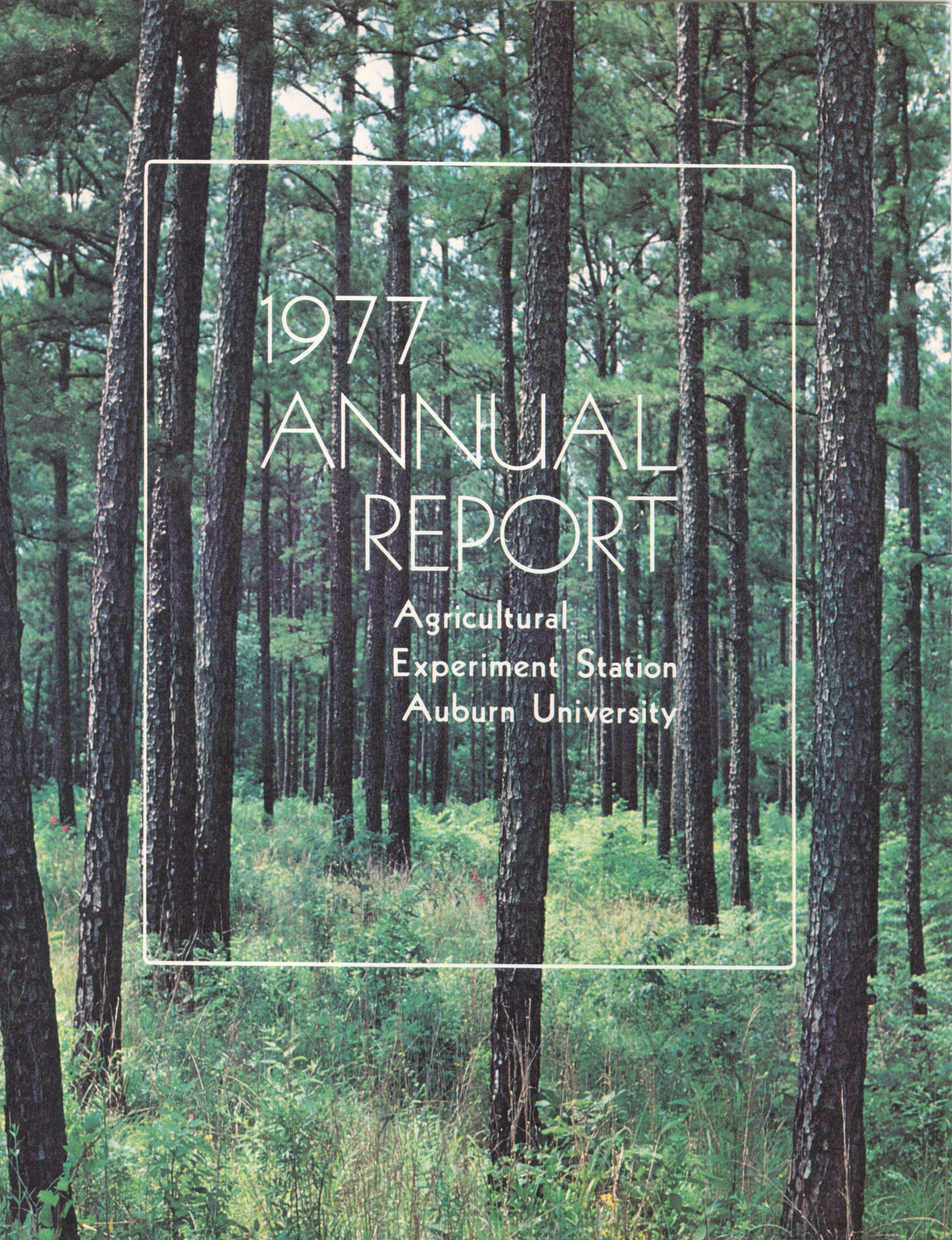

1977 ANNUAL REPORT

Agricultural
Experiment Station
Auburn University

AUBURN UNIVERSITY

AUBURN ALABAMA

36830

SCHOOL OF AGRICULTURE AND
AGRICULTURAL EXPERIMENT STATION SYSTEM

July 1, 1978

Office of Dean and Director

To the Citizens of Alabama:

This report of 1977 work of your Alabama Agricultural Experiment Station is made for a year that in general was not a good year in Alabama for crop and livestock production and marketing but was a year that saw the passage of a new farm bill, PL 95-113, which for the first time included in the law a title dealing with research and education—Title XIV, National Agricultural Research, Extension and Teaching Policy Act of 1977. The year's end saw farmers protesting over low farm prices and expressing their frustration as the price of everything they purchase continues to rise while the price they receive for agricultural products remains below the cost of production. Yet 1977 was a year of exciting research accomplishments as illustrated on the following pages. Once again we are able to report significant advances in knowledge from the research of our Agricultural Experiment Station scientists, advances that will help farmers assure the people of this nation of a continued supply of food and fiber to meet their needs and in addition provide products for export which in 1977 amounted to $24 billion.

The mission of the Alabama Agricultural Experiment Station is to conduct effective research bearing on the establishment and maintenance of permanent and effective agricultural and forest industries in Alabama, including appropriate mission oriented basic research and problems of agriculture in their broadest aspects; on the development and improvement of the rural home and rural life; on increasing the contribution of agriculture to the welfare of the people of Alabama and the nation, and the environment in which they live; and on the promotion of world peace and human welfare.

By any comparison the state and federal funds assigned to the Agricultural Experiment Stations have given the taxpayers a high return on their investment. Continuous funding of agricultural research at the State Agricultural Experiment Stations is essential for the achievement of this mission. Were it not for a system of continued funding—both state and federal—we would not be able to attract to and retain in agricultural research the quality of scientists who hold appointments in the Agricultural Experiment Station of Auburn University—scientists who demonstrate in many ways each year how valuable it is to have an organized group of scientists in Alabama dedicated to identifying and solving the problems facing the agricultural producers and the consumers of farm products; scientists who have the capacity to make advances in basic research but who are ever diligent in recognizing every day problems of the producers and consumers and who give priority to finding practical solutions to these problems.

Those who almost 100 years ago saw the need for a public-supported agricultural research organization in association with our Land Grant Universities were indeed wise. Certainly the continuation of this research program properly supported is equally as important today and in the future as it was then.

Sincerely,

R. Dennis Rouse

R. Dennis Rouse
Dean and Director

A LAND-GRANT UNIVERSITY

ANNUAL REPORT 1977

Research Capability Improved

The Alabama Agricultural Experiment Station (AES) at Auburn University has a singular goal—to reach maximum efficiency in developing usable new information for Alabama farmers, agribusiness, and the forest industry. Improvement in efficiency is primarily realized through improvement of the overall quality of the staff, meaning that the most innovative and dedicated scientific minds are being and must continue to be brought into agricultural and forestry research in Alabama. To successfully compete for the very best scientific minds requires a competitive salary structure, but support in forms of technical help, facilities, and funds also must be available and must be committed.

In 1977, construction of research facilities in the AES has continued. The Environmental Physiology Building was completed, thus allowing for very basic studies into the effects of temperature and humidity upon physiological mechanisms that control productivity and growth of livestock. This facility has the capability of producing any combination of temperature and relative humidity ranging from 50-110° F and 25-95 percent, respectively. Only a very few agricultural experiment stations have environmental control capability for large animals.

A new bull test facility was completed in 1977. Located on Shug Jordan Parkway, on the southern edge of the Main Station, the new Agricultural Experiment Station facility includes a feeding barn, attached building for feed storage and handling, dirt exercise lots, and a corral system. The barn has eight feeding pens, each equipped with 12 individual feeding stalls, for a total capacity of 96 bulls.

The unique feature of the new test station is its provision for individual feeding without the necessity of bulls being confined separately. Each feeding stall (bunk) has an electronically controlled door that provides access to the feed for the assigned animal only. Each bull has an electronic "key" on a neck chain, and this key opens the specific door assigned to him. Amount of feed consumed by each individual animal can be determined by recording the amount supplied to his feed bunk. Thus, feed efficiency (pounds of feed required for each pound of gain) can be calculated to complement other test data on performance and live animal measurements to give a more complete evaluation of bulls for commercial beef herds.

Cost of this new Auburn facility totaled $150,000. The Alabama Cattlemen's Association, Southeast Livestock Exposition, Alabama Santa Gertrudis Association, Beef Cattle Improvement Association, and several county cattlemen's associations and individual producers have contributed funds to help with the construction of this facility.

The new dairy at the E. V. Smith Center was nearing completion at the end of 1977. This is a highly automated confinement facility that will greatly improve the capability of the Agricultural Experiment Station to serve the dairy industry of Alabama and the Southeast. Management and nutrition research with emphasis on studies of various silage-grain rations will be conducted.

One of the nation's most modern bull test facilities is now in use by the Agricultural Experiment Station. The 96-animal capacity test facility is also used in other nutrition research.

The new Environmental Physiology Building provides precise control of temperature and humidity, allowing basic studies on how environment affects livestock production.

In cooperation with the Auburn University School of Veterinary Medicine, three new research facilities were constructed to improve the animal health research program. They are farrowing and gestation houses for swine and a calf barn. These new facilities will greatly enhance the Animal Health research program in the Agricultural Experiment Station and at the same time provide practical laboratories for students in Veterinary Medicine.

The research program of the Agricultural Experiment Station is composed of more than 500 individual experiments conducted under approximately 250 official projects. Brief reports of research in this annual report for 1977 are presented by departments; however, this does not mean that departments work independently. To the contrary, most projects are cooperative efforts that utilize expertise of scientists in many scientific disciplines.

