farm and Home Sci. Prog. Rep. 37, March 1961.

van de Werken, H., J. S. Alexander, T. R. Gilmore, P. H. Parham, B. S. Pickett, W. E. Roever, and R. B. Thompson. Tennessee Progress Report On Research Of Interest To Nurserymen. 5th Annual Rep. on Ornamental Research, So. Nurserymen's Assn., Feb. 1961.

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Tomato Varieties for West Tennessee. Tenn. Farm and Home Sci. Prog. Rep. 42, June 1962.

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PHYSICS

IN the last 100 years, the conversion of cotton fiber into finished fabrics has developed from a highly skilled craft of many small production units to a mechanized industry of fewer large units.

It has been recognized throughout the years that certain properties are needed to provide strength in the twisted strand of cotton fibers that make up a yarn. Several of these properties have been studied by the Department of Physics in the Agricultural Experiment Station.

Fiber length is one such property and has been used in the market as a factor for determining price. Although the exact relationship of fiber length to yarn quality is not known, the price differential is strong evidence of its importance.

Until an instrument, called the fibrograph, was developed at the University of Tennessee, measuring the fiber length depended upon the art of evaluating the cotton by the unaided senses of the cotton classifier. Although these senses can become highly developed, they do not provide the precision and speed needed in the large mills of today.

Current investigations by the Station are largely concerned with factors that affect the accuracy of the fibrograph. For example, fibers are known to have tapered ends and to be crimped. The effect that these and other characteristics have on the accuracy of the fibrograph are now being tested.

Developing Cotton Fiber Testing Machines: This Physics Department laboratory worker is brushing a pair of cotton samples on the Digital Fibrograph. The samples were taken with the Fibro-sampler shown in the foreground.

Proj. No.	Research Project Titles
Hatch 131	Development of New and the Improvement of Existing Instruments and Techniques for Measuring Properties of Cotton (contributing to Regional Proj. S-1).
Hatch 188	Measurement of Standard Cotton Fiber Properties.

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Hertel, K. L.
Patents Pose Problems for International Textile Committee. The Magazine of Standards, 32(2):49-50, Feb. 1961.

Hertel, K. L.
Cotton Fibers: How Short is Short? Textile Industries, 126(6):105-7-9, June 1961.

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PLANT PATHOLOGY

PLANT diseases have caused some dark moments in history. Just over 100 years ago, between 1845 and 1860, Ireland lost almost a third of its population because of an outbreak of late blight in potatoes. A million people died from starvation or from disease following malnutrition.

Late blight is said to have been a contributing cause of Germany's defeat in World War I; one year about a third of Germany's potato crop was lost. Rice disease in Japan and coffee tree disease in Ceylon resulted either in starvation or great changes in the agricultural economies of the countries.

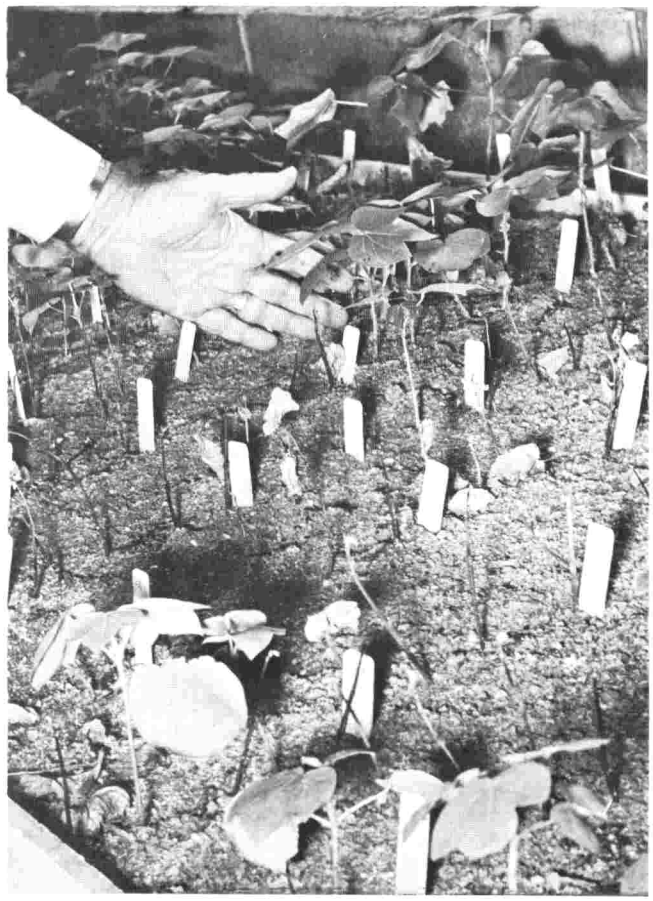
Cotton has long been Tennessee's leading cash crop, and the yields per acre have been quite high, partly because it is relatively free from disease. One exception is verticillium wilt. In some years, losses in yield and in lowered quality of the lint from badly-infected plants are heavy.

