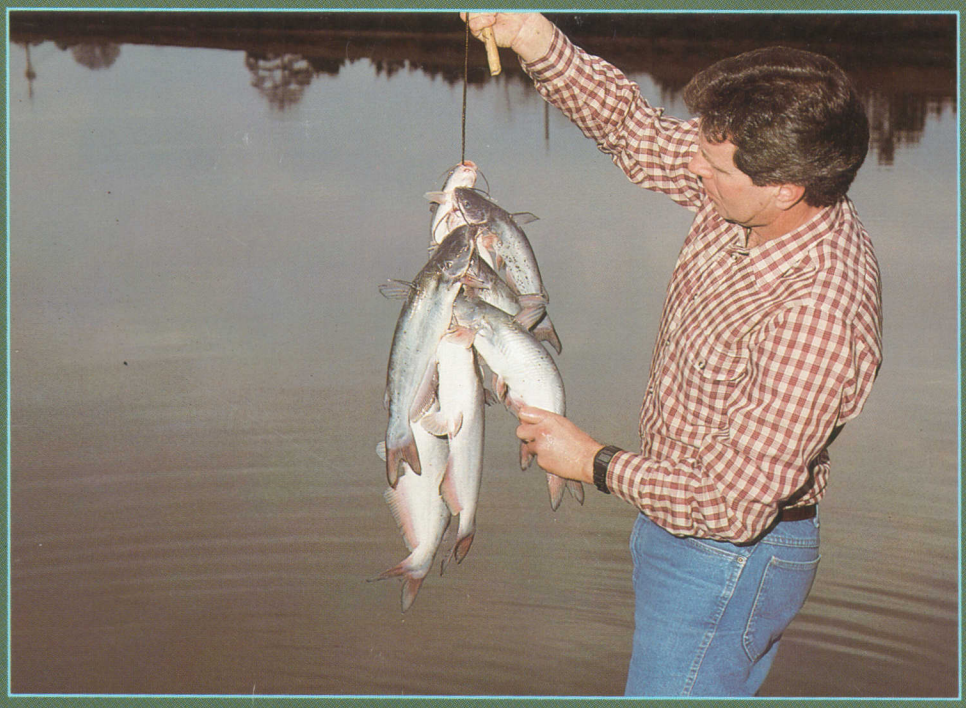
1988 Annual Report



Alabama
Agricultural
Experiment
Station

Auburn
University

COVER STORY: The farm-raised catfish industry and catfish fishout operations in Alabama have grown dramatically in the past decade. The development of successful spawning techniques by Alabama Agricultural Experiment Station researchers has produced a crossbred catfish that could provide another big boost for the State's catfish industry. The channel catfish-blue catfish cross grows faster and more uniformly, has more edible meat, is more feed efficient, and is less susceptible to reduced oxygen content in pond water than channel catfish. The crossbreed is also a more aggressive feeder and swims nearer the surface than channel catfish, making it easier to catch in fishout operations and easier to harvest for commercial use. As shown on the cover, even cool winter temperatures don't prohibit catching these channel-blue catfish crossbreeds.

Field days and other meetings, held throughout the year at research facilities across the State, help get research information to the people who need and use it.

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This report was produced by the Department of Research Information
R.E. Stevenson, Editor and Head
J.R. Roberson, Associate Editor
C.L. Smith, Assistant Editor
T.E. Rodriguez, Art Designer

FOREWORD

Dr. Lowell T. Frobish, Director, Alabama Agricultural Experiment Station

Service and teamwork were the twin themes of the 1987 Annual Report of the Alabama Agricultural Experiment Station (AAES), and with good reason. Service to Alabama agriculture and forestry is the mission for which the AAES was established 105 years ago. Teamwork continues to be the key organizational approach under which the AAES operates in carrying out its mission of service.

Teamwork involves many different individuals, agencies, or organizations -- not just Auburn faculty. Vital components of the AAES team are the citizens of Alabama, and especially the State Legislature. We at the AAES take this opportunity to say thank you to the Legislature for the increase in research funds approved in the recent budget and to our friends throughout the State for their interest and support. Too often we express our needs and concerns, but fail to say thank you for a job well done.

The increased funding provided for 1989 will help the AAES carry out its mandated mission of service to Alabama. It will allow us to develop a research program targeted to the needs of all Alabamians for the next decade and into the next century.

To help plan for the future, we have established a Task Force to review Alabama's agricultural and forestry industries and to take a hard look at Auburn's research program to support these enterprises. This group has been asked to develop a strategic research plan, officially labeled 'Alabama Agriculture in the 21st Century.'

Members of the Task Force are Senator Ann Bedsole; Representative Ben Richardson; Commissioner Albert McDonald; Mr. Jimmy Sanford, Agribusinessman; Dr. James Anderson, Michigan State University; Dr. Van Volk, Oregon State University; Dr. Bobby Robinson, Washington, D.C.; Dr. Robert Oltjen, Beltsville, Maryland; Dr. Robert Stickney, University of Washington; Dr. John Ayres, Lithonia, Georgia; Dr. Fred Hill, Savannah, Georgia; Dr. Irv Omtvedt, University of Nebraska; and Dr. Gideon Hill, Wilmington, Delaware. Dr. E. T. York, Chancellor (Retired) of the State University System of Florida, will chair the committee. The committee will be drawing on all resources in Alabama to develop this important strategic plan.