For approximately 100 years public funds have supported agricultural research in the United States. During these years, American agriculture has become the most efficient producer of food and fiber in the world. There is every reason to believe that this foundation of consistent funding of agricultural research and extension has been a primary factor in the development of modern agriculture in the United States. At this time, when the world depends so heavily on United States agricultural productivity, it is important for the people of this country and the State of Alabama to realize that the real beneficiaries of agricultural research are consumers.

Buildings and other facilities were completed at the E. V. Smith Research Center during the year, allowing the beginning of full operation at the modern Main Station. Among the buildings completed and put into use were the service structures for Department of Agronomy and Soils (above), houses for supervisory staff (top right), Department of Horticulture facilities (center right), and Dairy Unit (bottom right). In addition to the units shown, modern facilities also are provided for the Animal Nutrition and Animal Breeding units.

ANNUAL REPORT 1977 Noteworthy Results

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

Economic Impact of State Parks

The impact of park development and operation at Guntersville and Eufaula was studied in 1977 to determine the effects of lodging, campground, golf course, and marina developments on the economy of the immediate and surrounding areas. In the capital development stage, effects of certain expenditures were incurred considerably distant from the sites. Increased energy costs have helped raise total costs of operating parks making it more difficult for revenue to cover expenses.

Variations in Farm Real Estate Values

Farm real estate values were studied in the Wiregrass Area, the second of three major farming areas under study. It was found that 84 percent of transactions were negotiated between buyer and seller, while only 16 percent were consummated through a real estate broker. Farming as a reason for purchase accounted for 52 percent of the purchases and farming together with a homesite accounted for an additional 21 percent of purchases. Proximity to a city of greater than 25,000 population, distance to a railroad loading point, improvement value per acre, and size of the tract were found to have a significant impact on value. Eighty-three percent of the variation in rural real estate was explained by location, physical, sale, and ownership characteristics of the parcels.

Financial Management and Farm Growth

A multiperiod linear programming model that included farm enterprises, investments, credit, land payments, capital accumulation, and cash flow for a 9-year period was used to study the effects of financial management on farm growth. Substantial savings in interest costs were possible from plans that allowed payment of interest on the unpaid balance rather than borrowing at the beginning of the year and paying back at the end of the year. With price structures at the time of this study, a combination of enterprises involving beef cows and soybeans did not prove profitable; however, the combination of a stocker program and row crops was highly profitable.

Changing Role of Agricultural Credit Agencies

Agricultural lending was studied for 34 commercial banks during 1977, including activities and effects of holding companies as they related to farm loans. Banks experienced few problems in supplying enough funds to meet the agricultural loan demand. Bankers indicated a trend of consumer installment and commercial-industrial loans receiving more emphasis in the future. Holding companies controlled 29 percent of the selected agriculturally oriented banks and accounted for over 50 percent of their total agricultural loan volume.

Construction of the golf course at Lakepoint Resort State Park, Eufaula, and other recreational facility development were found to have economic impact on surrounding areas.

Hill Pond Aquaculture in Piedmont Offers Some Opportunities

Information was obtained during the year on 1,513 ponds totaling 2,547 acres in a three-county area of the Piedmont Region of Alabama. About 52 percent of the farmers surveyed were interested in commercial fish production. Budgets were developed for three major production systems. The feasibility of using animal wastes in fish culture was also explored based on transporting wastes from sites of production to the fish ponds. Utilization of animal wastes in fish culture yielded higher net returns to the waste material than alternative uses as fertilizer or animal feed. A study of production of catfish and rainbow trout in hill ponds is being made.

Public Services and Economic Development

Rural development studies in three Piedmont counties were continued with research information being obtained from 126 government leaders, 110 business managers and proprietors, and 100 household residents. Information on quality of life, citizen participation, organizing for development, community growth, satisfaction, services, decision-making, and community development choices was secured. Preferences for rural development revealed consensus on the need for more large industries among household residents, but business and government respondents were less likely to endorse broad scale industrial expansion. The latter group tended to perceive linkages between industrial development, public service demand, and tax increases necessary to finance capital improvements. As for ratings of public services, fire protection, recreational facilities, roads, and sewage systems tended to receive the lowest ratings.

Outdoor Recreation Planning Studies Continued

During 1977, over 950 interviews were taken with State Park users throughout Alabama. Additional interviews with park management personnel were conducted. Preliminary findings are that Alabama State Parks are increasingly being viewed as desirable sources of family recreation experiences. The general profile of park users shows them to be middle income, well-educated, professional and skilled workers, family, or small groups who are seeking destination types of experiences. Day use facilities are in high demand by weekend users. Minimum standards for facility quality and availability are expected by park users.

How Thirsty is a Thirty-Foot Pecan Tree?

Is one drip irrigation emitter, providing a gallon of water per hour, enough for a 7-year-old, 30-foot high pecan tree? Apparently so, according to research being conducted at the Gulf Coast Substation. When a soil sensor was used to turn irrigation on and off only 10 hours were required to re-wet the pocket of moisture supplying the tree in a period of drought. Two to three times as much time elapsed after the irrigation before water was needed again.

Paddlewheel Aeration Device Provides Uniform Oxygen Levels in a Fish Pond

Paddlewheels and other aeration devices provide water movement which can be important for maintaining water quality. With water movement the oxygen rich top waters produced by algae during sunny days are distributed to oxygen poor lower levels. This increases the total oxygen available in the pond and avoids the buildup of low quality water in the deepest portions of the pond. Experiments at the Auburn University Agricultural Experiment Station showed that 3 hours of multiple paddlewheel operation was enough to eliminate oxygen level differences in a 1 1/2-acre pond all the way to its 10-foot deep bottom.

Irrigation Policies for Peanuts are Being Developed

In irrigation experiments at the Wiregrass Substation, plots of Florunner peanuts were grown under four irrigation policies. Tensiometers were placed at 6-, 12-, and 18-inch depths to determine irrigation need.

AGRICULTURAL ENGINEERING

Equipment for Handling Peanut Crop Residues

Special equipment has been developed by the Alabama Agricultural Experiment Station to assist in harvesting peanut residue. The equipment is a cross conveyor that fits onto the peanut combine and deposits the peanut hay in windrows. Peanut hay can be picked up from these windrows with either a conventional or large round baler. A lift has also been developed that will fit onto a front end loader of a tractor to lift the large bales onto wagons for moving the bales to storage. By using this lift the large bales of residue can be stacked three bales high in storage. This lift is very useful for dumping the large bales into the tub grinders.

An early drought resulted in rainfall deficits during the first 94 days of the growing season with late season rains generally adequate. Peanuts which had been irrigated only at planting produced 3,447 pounds per acre. The 60-centibar and 40-centibar irrigation treatments produced no increase in yield even though 5.8 and 8.5 inches of supplemental water were applied. Only the 20-centibar treatment increased yields significantly. The higher yield was 3,836 pounds per acre with 11.6 inches applied and 31.4 total inches including rainfall. This yield was significantly below the yield of 4,873 pounds per acre obtained the previous year. Nut maturity varied from 148 to 167 days, with the nonirrigated peanuts requiring the longest time for maturity. The late season rainfall allowed the nonirrigated nuts to peg, mature, and produce moderate yields.

Digital Electronics Improve Tractor Steering Accuracy

Techniques of digital electronics are significantly improving tractor steering accuracy and stability to assure repeated travel over a narrowly defined path. Tracking accuracies of ± 1 inch are being realized through ground speeds ranging from one to 12 mph. Moreover, the digital guidance system is compatible with modern mini computers. Currently the concept of automatic steering can relieve the tractor operator of a continuous, demanding task so that he can better control other, complex tractor and implement functions. Yet automatic steering is but one step toward automation of other tractor functions. Digital control techniques and onboard computerization could eventually remove the human operator from the tractor and its associated health hazards while obtaining higher crop yields with lower labor costs.

Controlled Traffic Offers Potential for Reducing Production Costs

Research results show that the system used by the Agricultural Engineering Department to control traffic in cotton production has a number of distinct advantages over conventional free-flow traffic systems: loose soil in the rootbed is not recompacted; there is a greater volume of soil more conducive for root development; yields are increased; the maintenance of loose soil in the rootbed eliminates the need for costly tillage operations; the deeper rootbed allows better moisture conservation; the good trafficability of the traffic lanes permits timely conduct of all operations irrespective of weather conditions; and traffic efficiency is improved for all operations.

Page 6: Top—Tensiometers placed at depths of 6, 12, and 18 inches in the soil monitored moisture at those depths to indicate when irrigation treatments should begin. Bottom—Three-bale and 4-bale transport systems for large round bales appeared to be well suited for handling of 250 tons of hay per year. Page 7: A mini computer now being used in the Soil Testing Laboratory will collect information from instruments as the sample is being analyzed and merge it with the crop information for the final report.

Round Bale Hay Transport Systems

Round bale transport machine evaluation studies were started in 1976 and finished in 1977. There were 10 machines in the study including four 1-bale machines, three 2-bale machines, one 3-bale machine, and two 4-bale machines.

One-bale systems appear to be reasonable for the operator handling 100 to 150 tons or less per year. For example the lowest cost system, the 2-wheel, self-loading trailer and pickup truck, had a cost of $4.78 per ton for 25 tons per year and $2.52 for 100 tons per year. Corresponding costs for the most expensive system, the front-end tractor loader, were $14.16 and $5.99, respectively.

The 2-bale machines appear to be reasonable for operators handling from 50 to about 300 tons per year. The self-loading pickup truck system had a cost of $5.73 per ton when handling 50 tons per year and $1.74 when handling 250 tons. For the highest cost system, the dump bed on a pickup truck, the costs were $10.76 and $3.51 per ton, respectively.

The 3- and 4-bale systems appear to be suited for 250 tons per year and above. The cost per ton for these machines is about $2.00 for an annual production of 1,000 tons.