In the alluvial lands of the Mississippi River bottoms trouble appeared many years ago. At first the disease was thought to be fusarium wilt, the only wilt then recognized in cotton there. However, the symptoms were not quite typical. Specimens were studied in the laboratory, cultures of the diseased tissue made, and the fungus *Verticillium albo-atrum* identified, showing that the disease was verticillium wilt and not fusarium wilt. However, both diseases may be present in the same field.

The disease was most prevalent in cool, rainy seasons and all common cotton varieties were susceptible. Inspection of cotton grown in the heavily-infested land in Lake County showed striking variations in disease symptoms among individual plants. But no consistently resistant lines were found.

Therefore, seeds of a common variety (DPL-15) were subjected to gamma radiation at 10, 20, and 30KR (kilo-roentgens*) in order to induce mutations. Enough seeds were treated to plant about 0.5 acre. Selfing the progenies for two successive generations produced about 6,000 seeds. These were screened by treating greenhouse seedlings with a virulent culture of *Verticillium albo-atrum*.

*A kilo-roentgen is 1,000 roentgens; a chest X-ray involves about 0.5 to 5 roentgens.



Aim Toward Disease-Resistant Cotton: **These cotton seedings are showing resistance to *Verticillium albo-atrum*. The soil is heavily infested with the fungus and most of the plants have been killed. Seed from the survivors will be used in later experiments.**

About 200 plants survived. They are now being further screened. So far, 80 plants have been kept for further screening under field conditions where disease should be widespread. While greenhouse tests have showed most of these lines to be highly resistant, results from field tests must be evaluated before a disease-resistant variety can be developed.

Proj. No.	Research Project Titles
Hatch 132	Breeding Disease-Resistant Tobacco; cooperative with the U.S. Department of Agriculture.

Hatch 135 Control of Cotton Verticillium Wilt; cooperative with the UT-AEC Agric. Res. Lab.

Hatch 138 Biology and Control of Plant Parasitic Nematodes; cooperative with the U.S. Department of Agriculture (contributing to Regional Proj. S-19).

Hatch 139 Associations of Soil Microorganisms as Related to Plant Diseases (contributing to Regional Proj. S-26).

Hatch 140 Evaluating New Fungicides.

Hatch 167 Breeding Tomatoes for Tennessee Markets with Emphasis on Earliness and Disease Resistance; cooperative with the Horticulture Department.

Hatch 174 Breeding Strawberries for Tennessee Markets with Emphasis on Climatic Adaptability and Disease Resistance; cooperative with the Horticulture Department.

State 4 The Identification and Control of Strawberry Virus Diseases; cooperative with the Tennessee State Department of Agriculture.

State 23 Tobacco Diseases

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Lima Bean Stem Anthracnose. Tenn. Farm and Home Sci. Prog. Rep. 37, March 1961.

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Root-Knot Nematode Control in Tomato Transplants. Tenn. Farm and Home Sci. Prog. Rep. 40, Dec. 1961.

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Late Symptom Expression in Strawberry-Virus Indexing. Phytopathology 51:645, 1961.

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Chambers, A. Y., and J. O. Andes
Stem Anthracnose Control on Lima Beans. Tenn. Agric. Expt. Sta. Bul. 338, 1962.

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POULTRY

LESS than 25 years ago—to say nothing of a century ago—an enviable goal for a poultry farmer was to have fried "spring" chicken by the Fourth of July. Now, broilers or fryers are available every day of the year.

Increasing the growth rate of chickens through breeding, disease control, confinement rearing and better nutrition have been responsible for this dramatic change. Today's broilers carry more meat on their carcasses than did the spring chickens of 1940. They are ready for market in 8 weeks or less rather than in 12 to 14 weeks. They consume about half as much feed per pound of gain as did broilers just a generation ago.

Improved diets for broilers have helped bring about this great increase in efficiency. Studies aimed at improving broiler diets have been underway in the Poultry Department for some time. Some of these studies are reported here.

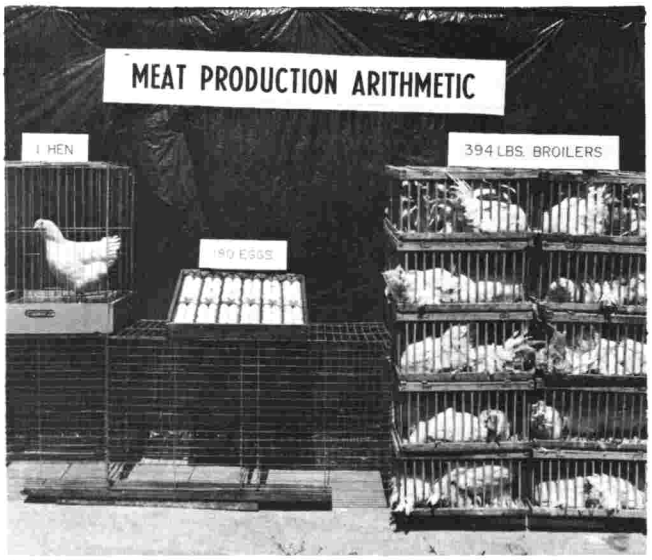
Feathers are a byproduct of the poultry processing industry. Hydrolyzed feather meal and lime processed feather meal were found to be equal in nutritive value. Feather meal was found to be a satisfactory feed ingredient in broiler diets when fed not in excess of 6.0% of the total diet.

The amount of yellow pigment deposited in and under the skin of broilers affects sales.

Poultry processors demand a well pigmented broiler. Consumers prefer the same.

A diet containing 10 milligrams of xanthophyll per pound of feed was found to produce desirable pigmentation in broilers when fed for the last 4 weeks prior to slaughter. Feeding of additional xanthophyll did not further build up the yellow pigment. Yellow corn, yellow corn gluten meal, and alfalfa meal were found to be satisfactory sources of xanthophyll.

Adding dienestrol diacetate, a hormone-like compound, to a broiler starter diet significantly increased the growth rate and finish at 6 weeks of age above those fed the diet without the compound.



Research Dividends from Poultry: One meat type hen can be responsible for producing 394 pounds of broilers during her 10 months of production. This is if she is fed diets such as those developed by Tennessee research workers and her chicks are fed diets containing 25% protein and 975 calories of production energy per pound of feed.

Proj. No.	Research Project Titles
Hatch 144	Influence of Environment on Performance of Hens.
Hatch 146	Amino Acid Supplementation of Hydrolyzed Poultry Feathers for Use in Poultry Feed.
Hatch 147	Relationship of Protein to Energy for Laying Hens.
Hatch 152	Radiation Effects on Growth of Broilers; cooperative with the UT-AEC Agric. Res. Lab. (contributing to Regional Proj. S-41).
Hatch 155	The Influence of Light Upon Performance of Domestic Chickens.
Hatch 160	Improving Diets for Broilers and Roasters.
Hatch 168	Effects of Restricting Feed Intake to Growing Pullets.
Hatch 172	Housing for Chicks; cooperative with the Department of Agricultural Engineering.
Hatch 178	Value of Various Grades of Grains for Poultry.
Hatch 182	Evaluation of Poultry Disease Medicants.
Hatch 194	Secondary Infections from Intestinal Bacterial Microflora.
State 1	Random Sample Testing of Chickens Available to Tennessee Poultrymen.

Projects Concluded in 1961

Hatch 141 Drugs in the Control of Internal Parasites of Poultry.