AGRONOMY AND SOILS

Soybeans May be Starved for Nitrogen

Field experiments were conducted in 1976 and 1977 at the E. V. Smith Research Center with more than 45 root nodule bacteria products purchased at seed stores in Alabama. Soils were essentially free of soybean *Rhizobium* so that nodulation was dependent upon the product applied. Each inoculant was applied at planting according to manufacturer's instructions. Plants were dug at early bloom stage each year to determine root nodulation.

The peat-base products of Nitragin and Rudy-Patrick have provided adequate nodulation and N fixation in soybeans. Dormal (dried bacteria with clay base) and Triple Noctin (dried bacteria with molybdenum and fungicide) produced no nodulation. With hot-dry soil conditions after planting in 1977, many of the Unico, ABC, and Legume Aid treatments were little if any better than untreated controls. Results show a wide range in effectiveness of soybean inoculants offered for sale in Alabama.

Soil Testing to be Computerized

Use of the soil testing service to arrive at lime and fertilizer recommendations has increased tremendously in recent years. For several years computers have been used to handle laboratory information and to print out the final reports. A need for additional computer capability has been indicated and a mini computer has been added in the Soil Testing Laboratory. This mini computer will collect laboratory information directly from the instrument when the sample is being analyzed, and merge it with the crop information for the final report.

New Vetch Varieties Released

Increased nitrogen prices have caused a renewed interest in legumes for green manure—to supply nitrogen to summer row crops—and for grazing. Four new vetch varieties were released in 1977: 'Vantage', 'Nova II', 'Cahaba White', and 'Vanguard'. These are products of the long-time legume breeding program, and resulted from interspecific hybridization. These varieties produce high seed yields and have large seed and good seedling vigor. Seed have hard

The reseeding Nova II vetch covering grain sorghum stubble in this April 19 photo is a reseeding stand of the new Auburn variety that emerged after grain sorghum was combined.

seedcoats and reseed when mature seed are turned ahead of crops such as grain sorghum or soybeans. Reseeding stands in two successive years have been obtained from one seed crop in such a cropping system. These varieties are resistant to three species of rootknot nematodes, two races of the soybean cyst nematode, and the vetch bruchid or weevil. The latter destroys a large percentage of seed of susceptible species. The above vetches have adequate cold hardiness for the southern two-thirds of Alabama. During most years, these produce herbage earlier than hairy vetch and thus can be turned earlier for green manure ahead of crops such as corn.

Combinations of Herbicides Prove Superior

Goosegrass is one of the more difficult weeds to control in bermudagrass turf. Current research shows postemergence application of organic arsonates gives only moderate control. Additions of small amounts of a preemergence soybean herbicide, Sencor, to the arsonate sprays dramatically increased control of mature goosegrass with no injury to the bermudagrass.

Management Affects Centipedegrass Survival

Centipedegrass is used extensively throughout the lower half of Alabama for lawns and general turf. In many cases turf managers and sod producers experience winterkill of established stands. Results of a four-year study completed in 1977 indicate that changes in management procedures could well reduce or eliminate the problem. Increased cold tolerance and winter survival were associated with lower mowing heights, moderate fertilization rates, and supplemental iron applications.

Balloonvine, An Increasing Problem for Soybean Seed Producers

Balloonvine (*Cardiospermum halicacabum* L.) is becoming more of a problem for soybean producers in central and south Alabama, particularly those producers growing certified seed. Balloonvine is found more on the heavier, wetter soils that are characteristic of the Black Belt area; however, it is spreading to the sandier soils of south Alabama.

Preliminary investigations with soil applications of Vernam, Lexone, Sencor, and Lorox show promise in controlling balloonvine. Lexone or Sencor consistently produced the best preemergence control. Postemergence directed treatments of 2,4-DB or 2,4-DB + Lorox were effective also. Further investigations are underway for control of balloonvine in soybeans as well as competition and weed biology studies.

Directed Sprays

A timely post-directed application of herbicide(s) must be included in a weed control system for control of sicklepod in soybeans, Auburn University weed scientists have found. Soybean yields can be reduced by sicklepod competition, even at low densities. Average yield losses with as few as 1, 2, or 3 sicklepod plants per foot of row were 11, 23, and 46 percent, respectively. A preemergence application of metribuzin plus a timely cultivation has provided 85 to 95 percent control for a period of 2 to 3 weeks. This period was sufficient to allow the soybeans time to gain a height differential for a post-directed application of linuron, linuron + 2,4-DB, metribuzin, or metribuzin + 2,4-DB to finish the job. These post-directed treatments provided 85 to 100 percent control of sicklepod 4 inches tall or less. Afterwards, the soybeans were sufficiently competitive with late germinating sicklepod to prevent yield reductions.

ANIMAL AND DAIRY SCIENCES

Individual Animal Feed Efficiency Measured

For the first time in the history of beef cattle performance testing at Auburn University it was possible to measure individual animal feed efficiency as a feature of the 1977-78 test. An average 7.3 pounds of feed were required to produce 1 pound of gain by the 84 young beef bulls. The most efficient animal required only 5.6 pounds of feed per pound of gain while the least efficient consumed more than double that amount (11.6 pounds) for each pound of weight gained. As expected, younger animals were somewhat more efficient in feed utilization than older ones.

Restructured Fresh Meat Items

A patent disclosure entitled "A Process for Restructured Fresh Meat Items" has been filed with the U.S. Patent Office and a registry number has been issued. The process combined mechanically tenderized chunks of beef or pork and thinly sliced meat into restructured beef steaks or pork chops. Variation can be achieved in such sensory properties as texture and flavor by altering processing variables.

Chemical Treatment of Lignocellulose Products

Chemical treatment of lignocellulose products, including sawdust, materially improved digestibility and appears to offer promise as a procedure for converting waste lignocellulose materials to economically attractive cattle feed.

Shelled Corn Effective as Creep Feed

Whole shelled corn was as effective as a protein enriched concentrate feed mixture for creep feeding to nursed beef calves and offers a major element of simplicity compared to the feeding of a formulated ground and mixed conventional creep feed.

Recycling Program Safe

There was no detectable mineral or other inorganic matter in wastelage produced and consumed by cattle in a continuous recycling program. In addition, the dry matter digestibility of the wastelage was not reduced in a 143-day feeding trial and the ensiled wastelage was free of the coccidia stages of *E. bovis* after 5 days storage at 35° C. The safety and efficacy of the animal waste recycling program have been established.

Overseeding with Small Grains Increased Beef Gains

Overseeding of warm season perennial pastures with small grains and/or clovers increased beef calf gain per acre from 293 pounds for the Coastal Bermuda control to 511 pounds when Coastal was overseeded with rye-clover.

Cholesterol Level Measured

Blood plasma cholesterol and total lipids were greater in bulls fed a ration containing screw press processed cottonseed meal than those fed a ration containing soybean meal, but cholesterol level in the omental fat and in the liver was not affected by the protein supplement.

Inadequate Hormones May Affect Estrus

Cows that ovulate without showing signs of estrus may lack adequate progestational hormones during estrus. This conclusion is based on daily determinations of progestins in milk from 19 dairy cows from the time of calving until they were diagnosed pregnant. The average number of days to the first ovulation after calving was 22 days while the average number of days to the first observed estrus was 46 days, indicating that cows may ovulate without showing estrus. A higher percentage of first calf heifers showed estrus at the time of first ovulation after calving and exhibited estrus sooner after calving than older cows.

ANIMAL HEALTH RESEARCH

Diseases and Defects Studied

Abortions, weak and unthrifty calves, and low rate of reproduction are problems which are receiving high priority in Animal Health Research. Research shows that calves can be immunized against certain disease producing agents before being born. These procedures hold promise for protecting calves during first weeks of life, a period when they are most susceptible to diseases.

Current procedures employed for controlling brucellosis in cattle assume that calves from infected dams do not harbor the disease. Preliminary studies in France indicate that this assumption may be false. More than 100 female calves from infected cows are being assembled to determine if these animals are carriers of brucellosis and provide a source of infection to clean herds.

Various wildlife species (cotton rats, mice, opossum, fox, raccoon, crows), inhabiting premises where brucellosis-infected cattle are being pastured, are being examined for brucellosis. This is being done to determine what role, if any, wildlife may play in spreading the infection.

Wide differences in feed efficiency among animals is being found in the bull performance test and other feeding trials being conducted in the new bull test station facility. Electronic gates to feeding bunks permit measurement of individual animal feed efficiency without confining animals separately.

BOTANY AND MICROBIOLOGY

The Relationships Between Variety, Environment, and Fungicide to Foliar Disease Losses in Soybeans

Evaluation of 33 replicated soybean tests conducted throughout Alabama indicated that yield increases in response to benomyl applications were dependent on wet weather occurring between the bloom and pod-fill growth stages. Early- and late-maturing cultivars averaged yield increases of 15.3 and 11.0 percent, respectively, if benomyl was applied and infection conditions occurred. If weather was dry, yield responses to benomyl were 1 percent or less. Studies revealed that cultivars could not be adequately compared for disease susceptibility when planted simultaneously because the critical bloom-pod fill-infection period was reached during different environments.

Soybean yield response to benomyl applications went as high as 15 percent when wet weather occurred to promote foliar disease development. The increase was no more than 1 percent when weather was dry between bloom and pod-fill stages of growth.

Arginine Maturity Index (AMI) Method for Peanut Harvest

The AMI method of determining maturity and forecasting harvest dates for peanuts has proven effective for peanuts grown on experimental plots at the Wiregrass Substation, Headland, and by selected Alabama peanut farmers. It should be emphasized, however, that the AMI method may vary in its effectiveness from year to year and at different locations within a single year, depending on environmental factors and cultivation practices used. When peanuts were harvested according to the AMI method, the result was higher yield, grade, and price-return on a long-term basis compared to fields harvested according to the various subjective methods currently used. However, the commonly used Shellout Technique of determining peanut harvest dates, when used by an expert, was found to be as accurate as the AMI method in 1977 comparisons.