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UT-AEC AGRICULTURAL RESEARCH LABORATORY

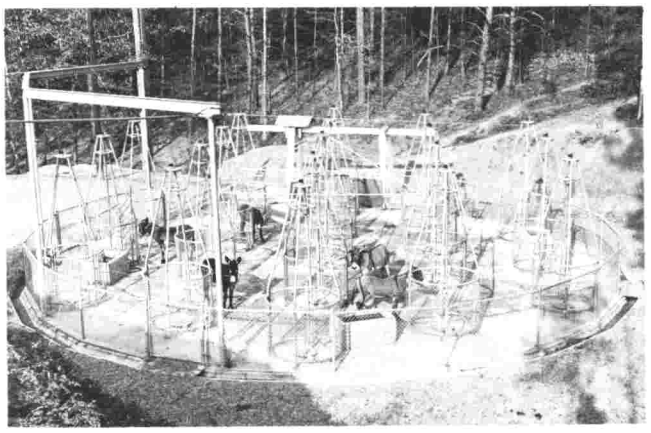
FARMERS and scientists of 100 years ago had not the slightest inkling that a force capable of destroying civilization would also be aiding agriculture today.

That force is atomic energy—first developed as a military weapon—but later put to use for peaceful purposes, too. Since 1948, the Agricultural Experiment Station has been working closely with the U.S. Atomic Energy Commission in the use of atomic radiation to learn more about plant and animal life. The UT-AEC Agricultural Research Laboratory is located at Oak Ridge.

Research at the laboratory is of a basic nature. Information gained may not have an immediate use but does add to the storehouse of knowledge that researchers of the future can call upon to solve problems of their day.

The radiation-physiology-reproduction project, for instance, is aimed at gaining a better understanding of the physiological processes involved in the development, growth, and fertility of animals. This information could help the farmer produce 100% calf crops—"a calf for every cow at market time."

By irradiating the entire bodies of pregnant cows, researchers have learned exactly when during the gestation period the various parts of the unborn animal develop. For instance, cows irradiated the fourth week of gestation had



A radiation field is used in studies to see how radiation affects the reproduction and physiology of farm animals, burros, and laboratory animals, and also to see whether different radiation dosages have both short-time and/or latent effects. Radiation effects are also studied according to rate and frequency of exposure, with these scheduled one time, weekly, or at other intervals. The 19 sources of radiation, all from cobalt-60, have been used with all large animals as well as the laboratory animals of rats, rabbits, and chickens. From 6 to 8 head of cattle and 20 hogs or sheep can be treated at once, depending upon the type of study being conducted.

calves with deformed feet and legs. Cows irradiated earlier than the fourth week or after the fifth week had normal-appearing calves.

With sheep, the observed period of fetal sensitivity to radiation damage was even shorter—about 3 to 4 days.

The researchers are also interested in the effects of radiation on the reproductive ability of the animal. Cattle, sheep, hogs, and burros have been subjected to radiation at various stages of their development, from the embryo to the adult. Contrary to some beliefs, radiation does not always cause sterility. Irradiated mature bulls recover fertility within 6 months after exposure. Cows have shown no evidence of lowered fertility even as long as 6 years after irradiation.

Bulls that received irradiation during their mother's gestation period have produced so few sperm that they are expected to be sterile. However, no evidence of lowered fertility or damage to reproductive organs has been detected in females receiving irradiation at this same time.

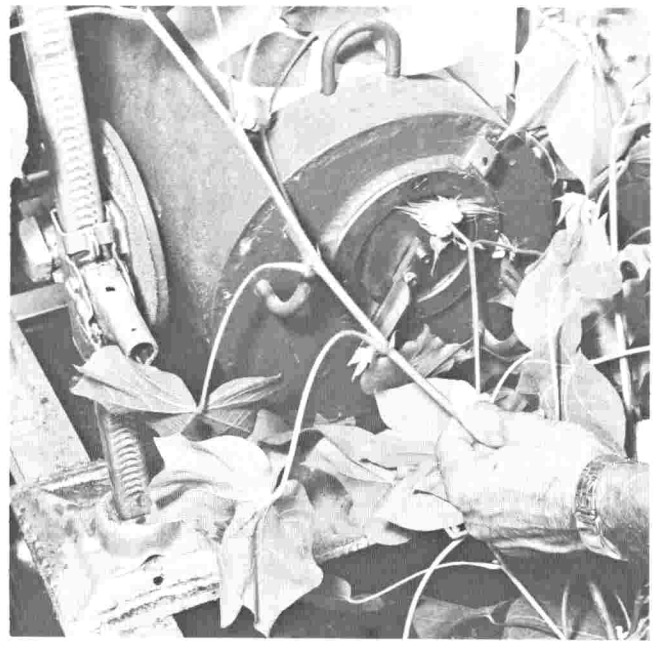
The radiobotany project is devoted mainly to obtaining information that will help make radiation a more productive and more repeatable breeding technique.