Rate and Effects of a Pesticide in the Salt Marsh

Experiments in the field and in microecosystems constructed to simulate field conditions showed that 10,000 p.p.m. of atrazine, supplied as AAtrex, decreased the number of *Uca pugnax* (fiddler crab) in the treated areas, but did not significantly affect the number of *Sesarma cinereum* (box crab). Treatment rates of 1,000 p.p.m. and 100 p.p.m. had no effect. The inactive ingredients in AAtrex were not toxic and did not affect the toxicity of atrazine. Adding marsh soil to atrazine solutions decreased their toxicity to *U. pugnax.*

Poisonous Plants (Ferns)

A study on the distribution of Alabama ferns (Pteridophytes) was completed during 1977. Excellent treatment of poisonous ferns and fern allies in Alabama was gained from the comprehensive taxonomic and distributional study of this group. About 600 collections of pteridophytes were made, the majority of them represented by several duplicate specimens.

Mycological Research

Material of 70 species of fungi not previously found was deposited in the Auburn University Mycological Herbarium. This brings the total housed in folders to almost 2,000 specimens. As in previous years, a number of the fungi collected or isolated from diseased higher plants were found to be undescribed. New names were established for five taxa, including the generic name *Paraphaeoisaria.* The new species are: *Cladosporium leprosum, Paraphaeoisaria alabamensis, Phaeoisaripsis bambusicola, Phialophora pinicola,* and *Sporidesmium carrii.* Descriptions and illustrations of these taxa and of 10 others which attest new records were prepared.

Phony Disease of Peach and Plum

A most significant discovery in 1977 was how phony disease symptoms are expressed in domestic plums. Peach phony disease is manifest as dark green, flat leaves, shortened internodes, and compact trees. Trees having such symptoms are readily recognized. Symptoms of this nature have not been associated with plum. Wild plum has been considered symptomless for this disease. Several rows of peaches exhibiting phony disease symptoms were destroyed at the Chilton Area Horticulture Substation in July. Roots and twigs from the diseased trees were compared with roots and twigs from adjacent plums and healthy peach trees in the orchard. Symptoms considered due to dry weather or "growth habit" of a particular plum were shown to be the expression of phony disease. Symptoms of phony disease of plum consisted of marginal leaf roll, scorch, and severe leaf coloration, depending on cultivar infected.

Nematology Research

The presence of root-knot nematodes, especially *Meloidogyne arenaria* and *M. hapla,* as well as other plant parasitic nematodes, in Alabama peanut fields is a major factor in maximum yield production. The southern peanut root-knot nematode, *M. arenaria,* in particular, parasitizes soybeans in addition to peanuts and reproduces well in corn and other cereals. Since corn is the normal rotational crop with peanuts, the presence of this nematode in peanut fields is a real threat because it is generally present throughout the peanut belt. Thus, nematicide applications can mean the difference between profit or loss to the grower of this major plant disease.

The recent virtual elimination of the fumigant DBCP as the economical means for control of this nematode in Alabama peanut fields led to a study of alternate fumigants. Formulations containing ethylene dibromide (EDB) were tested and found to be as effective as DBCP in control of the southern peanut root-knot nematode. The formulations Soilbrom 90 EC (90% EDB) and Terr-O-Cide 72-27 (72% EDB plus 27% chloropicrin), when applied at the rate of 1 gallon per acre in a field heavily infested with this nematode, showed 126 percent and 97 percent increases, respectively, in the yield of Florunner peanuts. DBCP applied at the same rate reflected

Treatment rates of 100 and 1,000 p.p.m. of atrazine did not affect fiddler crab or box crab in a salt marsh.

a 93 percent yield increase. Rates of 2, 3, and 4 gallons per acre of Soilbrom 90 resulted in 152, 145, and 134 percent yield increases in the field, respectively. The same rates of Terr-O-Cide 72-27 showed yield increases of 141, 148, and 139 percent, respectively.

Grower acceptance of these materials has been high because of their effectiveness and relatively inexpensive cost and because of the ineffectiveness and cost of granular non-fumigant nematicides in the control of plant parasitic nematodes. Moreover, in contrast to DBCP the EDB nematicides have not stimulated the incidence of peanut southern blight caused by the plant pathogen, *Sclerotium rolfsii,* the major fungal soil-borne disease of peanuts in Alabama.

FISHERIES AND ALLIED AQUACULTURES

Research on the Quality of Alabama's Aquatic Resources

During the past 5 years, Auburn scientists have studied plankton communities from 10 locations on eight rivers in Alabama. Quantitative estimates of phytoplankton were based on actual organism counts made with the aid of microscopes and the measurement of chlorophyll content in a known quantity of water. Quantitative zooplankton estimates were based entirely on organism counts. Estimates of total organic content and total organic carbon content of waters have also been made. On occasions, estimates of the rate of production of organic matter by phytoplankton were obtained employing a radioactive carbon tracer technique.

Role of Stress in Fish Disease Susceptibility

Environmental stress plays a very important part in the physiological response of fish and their susceptibility to infectious agents. The most important water quality parameters that affect disease susceptibility of fish are low oxygen, high ammonia, and high carbon dioxide concentrations. All of these stress factors significantly increase bacterial infections in fish under controlled conditions. One of the stress factors alone had less detrimental effects than a combination of two or more factors.

Symptoms of phony disease are easily recognized in peaches—shortened internodes and compact shape of affected tree at right as compared with normal tree at left—but plum symptoms were not known. New research findings identified marginal leaf roll, scorch, and severe leaf coloration as symptoms on plums.

Hybrid sunfish (crosses of green and redear) stocked into established ponds containing bass, bluegill, and redear populations can reproduce readily, according to new Auburn findings.

Efforts are continuing to develop methods of spawning the edible Louisiana crayfish in captivity for pond production. Laboratory spawning in plastic boxes and glass jars was successful.

Hybrid Sunfish (Green x Redear) in Farm Ponds

The hybrid cross (green sunfish × redear sunfish) usually produces a sex ratio of 70:30 males to females. As a result, hybrids stocked into established farm ponds containing bass/bluegill/redear populations can readily reproduce. Stocked alone and with largemouth bass they grow at a rate comparable to bluegills in fertilized ponds. Stocking 500 hybrids with 100 bass fingerlings per acre gave the highest percentage of harvestable size fish after 18 months. The original stock of hybrids in ponds is highly susceptible to angling and are readily harvested leaving only individuals of the F_2 or first generation produced in the pond. No information is yet available on the growth characteristics of the F_2 generation in ponds or on problems encountered in keeping pond populations containing the F_2 and F_3 generations in balance.

Closed System for the Culture of Fish

A simplified solar collector for overwintering Tilapia in outdoor pools was designed, constructed, and evaluated. Temperatures at 70°F and above were maintained from October 1976 through February 1977. The results were of significant magnitude to consider testing this principle in a larger greenhouse designed primarily for aquacultural production with possible secondary horticultural application.

Two recirculating systems were designed, constructed, and tested in a short term yield trial. Net gains in excess of 300 pounds of fish (60,000 pounds per acre) were obtained in 9×24×2.5-foot tanks in a 56-day period. One system was maintained with unicellular algae in the production unit and the other with higher plants. There was no significant difference in production in the two systems. Certain water quality parameters varied considerably between the two systems, but all parameters remained at satisfactory levels for fish production in both systems.

Fish Parasite Control

Bass tapeworms can cause serious problems in hatcheries producing largemouth bass and bluegill fingerlings for stocking in farm ponds. The anthelminthic Mebendozole was highly effective against the systemic larval form of the bass tapeworm when applied as an intraperitoneal injection. A follow-up of treated fish showed no apparent ill effects of the drug. The fish spawned normally and blood samples appeared normal.

Sex Reversal of Fish as a Potential Tool in Fish Farming

Some promising species of fish for farming, such as tilapia, tend to "overcrowd" culture ponds with "unwanted" small fish. Control of unwanted reproduction can be achieved by stocking only one sex, usually males. In recent years research has been conducted on converting females into males by feeding the fish small amounts of male sex hormones when they are very young. Sex reversal was accomplished for *Tilapia nilotica* using androgens (the male hormone) and estrogens (the female hormone). Male tilapia were functionally reversed with estrogens, and grass carp have been androgen treated. Effects on the latter species are being evaluated.

Sportfish Research on West Point Reservoir

The initial (1975) year class of largemouth bass in West Point Reservoir (the first fish hatched in the lake after it was filled) first reached harvestable size in the spring of 1976. This group of fish supported the sport fishery through July 1977 when the majority of the 1976 year class reached harvestable size. Fishing pressure on that initial year class was substantial (an estimated 30 percent were removed by angling in 1977). Fishing mortality with natural mortality has reduced their numbers to the extent that they now constitute only a small percentage of the fisherman's catch. The result was not "overfishing" in the classical sense; however, fishing pressure has altered the size composition so that the majority of the fish harvested are relatively small.

Spawning Crayfish Under Controlled Conditions

The edible Louisiana red crayfish usually spawns in holes or burrows in swampy areas. In recent years research has been conducted at Auburn to develop techniques to spawn them in captivity so the young would be available for stocking in culture ponds.

Recently crayfish were spawned in plastic boxes and in glass jars in the laboratory. The earliest spawn was on September 12, and the latest was on December 19. Most of the spawning was during the middle 2 weeks of October. Numbers of young per clutch of eggs varied from 0 to 314. Probably some females spawned infertile eggs. Cannibalism was a problem, especially among young crayfish.

Catfish Breeding Accomplishments

Three species of catfish, blue, channel, and white, and several inter- and intraspecific crosses were evaluated in yield trials. Channel × blue hybrids exhibited heterosis in growth over both parents. White × blue hybrids grew more slowly than either parent. Average gains (pounds per acre) for the three catfish species were: channel, 2,536; blue, 2,256; white, 1,739.

The Marion strain of channel catfish was significantly more uniform in size than three other strains and two strain crosses. This character will be of importance to the processing industry.

Sex-weight relationships of blue, channel, and white catfishes at 6 and 18 months indicated that male catfish were longer than females at both ages, and probably at an earlier age. Selection of larger fingerlings at early age for future broodstock would, therefore, likely result in insufficient numbers of females.

Yield trials with various genetic groups of branded channel catfish grown in separate ponds and communal ponds showed similar rankings for the groups, indicating communal ponds may be used to evaluate different genetic stocks.

Feeds for Ornamental Fishes

On a dollar basis, the ornamental fish industry in the United States is much larger than the food fish industry. Aquarium fish feeds cost $5.00 or more per pound, and those presently on the market are not formulated on a scientific, least-cost basis. A diet for aquarium feeding should be nutritionally balanced, palatable, crumble resistant, water stable, buoyant, and enhance pigmentation in the fish. A series of experimental diets was prepared using various processing techniques and ingredient formulations. These diets were tested for physical properties and fed to three species of aquarium fishes to see if they met the criteria for aquarium feeds. The diet that most closely met the necessary prerequisites was processed as flakes on a drum-dryer and contained shrimp meal, fish meal, and wheat bran as major ingredients, marigold petal meal as a pigment enhancer, and a fish vitamin mixture. The cost is approximately one-tenth that of commercial aquarium feeds.

Antibiotic Sensitivity of Bacteria Isolated from Diseased Fish

Bacterial infections are involved in approximately 30 percent of fish disease cases. Most bacterial infections of fish involve the organism *Aeromonas hydrophila* which is treated with the antibiotic Terramycin incorporated into the feed and fed to diseased fish. However, *Aeromonas* may develop a resistance to Terramycin if exposed to it for long periods of time. In previous years the percentage of *Aeromonas* isolates from fish that are resistant to Terramycin has ranged from very low (5 to 10 percent) up to 39 percent. During 1977 this percentage was 17 percent. The trend appears to be an increasing number of Terramycin-resistant bacterial isolates which reflects a wider and more indiscriminant use of the antibiotic.

Management of Water Quality and Productivity in Ponds

Two practical techniques were developed for predicting the overnight decline in dissolved oxygen concentration in catfish ponds. One procedure requires data on water temperature, pounds of fish per acre, water transparency, and dissolved oxygen concentration at dusk. These data are used to determine from tables (available from the Department of Fisheries and Allied Aquacultures) whether dissolved oxygen depletion will occur during a particular night. The other procedure involves plotting dissolved oxygen concentrations at dusk and 2 or 3 hours later on a graph and projecting a line through the two points to predict dissolved oxygen concentrations later in the night. Both techniques gave highly reliable estimates of dissolved oxygen concentrations at dawn.

Studies of plankton and fish production in ponds on wooded watersheds indicate that high levels of sunfish and largemouth bass production may be achieved in ponds without nitrogen fertilizers if phosphorus fertilizers are applied periodically.

Application of alum proved to be an effective technique for clearing "muddy" ponds. Concentrations of 15-25 parts per million of alum removed 90-95 percent of the turbidity from most ponds.

Increasing the Production of Striped Bass Fingerlings

The striped bass that attains a large size in the ocean also grows to a large size in Alabama rivers and reservoirs when stocked as small fish from hatcheries. Young stripes are more vulnerable to loss in hatcheries during the first 3 weeks of life than at any other stage of development. Pond weeds interfere with natural food production, hinder sampling efforts, and interfere with harvesting. Competitive and predatory invertebrates eat the desirable natural food organisms and prey upon the fry.

Simazine (2-chloro-4-6-bis (ethylamino)-s-triazine) applied as a preflooding bottom treatment at a rate of 9.99 pounds per acre controlled submerged rooted weeds and filamentous algae for a period of 60 days or more in rearing ponds stocked with striped bass fry, *Morone saxatilis.* An exception was dwarf spikerush, *Eleocharis* sp.

Masoten,® dimethyl (2, 2, 2-trichloro-1-hydroxyethyl) phosphorate, shows promise as an agent to control predaceous and competitive invertebrates without adversely affecting rotifers, a first food organism of the striped bass, or the fry themselves. The best rate and schedule of application of this chemical is still under study.

FORESTRY

Breeding Commercial Species

The cooperative tree breeding program, started 14 years ago by the Alabama Forestry Commission and the Auburn University Agricultural Experiment Station, has begun to yield limited quantities of slash and loblolly pine seedlings. These seedlings have been bred by selection for improved growth, straightness, crown form, and wood specific gravity.

Two southern Alabama loblolly pine seed orchards and one Alabama slash pine seed orchard have begun to yield limited quantities of seed. In the spring of 1976, the Alabama Crop Improvement Association approved these three orchards for the production of "Certified Non-tested Seed Orchard Seed." The first crop of these seeds was collected last fall and they are being used in the Forestry Commission's nurseries to produce the first crop of "Certified Non-tested Seed Orchard Seedlings."

Christmas Tree Improvement

Trials of Virginia pine and Arizona cypress in Alabama have shown that these species will produce good Christmas trees. Virginia pines are best for general production in the entire State.

Virginia pine is best suited for Christmas tree production in Alabama. Arizona cypress, because of cold problems, is suited only for production in the southern two-thirds of the State.

Since Arizona Cypresses are degraded by extreme freezes, they grow satisfactorily only in the southern two-thirds of the State. Also, sales of Arizona cypress should be limited to local areas because this species will not maintain its quality under the harsh conditions of long distance shipping.

Disease Resistance

Since southern fusiform rust disease causes large, important losses each year in the slash and loblolly pine forests of the South, tree breeders are working very hard to develop rust resistant pine trees. One of the methods used by the Auburn University Agricultural Experiment Station to develop resistant trees involves the use of interspecific hybrids. The least resistant southern pines, slash and loblolly, are being crossed with longleaf and shortleaf, the most resistant pines. Sixty-five of these interspecific hybrids have been made. They will be tested in nursery and field plantings.

Forest Photogrammetry

The Department of Forestry is developing a series of photo-interpretation keys for the forest cover in Alabama. These keys make use of photographic tone, topographic position of the stand, aspect of the slope, degree of slope, and geologic structure and material to arrive at the species complex likely to be found in the stand being evaluated. A separate key has been, or will be, developed for each of the forest habitat regions making up the State. During 1977, a key for the Ridge and Valley Forest Habitat Region was published in the Forestry Departmental Series of the Agricultural Experiment Station. The work is continuing and the series of keys probably will be completed within the next 5 years. Foresters, land use planners, environmental impact assessors, and ecological research workers have used or have expressed interest in the use of the keys.

Reclamation of Surface Mined Lands in Alabama

Many of the mine soils developed from surface coal mining in Alabama are too acid for adequate plant growth. A 1976 study was initiated to determine the amount of limestone needed to establish and maintain vegetation on an extremely acid mine soil in Tuscaloosa County, Alabama. Limestone was applied to experiment plots at rates of 10, 20, and 30 tons per acre. Rates of nitrogen, phosphorus, and potassium fertilizers were also applied as recommended by the Soil Testing Laboratory at Auburn University. A mixture of an annual grass, a perennial grass, and a reseeding legume was planted on each plot. The annual grass produced an overall average of 1,406 pounds per acre of oven dry forage the first year. However, the legume and perennial grass produced very little the first year. In the third growing season the legume appears to have failed completely, but the perennial grass is covering the soil surface at an increasing rate. While the annual grass did as well using 30 tons of limestone as it did with 10 or 20 tons, the perennial grass failed completely at 30 tons of limestone per acre.

Forest Tree Physiology

One objective of this research is early identification of nutrient deficiencies in pine and hardwoods. Greenhouse and field studies are being conducted to develop relationships between nutrition stress and leaf reflectance. When these relationships are developed, forest managers will be able to diagnose and prescribe treatment.

In addition, forest physiology researchers are evaluating the effectiveness of selected herbicides in controlling unwanted vegetation in forest nurseries, and in site preparation and stand release operations. To fulfill this objective, a new cooperative entitled "The Auburn University Forestry Chemicals Cooperative" was developed during 1977. In addition to Auburn, membership includes forest industries and the U.S. Forest Service. A major goal is registration of herbicides for forest nurseries, site preparation, and stand release. Data obtained in 1977 produced one regional and 12 state registrations for herbicide use in forest nurseries.

Evaluation of Particleboard Constructed from Loblolly Pine Logging Residue

During 1977 experimental work concerning evaluation of particleboard made from southern yellow pine rootwood and stumpwood was completed. Results indicate that all important strength properties and dimensional stability of particleboard made from rootwood met or exceeded commercial standards. This work has demonstrated that rootwood and stumpwood of southern pine material, representing more than 20 percent of total wood volume in a tree, can be used to produce a commercial product for use in construction of houses as floor underlayment and in furniture manufacture.

HOME ECONOMICS RESEARCH

Patterns of Food Intake and Nutritional Health of Girls

A 3-year study of the growth, development, and nutritional health of 9-11 year old girls showed that dietary intakes of vitamins B_1, B_6, and C were less than adequate for a large number of the girls. Inadequate iron intakes and anemia were problems at 9 years of age, but not when the girls were 10 and 11. Black girls had significantly higher levels of serum cholesterol than white girls at ages 9 and 10, but not at age 11. However, the number of girls having seriously elevated cholesterol levels (over 180 mg/100 ml) increased with age: 16.8 percent at age 9, 18.7 percent at age 10, and 39.0 percent at age 11. During all 3 years, girls from lower income families weighed less than those from higher income families, possibly indicating consistently lower nutritional intake.