Mutations, or changes from normal growth characteristics, occur in nature very seldom: radiation can cause them to occur more often. Usually these changes are harmful, occasionally beneficial. It is often feasible to seek out and use that small fraction of desirable changes in economic plants.

Advanced generations from irradiated seeds of cotton, soybeans, and two forage grasses—fescue and orchardgrass—are now being grown on a field-scale. First generation American chestnut trees are approaching maturity and if enough escape the blight to produce an adequate supply of seeds, a second generation will be grown and tested for induced resistance.

These examples suggest how a new scientific discovery, atomic radiation, is being put to work to benefit the agriculture of Tennessee and of the Nation.

Proj. No.	Research Project Titles
UT-AEC 101a	Physiological and Clinical Effects of Radiation.
UT-AEC 101b	Physiology of Reproduction.
UT-AEC 101c	Radiation Pathology.



This portable gamma ray device is used at the University of Tennessee-AEC Agricultural Research Laboratory at Oak Ridge for irradiating cotton squares after fertilization in order to try to develop a new cotton variety. The new variety should have the desirable growth habits of the American upland and the long fibers of the Sea Island varieties. Bolls are irradiated in the one-celled stage for 11 or 12 minutes in front of this machine, which uses cobalt-60 as the source of irradiation. Of course the operator's hand is not in front of the machine during the irradiation process.

UT-AEC 102a	Fission Product Metabolism in Beef Cattle, Sheep, and Swine.
UT-AEC 102b	Fission Product Metabolism in Dairy Cattle.
UT-AEC 102c	Fission Product Metabolism in Poultry.
UT-AEC 102d	Fission Product Chemistry of Soils.
UT-AEC 102e	Biochemistry of Fission Product Elements.
UT-AEC 201	Plant Genetics

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HENRY ANDREWS, Assistant Professor
F. F. BELL, Professor
D. R. BOWMAN, Associate Professor[1]
E. W. COUNCE, Assistant Professor, Martin
R. L. DAVIS, Assistant Professor, Greeneville[1]
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D. M. ELKINS, Assistant in Agronomy
C. E. FREEMAN, Assistant in Agronomy
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SMITH WORLEY, JR., Associate Professor[1]

Animal Husbandry-Veterinary Science

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M. C. BELL, Associate Professor
C. R. BURGESS, Assistant in Animal Husbandry
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TERRY HOLDER, Farm Manager
H. M. JAMISON, Assistant in Animal Husbandry
E. R. LIDVALL, Associate Professor
J. B. MCLAREN, Assistant Professor, Grand Junction
G. C. MAYS, Assistant in Animal Husbandry
G. M. MERRIMAN, Professor
R. L. MURPHREE, Professor
R. A. REYNOLDS, Assistant Professor
C. B. RAMSEY, Assistant Professor
J. D. SMALLING, Assistant Professor
H. J. SMITH, Professor
R. S. TEMPLE, Professor[1]
B. L. WHITTENBURG, Assistant in Animal Husbandry, Spring Hill
J. N. WILLIAMS, II, Assistant in Animal Husbandry
B. B. WILSON, JR., Assistant in Animal Husbandry
G. R. WILSON, Assistant in Animal Husbandry

Dairy

J. T. MILES, Head of Department
H. D. BAXTER, Assistant Professor, Lewisburg[1]

B. J. BEARDEN, Assistant Professor, Spring Hill
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J. A. COLLINS, Assistant in Dairy Husbandry
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J. H. RANKIN, Assistant in Dairy Husbandry
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E. W. SWANSON, Professor
J. E. THIGPEN, Assistant in Dairy Husbandry

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KATHLEEN M. MCCOOK, Assistant in Foods

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Nutrition

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DOROTHY E. WILLIAMS, Professor

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SIGRID H. CHILDERS, Assistant Professor
JOYCE L. ARMSTRONG, Instructor

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D. D. BAIRD, Assistant in Horticulture
K. M. BATAL, Assistant in Horticulture
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C. B. LANDSTREET, Assistant Professor[1]
REBA LAWSON, Assistant in Physics[1]