Body measurements of youngsters (left) identified nutritional problems that are common among many in the pre-teen years. AU-Producer plum (right), a new variety from the Agricultural Experiment Station, combines good quality fruit production with resistance to diseases that interfere with the fruit in Alabama.

Influence of Socioeconomic Factors on Food Habits and Nutritional Status of Noninstitutionalized Older Persons

Dietary, socioeconomic, clinical, and anthropometric (height, weight, triceps, skinfold) data have been collected on 250 volunteer subjects who participate in Alabama's Title VII Nutrition Program for the Elderly. A high incidence of low hemoglobin and hematocrit values was found in black males. The mean hemoglobin level for this group was 12.3 g/100 ml, as compared with an acceptable level of 14.0 or above. The hemoglobin mean for white males was 15.4. Blood cholesterol levels were high (over 250 mg/100 ml) in 34 percent of the women and 16.4 percent of the men. Elevated cholesterol values were not significantly correlated with the incidence of obesity for either sex or race. Elevated cholesterol levels were a problem for 35 percent of the white males and 11 percent of the black males. Eighty percent of the white males having elevated cholesterol levels were being treated for hypertension. In black females, a high incidence of diabetes accompanied elevated cholesterol levels.

Effect of Alkaline Earth and Alkali Metal Ions on Flame Retardancy of Selected Fabrics

Preliminary results indicated that the manner of calcium salt deposition might be a factor in the effect of calcium carbonate on the FR (flame resistance) of cotton fabrics. Therefore calcium carbonate was deposited on flame retardant finished fabrics by two methods: (a) dipping in a solution of the salts and then running through a wringer (padding), and (b) laundering 50 times in hard water using a carbonate built detergent. Addition of cabonate salts by both methods increased the flammability of FR fabrics. However, laundering deposition caused a greater reduction in flame resistance than did padding. When the salts on the fabrics were examined by scanning electron microscopy, there were obvious differences between the laundered and padded fabric specimens. The laundered samples showed surface abrasion and had areas covered with many small crystals. Much larger and more regular crystals were formed on the surface of the padded specimens. Attempts to determine whether there is a difference between the two deposition methods in the way salts penetrate to the interior of the fiber have not yet been successful.

HORTICULTURE

Pickling Cucumber Hybrid Performs Well in Trials

An experimental hybrid cucumber, AUH-4, the result of pickling cucumber breeding research, consistently received high ratings in commercial brine trial evaluations for the past 3 years. It has ranked outstanding in characteristics which are important for brining pickles. Dark green color, appealing appearance, good pickle shape, firmness, and good internal strength which results in practically an absence of bloating and breakdown during the brining process are its characteristics. This experimental hybrid is the product of a breeding program for the improvement of pickling cucumber, including insect and disease resistance as well as improvement of yield and general adaptability to production in the South on a commercial scale.

New Plum for Home, Roadside, and Commercial Market

A new excellent quality plum variety, AU-Producer, has been developed and released for home, local, and commercial market use. AU-Producer has consistently produced good yields of high quality fruit in central Alabama; it is adapted where chilling of 750 hours below 45°F occurs. AU-Producer compares favorably with varieties currently grown in home, roadside, and commercial plantings and is more resistant to bacterial fruit spot, bacterial leaf spot, and bacterial canker.

Correcting High Subsoil Acidity Increases Tomato Yields

Cooperative research between the departments of Agronomy and Soils and Horticulture and the U. S. Department of Agriculture has shown that tomatoes respond dramatically to the correction of low subsoil pH. The yield of Tropic tomatoes was only 25,410 pounds per acre where the subsoil pH was 4.4. When the subsoil pH was increased to 5.4-5.9, the yield increased to 45,660 pounds per acre.

A second variety, Walter, produced less than Tropic, but its yield showed the same effect of subsoil acidity. Yields of Tropic increased from 19,190 pounds per acre where the subsoil pH was low, to 34,130 pounds where the subsoil pH was in the 5.4-5.9 range. For both varieties, increasing subsoil pH above 5.8 showed no advan-

tage; in fact, there was a slight reduction in yield when the pH was 6 or higher.

The researchers also found that the favorable higher subsoil pH resulted in larger fruit and plants and greater depth of root penetration. Roots failed to penetrate the strongly acid subsoil and stopped at about the 6-inch depth, where the limed surface soil met the subsoil. Where the subsoil pH was favorable, many roots grew below the 6-inch depth, and taproots went as deep as 24 to 30 inches. Observations also indicated that disease problems were worse on soils having highly acid subsoils.

Insect Resistance in Southernpea

Research with resistant varieties of southernpea has shown that pods contain less of a chemical substance which stimulates insects to feed on the pods than the more susceptible varieties have. A method for extracting the feeding stimulants from pods of varieties susceptible to insect attack was developed, and the amount of insect feeding was controlled by the amounts of these extracts added to food materials. By this bioassay method a quantitative measure of feeding response can be obtained. The extracts are being analyzed chemically as well as by bioassay methods. Isolation and identification of the active components will be an aid in breeding improved varieties of southernpeas with resistance to insect attack.

POULTRY SCIENCE

The Incidence of Microbial Flora Contamination in the Oviduct of Broiler Breeders

Microbial flora observations were made within sections of the oviduct of virgin, naturally mated, and artificially inseminated hens. There were 10 major microorganisms found in all three groups. These data indicate, contrary to popular assumption, that artificial insemination does not introduce more bacteria or types of bacteria into the oviduct than natural mating.

Protein for Laying Hens

Recent studies suggest that protein content of a commercial-layer diet can be reduced to as low as 11.5 percent for at least 1 to 2 months prior to hen disposal without adversely affecting egg production. This reduction in dietary protein plus a decrease in feed consumption could result in substantial savings in feed cost to the poultry industry since it is well below the 15 percent protein requirement as stated by the National Research Council and 15-17 percent protein level typically fed to aged layers.

Potential for Conversion and Utilization of Solar Energy in Poultry Production

A solar heated poultry research facility has been tested and energy conservation research begun. Specific research has basically been centered around (1) comparison of heat delivery systems, (2) testing the efficiency of the collection and storage systems, and (3) monitoring meteorological parameters and establishing working criteria for future research. Early trials have shown that solar energy has furnished up to 2/3 of energy requirements during brooding.

Anticoccidial Drugs Against Infections Caused by Recent Field Isolates

Broiler chickens inoculated with certain pathogenic species of coccidia and fed a selected anticoccidial drug demonstrated improved weight gain and feed efficiency significantly better than that of uninfected unmedicated controls. A boost in performance was apparently because of enhanced utilization of nutrients during the prophylactic administration of the compounds.

The Toxicity of an Alternaria Metabolite to Chickens

Results of three experiments indicate that a fungal metabolite produced by several *Alternaria* species is toxic to young broiler and White Leghorn chickens. When young chickens consumed the substance tenuazonic acid, reduced weight gain, lowered feed efficiency, and hemorrhages in various organs resulted. Since *Alternaria* fungi occur widely in nature and grow readily in corn, mycotoxin experts should be on the lookout for this fungi as a possible contaminant in poultry rations.

ZOOLOGY-ENTOMOLOGY

The Year of the Worm

The fall armyworm has long been a pest of agricultural crops in Alabama. Although it occurs every year, infestations do not usually cause damage until July or August. However, by May 1977 damage could be seen over most of the State and soon reports indicated that the insecticides usually recommended were not killing the pest. Extensive tests with 20 insecticides not previously tested against this insect revealed new materials for its control. However, some of the best of the new poisons are not yet cleared by the USDA for use on crops and much research remains to be done before they are labelled for use.

Insects Damage Hardwood Tree Seedlings in Nurseries

Systematic surveys were made of insect pests of hardwood trees growing in tree nurseries at Auburn, Autaugaville, and Selma, Alabama. A total of 29 insect species was identified from 14 tree species being grown. Some of the species identified included the beet armyworm, fall armyworm, soybean looper, bagworm, and other pests of field crops.

Better feed utilization and a resultant boost in performance were recorded when an anticoccidial drug was administered to broilers that had been inoculated with pathogenic coccidia.

A study of the food habits of the bobcat indicated that this animal is not a serious predator of bobwhite quail. In fact, it was found to prey on small mammals which compete directly with quail for food.

Impacts of the Cattle Egret on its Environment

Aerial reconnaissance and on-foot surveys indicate that the cattle egret is increasing in numbers in Alabama, generally at the expense of other wading birds. Nesting sites in pine plantations may result in the physical destruction of the trees by the birds and their nesting activity. Soil samples indicate a great increase in fertility over the nesting site. Phosphorus may be increased from 15 to 1,500 pounds per acre with corresponding increases in potash, magnesium, and calcium. At the same time the site becomes more acid.

The Vegetable Leafminer

The vegetable leafminer, *Liriomyza sativae* Blanchard, has become a major pest of several vegetables and appears to be spreading into new areas of the State. Tomato production in north Alabama was particularly affected. Parasitism of this pest ranged from 25 to 88 percent in the field. Foliar sprays of six insecticides were applied and evaluated for efficacy in controlling this pest. Oxamyl was significantly better in reducing the number of miners than the five other insecticides.

Mosquito Vectors of Dog Heartworm

Mosquitoes were collected from a light trap at a dog pen at Loachapoka in Lee County, Alabama, from April to September 1977. Each mosquito was dissected to determine if it contained dog heartworms. Sixteen mosquito species were collected. Only two of these were infected with dog heartworm, *Aedes stictus* and *Anopheles punctipennis.*

Effects of Fungicides on Insect Diseases in Soybeans

Populations of insects and the incidence of fungus diseases were studied on four varieties of soybeans planted at the Black Belt Substation and the Plant Breeding Unit. Although pest populations were not heavy and differed between the two locations, fungicides, particularly Benlate and Duter, influenced insect populations by reducing the incidence of entomophagus fungus in the field. This effect was very short-lived following application of the fungicides.