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A. Y. CHAMBERS, Assistant Professor, Jackson
B. Y. ENDO, Associate Professor, Jackson[1]
J. M. EPPS, Associate Professor, Jackson[1]
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J. K. BLETNER, Associate Professor
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C. R. DOUGLAS, Assistant in Poultry
H. V. SHIRLEY, JR., Associate Professor
R. D. SIMPSON, Assistant in Poultry
H. A. STONE, Assistant in Poultry
R. L. TUGWELL, Professor

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C. G. ANDERSON, Assistant Professor[2]
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J. M. BIRD, Superintendent
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M. J. CONSTANTIN, Associate Professor
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D. F. JOHNSON, Professor
B. T. LADD, Assistant in Animal Husbandry
R. S. LOWREY, JR., Assistant Professor
A. O. LUNDEN, Assistant Professor
W. C. MAGRANE, Consultant
J. K. MILLER, Assistant Professor
F. R. MRAZ, Associate Professor
R. L. MURPHREE, Professor
T. S. OSBORNE, Associate Professor
W. C. PATRICK, Assistant to the Director
J. C. PEKAS, Assistant Professor
R. A. REYNOLDS, Assistant Professor
G. K. SCHWEITZER, Consultant
C. E. SHORT, Assistant Professor
F. W. SIGLER, Assistant Professor
J. SOUTO, Professor
P. R. WELCH, Assistant in Animal Husbandry
M. H. WYKOFF, Associate Professor

[1] In cooperation with the U. S. Department of Agriculture.
[2] On assignment with the Veterinary Corps, U. S. Army.

Personnel Changes
January 1 - December 31, 1961
Appointments

PETER W. ASCHBACHER, Associate Professor, UT-AEC, August 15, 1961

VERNON M. BOUNDS, Assistant in Agricultural Economics, July 1, 1961

JOE G. BRADSHAW, Assistant in Animal Husbandry, July 1, 1961

ADA MARIE CAMPBELL, Associate Professor, September 1, 1961

GEORGE M. CAMPBELL, Assistant Professor, Horticulture, September 1, 1961

KERMIT E. DUCKETT, Assistant in Physics, September 1, 1961

JAMES E. ELDER, Assistant in Agricultural Economics, August 21, 1961

JACK C. FARMER, Assistant in Animal Husbandry, February 1, 1961

MARVIS E. FRYER, Assistant Professor, Animal Husbandry, January 1, 1961

BURGESS F. GUINN, Assistant in Agronomy, March 15, 1961

HAROLD WAYNE HARR, Assistant in Journalism, September 16, 1961

ZACHARY A. HENRY, Assistant Professor, Agricultural Engineering, September 1, 1961

LARRY B. JONES, Assistant in Agronomy, July 1, 1961

TED L. JONES, Assistant Professor, Agricultural Economics, September 1, 1961

LARRY E. KRUG, Assistant Editor, September 1, 1961

ROBERT S. LOWERY, Assistant Professor, UT-AEC, September 1, 1961

THOMAS E. MADDOX, Assistant in Agricultural Engineering, July 1, 1961

DAVID R. MEYERS, Assistant in Agricultural Economics, July 1, 1961

JAMES K. MILLER, Assistant Professor, UT-AEC, November 1, 1961

FRED E. PARDUE, Assistant in Dairying, October 1, 1961

JEROME C. PEKAS, Assistant Professor, UT-AEC, October 16, 1961

DARBY J. REED, Instructor, Child Development, July 1, 1961

JOE K. ROBERTSON, Assistant in Agricultural Economics, April 1, 1961

JAMES A. SANDERS, Assistant in Agronomy, August 15, 1961

FRED W. SIGLER, Assistant Scientist, UT-AEC, June 15, 1961

RONALD D. SIMPSON, Assistant in Poultry, September 1, 1961

JOHN D. SMALLING, Assistant Professor, Animal Husbandry, November 27, 1961

JOSEPH P. SUTTON, Assistant in Agronomy, October 10, 1961

ROBERT S. TEMPLE,[1] Professor, Animal Husbandry, September 1, 1961

DONNA G. WALTERS, Assistant in Agricultural Economics, August 7, 1961

JOHN N. WILLIAMS, II, Assistant in Animal Husbandry, November 1, 1961

BENJAMIN B. WILSON, Assistant in Animal Husbandry, May 1, 1961

PAUL L. WRIGHT, Assistant Professor, UT-AEC, October 1, 1961

MATTHEW H. WYKOFF, Associate Professor, UT-AEC, June 15, 1961

Terminations

JAMES H. ANDERSON, Head, Agricultural Engineering, December 31, 1961

WILLIAM E. BRYAN, Assistant in Agronomy, July 15, 1961

RALPH E. DODSON, Assistant Professor, Animal Husbandry, August 21, 1961

JOE W. HIGH, Assistant Professor, Animal Husbandry, July 15, 1961

HAROLD D. HOLLOWAY, Professor, Home Economics, August 31, 1961

LARRY P. JONES, Associate Professor, UT AEC, January 6, 1961

TAYMOUR H. KAMAL, Assistant Professor, UT-AEC, August 31, 1961

JAMES T. LONG, Assistant in Agricultural Economics, June 30, 1961

THOMAS E. MADDOX, Assistant in Agricultural Engineering, July 31, 1961

DENNIS L. MONTGOMERY, Assistant in Agronomy, August 23, 1961

MARY E. PURCHASE, Associate Professor, Home Management, Equipment, and Family Economics, August 31, 1961

MAREK RAKOWER, Associate Professor, UT-AEC, March 10, 1961

DWIJENDRA N. ROY, Assistant Professor, UT-AEC, August 31, 1961

HAROLD G. RUTHERFORD, Assistant in Agricultural Economics, March 15, 1961

CARL T. SARTEN, Assistant in Agronomy, November 30, 1961

DAVID B. SHOAF, Assistant in Poultry, May 10, 1961

H. B. SMITH, Assistant in Agronomy, August 8, 1961

ROGER A. TEEKELL, Associate Professor, UT-AEC, August 18, 1961

ROBERT N. TERRELL, Assistant in Animal Husbandry, July 31, 1961

WILLIAM H. WALKER III, Assistant in Animal Husbandry, May 31, 1961

CAROLYN A. WERMAN, Assistant Professor, Textile and Clothing, August 31, 1961

Promotion

LLOYD F. SEATZ, to Head of Agronomy Department, February 1, 1961

On Leave

D. HOUSTON LUTTRELL, Assistant Professor, Agricultural Engineering, July 31, 1961

Retired

ALFRED B. STRAND, Associate Professor, Horticulture, August 31, 1961

Personnel Changes
January 1 - December 31, 1962
Appointments

JAMES F. BROWN, Assistant in Horticulture, September 1, 1962

KHEIREDDIN M. Batal, Assistant in Horticulture, May 1, 1962

CHARLES R. BURGESS, Assistant in Animal Husbandry, July 1, 1962

ELMER W. COUNCE, Assistant Professor, Agronomy, July 1, 1962

ELIGE W. CULVAHOUSE, Assistant Professor, Dairy, July 1, 1962

JOEL ALLEN COLLINS, Assistant in Dairy, September 15, 1962

EMILY ANN DAVIS, Assistant in Poultry, August 1, 1962

CARROLL R. DOUGLAS, Assistant in Poultry, September 1, 1962

DONALD M. ELKINS, Assistant in Agronomy, June 11, 1962

HOWARD L. EARLY, Assistant in Agronomy, September 17, 1962

CHARLES E. FREEMAN, Assistant in Agronomy, July 1, 1962

ANDREW W. GIBBS, Assistant in Dairy, March 1, 1962

WILLIAM G. GIVAN, Assistant in Agricultural Economics, August 1, 1962

JULIA A. GLOVER, Assistant in Agronomy, July 1, 1962

ELMER GRAY, Assistant Professor, Agronomy, April 10, 1962

BUTLER E. HOLT, Assistant in Agronomy, July 1, 1962

HAYLEY M. JAMISON, Assistant in Animal Husbandry, March 1, 1962

RICHARD S. KROWICKI, Assistant in Physics, September 1, 1962

RUSSELL J. LEWIS, Assistant Professor, Agronomy, July 1, 1962

BARRY L. LADD, Assistant in Animal Husbandry, July 1, 1962

THOMAS WM. LITTLE, Assistant in Agricultural Economics, September 10, 1962

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WALTER C. PATRICK, Assistant to Director, UT-AEC, April 1, 1962