The Bobcat in Alabama

An investigation of the role of the bobcat as a predator on quail plantations in south Alabama was begun in March 1975. The food habits' data indicate that the bobcat is not a serious predator on bobwhite quail, but preys on small mammals which compete directly with quail for food. Home range data were collected from 20 bobcats instrumented with radio transmitters. The home ranges of these animals are approximately 1,000 acres and 500 acres for male and female bobcats, respectively. The average weight of the 213 bobcats collected was approximately 18 pounds for males and 15 pounds for females, and the sex ratio was approximately 50:50.

Field day programs at outlying units of the Agricultural Experiment Station were used successfully in informing farmers and agribusinessmen about current research directed at solving agricultural problems.

RESEARCH INFORMATION

Scientists of the Agricultural Experiment Station continued to use the services of the Department of Research Information for the dissemination of research results. Methods of dissemination included printing and distributing Experiment Station publications, preparation and release of stories to the mass media (newspapers, magazines, radio, and television), technical articles published in professional journals, and numerous programs held at the Agricultural Experiment Station and its outlying units.

Experiment Station publications produced during the year totaled 48 individual reports, with 155,200 copies. These were widely distributed to members of Alabama's agricultural and business community, as well as to selected groups in other states and numerous foreign countries. Faculty members had 259 technical articles published in professional journals.

Some 700 releases and cutline stories were distributed to newspapers, magazines, and specialty publications as well as radio and television, which brought to the attention of a wide variety of readers, listeners, and viewers the efforts and accomplishments of Auburn agricultural research.

A total of 31 field day programs, area meetings, and other commodity group conferences held at outlying units during the year brought thousands of visitors to the Agricultural Experiment Station. Each was attended by one or more staff members from this department and publicity given. Such sessions allowed face-to-face discussions between researchers and users of research data.

Exhibits portraying agricultural research were shown at 10 strategic locations throughout Alabama during the year. These consumer oriented exhibits were viewed by thousands at fairs, shopping centers, commodity conferences, and other special events. Completed was a 15-minute slide show on the School of Agriculture, Agricultural Experiment Station, and Cooperative Extension Service, which was shown before two international conferences on campus plus 12 or more other groups including civic clubs.

RESEARCH OPERATIONS

Drought and insect infestions during 1977 resulted in major problems in the production of feed for the Department of Animal and Dairy Sciences.

Responsibilities for operation of the teaching farm (formerly Department of Agronomy Farm) and for a unit at North Auburn (formerly Agricultural Engineering Farm) were assigned to this Department. Some renovation of facilities at both units has been accomplished. A dwelling was renovated at the old dairy unit. This unit is to be used for a beef cattle teaching herd.

Service buildings at Beef Cattle; Fruits, Nuts and Vegetables; and Field Crops Units at the E. V. Smith Research Center will be complete by July 1, 1978. Three new dwellings were completed during the year.

New facilities are as follows:

1. The Bull Test Facility was completed to accommodate 96 bulls for the performance test program. The facility will be used between performance tests for basic nutrition work.

2. Construction is underway on the new seed processing building and an annex to the office building presently occupied by the Alabama Crop Improvement Association. This addition will provide a modern technology center to service the seed industry of the State.

3. A 12-unit farrowing house with laboratory has been constructed at the Animal Health Research Unit.

4. A Fish Nutrition Laboratory at the North Auburn Fisheries Unit was under construction.

5. Some research was initiated on pecans at the Ikenberry-Turnipseed Unit. Pecan sales amounted to $20,000 in 1977.

ANNUAL REPORT

1977 Projects Underway

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Changing Role of Selected Agricultural Credit Agencies

Efficiency of Identification, Assembly, and Transportation of Cotton to Mills and Export Outlets

Evaluation of Irrigation Potential for Alabama

Freshwater Food Animals

Supply, Pricing, and Marketing Alternatives for Cattle, Beef Systems in the South

Marketing

Alternative Structures for Increasing Efficiency in Inter and Intra Regional Grain Marketing Systems

Marketing Performance of Selected Milk Pricing Systems for Southern Region

Price Discovery and Informational Flows for Major Agricultural Commodities in the Southern Region

Short-run and Long-run Demand for Broiler Meat

The Status and Relation of the Coastal Zone to Alabama's Economy

Resource Use and Planning

An Econometric Analysis of Variations in Rural Land Value

Effects of Investments in Recreational Resources on Income and Employment in Barbour and Marshall Counties

Efficient Vehicle Routing and Scheduling for Agribusiness Firms and Public Services

Estate Planning for Farmers

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Fertilizers and Organic Wastes Applied to Soils

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Plant Germplasm—Its Introduction, Maintenance, and Evaluation

Productivity and Quality of Phalaris, Annual Cool Season Grasses, and Legumes

Forage Legume Viruses

Grain Crops

Grains Crops Variety and Experimental Strains Testing

Plant Breeding

Breeding White Clover for Persistence and Yield

Breeding Phalaris and Tall Fescue for Improved Winter Forage Production

Genetics, Breeding, and Evaluation of Sericea and Vetch

Soil Chemistry and Soil Fertility

Availability of Residual and Fertilizer Phosphorus

Diagnosis and Correction of Manganese and Molybdenum Problems in Legumes

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Effects of Soil Acidity and Calcium on Soil Solutions and Yield of Crops
Enhancing Biological Dinitrogen Fixation in Soybeans and Other Legumes
Nitrate Movements in Soil Profiles
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Competitiveness and Control of Weeds in Soybeans
Cultural and Environmental Effects on Herbicide Persistence
National Agricultural Pesticide Impact Assessment Program
Economic Thresholds of Weed Populations in Cotton

ANIMAL AND DAIRY SCIENCES

Animal Health

Endocrine and Muscle Relationships in Swine and Cattle
Significance of Microflora of Healthy Bovine Udders in Mastitis Control

Breeding

Breeding Methods for Beef Cattle in the Southern Region
Effects of Breed and Breed Crosses on Milk Production and Other Factors in a Grade Beef Herd
Evaluation of Crossbred Beef Cattle
Genetic Improvement of Efficiency in the Production of Pork
Performance Testing of Prospective Sires
Selected Reproductive Phenomena in Cattle and Swine

Dairy Production

Comparison of Urea and Soybean Meal in a Silage-based Complete Feed for Dairy Cows
Development of Prediction Tests for Microbiological Quality of Fluid Milk Products
Effect of Level and Quality of Protein on Lactation in Cattle
Evaluation of Phalaris and Phalaris-ladino Clover Pastures for Dairy Cattle

Feeding

Effect of Feeding Systems and Animal Size on Efficiency of Beef Production
Evaluation of Pastures for Yearling Beef Steers in North Alabama
Growing and Finishing Stocker Cattle in the Gulf Coast Area
Growing and Finishing Systems for Beef Steers in North Alabama
Growing and Finishing Systems for Steers in the Coastal Plains
The Kinetics of Bacterial Thymidylate Synthetase and its Inhibition by Substrate Analogs

Forage Production

Beef Production on Selected Forage Systems
Marketability and Acceptability of Beef Produced Under Forage and Forage-grain Management Systems
Relationship Between Properties of Southern Forages and Animal Response

Nutrition

Chemical Profile and Nutritive Value of Forage Genotypes
Effect of Dietary Cholesterol on Longevity in Rats and Factors Affecting Milk Cholesterol in Cattle
Energy and Protein Levels in Blended Dairy Rations
Gluconeogenesis and Amino Acid Metabolism in Ruminants
Legume Protein, Preparation, Evaluation, and Amino Acid Composition and Metabolism
Livestock Waste as Animal Feed
Relationship of Nucleic Acid and Polyribosome Contents to Growth of Muscle of Beef Cattle
The Chemical Nature of Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances
The Quantitative Relationship Between Heat Production and Metabolic End Products in Anaerobic Bivalves
Vitamin E for Swine Research in Confinement

Meat

Factors Responsible for Tenderness Variation in Meat
Livestock Waste as Animal Feed
Processing and Marketing of Commercially Cultured Catfish

Waste Management

Animal Waste Treatment and Recycling Systems
Conserving and Feeding Crop Residues
Evaluation of Wastewater Reuse Lagoon Systems
Lagoon Waste Management and Recylcing Systems for Confined Dairy Cattle
Processes for Making Animal Feed from Waste from Cattle in Production Units

ANIMAL HEALTH RESEARCH

Cattle

Neurology of the Reproductive System in the Bull
Pathogenicity, Diagnosis, and Treatment of Intestinal Parasites in Calves
Persistence of Natural Infection in Calves Born to and Nursing Brucellosis-infected Dams
Resistance to and Epidemiology of Infectious Agents Affecting Bovine Reproduction
Transmission of Brucellosis from Cattle to Non-ruminant Wildlife Mammals
Virological Aspects of Bovine Respiratory Tract Disease

Poultry

Relationships of Blood Pressure and Aortic Tissue Lipids and Atherosclerosis in Turkeys
Reproductive Performance of Artificially Inseminated Broiler Breeders Maintained in Cages

Swine

The Role of Endotoxin in the Swine Agalactia Syndrome

BOTANY AND MICROBIOLOGY

Biological Control

Biological Control of Selected Arthropod Pests

Diseases

Ecology and Control of Soil-borne Fungal Pathogens of Forest Tree Seedlings

Biochemistry and Physiology of *Cronartium fusiforme* on Southern Pines
Ecology and Control of Fusiform Rust on Southern Pines
Viruses and Mycoplasma-like Organisms (MPLO) Causing Diseases of Corn and Sorghum
Viral Diseases of Selected Grasses: Identity, Control, and Role in Predisposition
Rhizosphere Ecology as Related to Plant Health and Vigor
Soil-borne Pathogens of Peanuts, Their Complexes and Control
Systems for Disease Management in Peanuts and Soybeans
Plant Diseases in Relation to Forage Crop Breeding
Forage Legume Viruses
Epiphytology and Control of Apple and Peach Diseases
Epiphytology and Control of Some Diseases of Peaches and Apples
Epiphytology and Control of Scab and Brown Leafspot of Pecan
Activities of Nematicides and Fungicides on Non-target Soil Nematodes and Fungi
The Effects of Seed Treatment Fungicides on the Rhizobium Host Infection Process in LDC Legumes
New or Unusual Plant Diseases in Alabama

Fungi and Mycotoxins

Ecology and Taxonomy of Some Alabama Fungi
Physiology and Biochemistry of Mycotoxin Producing Fungi
Chemistry and Physiology of Mycotoxins
Mycotoxicology of Stored Feeds and Seeds
Production of Mycotoxin (Other than Aflatoxin) by Fungi Isolated from Cottonseed

Herbicides

Minimum Tillage and Double Cropping on Weed Populations and Persistence and Fate of Herbicides
Fate and Effects of Atrazine in Salt Marsh Ecosystems

Morphology, Physiology, Taxonomy

Distribution and Habitats of Alabama Poisonous Vascular Plants
Flower and Pod Abscission in Soybean (*Glycine Max.* (L) Merr.)
Effects of Environmental Stress Factors on Some Energy-related Processes of Plants
Water Transport Phenomena in the Soil-plant System
Isolation and Identification of Odorous Metabolites of Aquatic Actinomycetes

Peanuts

Implementation of AMI Method for Determining Peanut Harvest Dates in Alabama
Fungal Spore Germination Inhibitors and Stimulators Associated with Surface Waxes of Peanuts

FISHERIES AND ALLIED AQUACULTURES

Aquatic Ecology

Management of Aquatic Plants for Sportfish Production in Ponds
Stream and Impoundment Ecology

Fish Biology

Ichthyology

Fish Diseases

Cooperative Fish Parasite and Disease Study

Pond Management

Aquaculture
Freshwater Food Animals, I
Freshwater Food Animals, II
Freshwater Food Animals, III
Freshwater Food Animals, IV
Procedures for Crayfish Culture in Alabama Ponds
Sportfish Management
The Culture of Fish, Shellfish, and Aquatic Plants in a Closed System

FORESTRY

Disease Control

Appraisal and Control of *Endothia gyrosa* on Pin Oak in Alabama
Ecology and Control of Fusiform Rust on Southern Pines

Forest Genetics and Tree Improvement

Breeding and Culture of Christmas Trees
Breeding Strategies for Genetic Improvement of Commercial Forest Trees in the South
Genetics, Breeding, and Evaluation of Selected Forest Tree Species

Forest Physiology and Nutrition

Forest Nursery Weed Control
Growth and Nutrient Requirements of Selected Hardwoods
Leaf Reflectance and Biological Processes of Trees as Affected by Environmental Conditions
Nitrogen Fertilization of Loblolly Pine (*pinus taeda* L.)

Forest Products and Technology

Cold Soaking of Fence Posts in Preservative Materials
Evaluation of Particleboard Constructed from Loblolly Pine Logging Residue
Evaluation of Southern Pine Plywood Properties

Forest Measurements

Effectiveness of Standardized Forest Condition Classes for Aerial Photographic Forest Inventory Purposes

Forest Site Quality

Physiographic Classification of Southern Pine Forest Lands

Forest Stand Improvement

Effects of Selected Silvicultural Practices on Timber Production and Wildlife Habitats
Precommercial Treatment of Semistagnated Natural Stands of Loblolly Pine
Variations in Height over Age Curves of Young Loblolly Pine Plantations

Harvesting

An Indepth Evaluation of Five Forest Harvesting Simulation Models for Use in South

Regeneration

Classification of Coal Surface Mine Soil Material for Vegetation Management and Soil Water Quality
Reclamation of Surface-mined Lands in Alabama

Resource Economics

Economic Alternatives for Managed Woodlots
Forestry's Contribution to Alabama's Economy

Resource Management

Forest Practice Alternatives in Central Alabama

HOME ECONOMICS RESEARCH

Housing

Quality Housing Environment for Low-income Families

Nutrition

Influence of Dietary Pyridoxine or Tissue Depletion of B-6 in the Rat

Influence of Socioeconomic Factors on Food Habits and Nutritional Status of Older Persons

Metabolic Basis of Appetite Response to Amino Acid Imbalance and Protein Level

Patterns of Food Intake and Nutritional Health of Girls

Textile Safety

Effect of Alkaline Earth and Alkali Metal Ions on Flame Retardancy of Selected Fabrics

Selected Factors Affecting the Consumer Use Performance of Flame Retardant Fabrics

Soiling, Soil Removal, and Durable Press Traits of Flame Retardant Cotton/Polyester Fabrics

Textile Utilization

Consumer Perception of Changes in Fabric Properties

Effect of Near Ultraviolet and Visible Radiation on Selected Non-linear Polyamides

HORTICULTURE

Breeding

Breeding for Resistance to Gummy Stem Blight and Cucumber Beetles in Pickling Cucumbers

Breeding Improved Tomato and Pepper Varieties for the South

Genetics and Breeding of Muskmelon and Watermelons

Genetics and Breeding of Plums

Southernpea Breeding for Insect and Virus Resistance, and Nature of Insect Resistance

Management

Factors Influencing Vegetative and Reproductive Development of Young Pecan Trees

Height Control in Floricultural Crops

Nutritional, Cultural, and Varietal Investigation of Apples

Peach Nutritional, Cultural, and Varietal Investigations

Regulation of Pistillate Flower Development in Pecan

Ornamentals & Landscape Conservation

Economics of Producing and Marketing Woody Ornamentals in the South

Nitrogen Requirements for Containerized Nursery Plants in Bark Growth Mixes

Identification and Control of Diseases on Ornamental Plants

Small Scale Computer Land Use Modeling in Coastal Alabama

Soil Fertility

Soil Fertility and Fertilizer Requirements of Vegetable Crops

Utilization

Quality Attributes of Selected Cultivars of Fruits and Vegetables

New Foods from the Southernpea

Varieties

Performance Trials of Commercially Important Vegetable Crops

POULTRY SCIENCE

Breeding

Artificial Insemination of Broiler Breeders

Reproductive Performance of Artificially Inseminated Broiler Breeders Maintained in Cages

Disease Control

Coccidiosis Study

Coccidia and Coccidiosis of Poultry

Development of Avian and Fish Virus Antigen Systems

Diagnostic Services-Poultry

Genetic Bases for Resistance to the Avian Leukosis Complex

Relationship of Blood Pressure to Blood and Aortic Tissue Lipids and Atherosclerosis in Turkeys

Susceptibility of Eimeria Species to Coccidiostats

Environment

Response of Chickens to Variations in Air Temperature, Humidity, and Velocity

Selected Environmental Factors on Feathering, Skin Lesions, and Growth of Broilers

Utilization of Solar Energy in Poultry Production

Eggshell Quality of Domestic Fowl

Feeding

Livestock Waste as Animal Feed

RESEARCH DATA ANALYSIS

Statistics

Development and Maintenance of Statistical Analysis System

Evaluation of Irrigation Potential for Alabama

ZOOLOGY-ENTOMOLOGY

Ecology

Ecological Impacts of Wading Birds on Aquatic Environment

Reptiles and Amphibians of Alabama

Natural History of the Alabama Red-bellied Turtle

Miscellaneous

Auburn University Entomological Museum

Endocrine and Muscle Relationships in Swine and Cattle

Structure and Function of Chemical Messengers of Arthropods

Pest Control

An Integrated System for the Suppression of Boll Weevil

Biological Control of Selected Arthropod Pests

Biology and Control of Arthropod Pest of Pecans

Biology and Control of Arthropod Pests of Woody Ornamental Plants in Alabama

Biology and Control of Selected Peanut and Soybean Insects

Biology, Ecology, and Control of Forest and Shade Tree Insects

Bionomics and Control of Arthropod Pests of Corn, Sorghum, and Small Grains

Bionomics and Control of the Face Fly and Other Diptera

Bionomics and Control of the Pecan Weevil

Biosystematics of Scale Insects of Alabama

Control Tactics and Management Systems for Arthropod Pest of Soybeans

Ecology and Management of Heliothis spp. on Cotton, Corn, Soybeans, and Other Host Plants

Insect Enemies of Bark Beetles Infesting Southern Pines

Southern Pine Beetle

Vegetable Insects Research

Wildlife Management

Bobwhite Quail Studies

Ecological Studies of Wild Turkeys

Furbearer and Mammalian Predator Studies

General Wildlife Studies

Reproductive Physiology of the Wild Turkey

Woodcock Studies

Report of Income 1977

Source of Funds

State (appropriated)	$ 5,510,000	41.5%
Federal (appropriated)	2,648,208	19.9%
Sales & Auxiliary	3,076,473	23.2%
Grants & Donations	2,041,120	15.4%
Total	$13,275,901	100%

Research Expenditures

Beef Cattle	12.5%
Cotton	4.1%
Dairy Cattle	6.5%
Feed Grains	2.9%
Fish & Wildlife	14.2%
Forestry	6.8%
Fruits, Nuts & Vegetables	7.7%
Human & Resource Development	2.5%
Ornamentals & Turf	3.2%
Pasture & Forage	8.3%
Peanuts	3.1%
Poultry	7.3%
Recreation	.6%
Soils, Land & Water	7.1%
Soybeans	5.2%
Swine	5.8%
Other	2.2%

Information contained herein is available to all without regard to race, color, or national origin.