CHARLES D. PLESS, Assistant in Entomology, July 1, 1962

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FERNANDO E. VITERI, Assistant Professor, UT-AEC, April 1, 1962

Terminations

PETER W. ASCHBACHER, Associate Professor, UT-AEC, August 24, 1962

JOE G. BRADSHAW, Assistant in Animal Husbandry, March 31, 1962

LOUIS J. BOYD, Associate Professor, Dairy, December 31, 1962

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DONALD M. ELKINS, Assistant in Agronomy, December 31, 1962

JACK C. FARMER, Assistant in Animal Husbandry, March 17, 1962

EUGENE W. HUPP, Associate Professor, UT-AEC, June 8, 1962

HAROLD W. HARR, Assistant in Journalism, December 10, 1962

JOHN T. LEEMAN, Assistant in Animal Husbandry, August 10, 1962

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DAVID R. MYERS, Assistant in Agricultural Economics, August 31, 1962

JOSEPH S. OHR, Assistant in Horticulture, June 30, 1962

ROBERT G. PALMER, Assistant in Agronomy, May 31, 1962

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PAULUS P. SHELBY, Assistant in Agronomy, June 15, 1962

ROBERT L. SMITH, Assistant in Poultry, March 15, 1962

JAMES F. STEPHENS, Assistant in Poultry, December 31, 1962

FERNANDO E. VITERI, Assistant Professor, UT-AEC, July 10, 1962

On Leave

HOMER D. SWINGLE, Associate Professor, Horticulture, October 1, 1962

Retired

NEWMAN I. HANCOCK, Professor, Agronomy, August 31, 1962

FLORENCE MACLEOD, Assistant Director, Home Economics, August 31, 1962

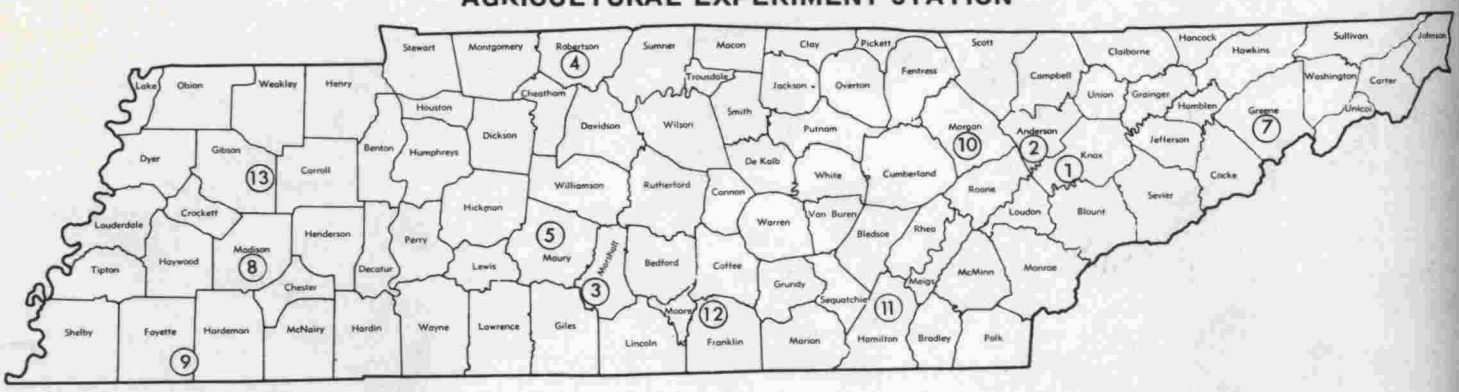
B. J. MCSPADDEN, Associate Professor, Poultry, August 31, 1962

Death

W. H. MACINTIRE, Emeritus Soil Chemist, April 21, 1962

The University of Tennessee
AGRICULTURAL EXPERIMENT STATION

UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION



1 Main Station
2 U.T.-AEC Agricultural Research Laboratory

BRANCH STATIONS
3 Dairy Experiment Station
4 Highland Rim Experiment Station
5 Middle Tennessee Experiment Station
6 Plateau Experiment Station

7 Tobacco Experiment Station
8 West Tennessee Experiment Station

FIELD STATIONS
9 Ames Plantation
10 Cumberland Forestry Field Station
11 Friendship Forestry Field Station
12 Highland Rim Forestry Field Station
13 Milan Field Station

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