While the Task Force is busy working, another group has reviewed the research facilities associated with the AAES and has developed a plan of action. High on the facility priority list is the replacement of our greenhouse facility with a state-of-the-art greenhouse and growth chamber complex. Such a complex will allow expansion of research in ornamentals, floriculture, and vegetables, along with more basic studies in plant and tree growth, plant diseases, and entomology.

A new Animal and Poultry Science Building is planned to facilitate studies in growth, development, and reproduction of farm animals. Forestry is an important industry in Alabama and renovation of the forestry complex will provide much needed space for research to assist this growth industry. The welfare of all Alabamians is important, and the expanded research effort in rural development and family life benefits all citizens of our State.

Renovation of the existing plant sciences building, Funchess Hall, will enable scientists to expand programs in soil physics, genetic engineering, plant physiology and growth, integrated pest management, and other important areas. Remodeling of existing buildings for offices and classrooms will allow the housing of extension specialists with teachers and researchers to complete the integration of all three groups into a single faculty to carry out the agricultural mission of the University.

Addition of a disease containment facility will improve our research in animal, poultry, and fish diseases. Catfish farming is a rapidly growing industry, but growth may be limited unless research solves future production problems before they become limiting factors. Wildlife is important aesthetically and economically to the State. We must continue to expand our research and extension effort in this area.

Considerable effort is being devoted to planning and to the development of a strategic plan. The research highlighted in this report is a result of past plans. There is a Chinese proverb that sums up our planning process: 'One generation plants the trees...another gets the shade.' We are planting the shade trees of the future, but in doing so we must stop occasionally to smell the flowers and listen to the sounds embracing us. Remember, this is your Agricultural Experiment Station. You, the citizens of Alabama and the State Legislature, are important team members. We need your input, your advice.

INTRODUCTION

Research in the Alabama Agricultural Experiment Station is diverse. Some high tech. Some more down to earth. Some simple, and the benefits easy to define. Some more of long term benefit. Regardless of the package research results come in, the goal is to help improve the way of life for all Alabamians. In this regard, 1988 was a rousing success for the scientists and administrators in the Alabama Agricultural Experiment Station and for the people of Alabama.

Scientific breakthroughs, unfortunately, don't often adhere to the 'Big Bang Theory,' more often coming after many years of meticulous, time-consuming work. In 1988, however, there were several 'big bangs' in the Experiment Station.

Plant breeders, for example, culminated several years of work by releasing a new variety of soybean, Stonewall. This new variety was bred specifically for the growing conditions in Alabama and planting seed should be available in limited quantities for growers in 1990. Release of new varieties of lettuce, alfalfa, and sericea for Alabama farmers emphasized success of efforts by forage and vegetable breeders.

For many years Auburn researchers have been key contributors to the stockpile of knowledge needed to combat fescue toxicity in beef cattle. In fact, Auburn researchers first identified the fungus causing the disease and developed a fungus-free fescue variety and management measures to combat it. In 1988, initial work by Experiment Station researchers indicates that higher stocking rates — allowing animals to graze the infected pastures closer — may be the best of all these alternatives currently available. While technological breakthroughs will no doubt ultimately conquer the costly disease problem for cattlemen, a simple solution found by Auburn researchers may save millions of dollars until the big bang in fescue toxicity comes along.

Stonewall, a new variety of soybean bred specifically for Alabama growing conditions, was released by the Experiment Station in 1988.

Preliminary results indicate heavy grazing may be a simple short term solution to the statewide problem of fescue toxicity.

Auburn researchers sample crappie population in Weiss Lake.

Animal research at Auburn continues to center on further developing economic methods of producing high protein, low fat, and low cholesterol meat. This effort includes developing alternative feed sources, like grain sorghum, that can be grown in Alabama, thus reducing the need to export Alabama cattle out of state for finishing or importing midwestern grain for finishing cattle in the State. Developing the type cattle that can best utilize feed grown in the State and processing and packaging meat products in forms most acceptable to consumers will help to more fully develop and utilize the State's beef cattle industry.

The good food-good health craze is also affecting animal researchers at the Experiment Station. Poultry researchers, for example, have found that commercial feedstuffs often lack adequate dietary lysine, causing a higher percentage of fat in poultry products. Fisheries researchers were able to increase the omega-3 fatty acids in catfish by adding fish oil to pelleted rations. Omega-3 fatty acids have been linked to decreased heart disease, but researchers found the addition of fish oil to catfish diet resulted in reduced quality of catfish, which may not be acceptable to consumers.

Though researchers are constantly seeking to improve the environmental and crop production improvements go hand in hand. Auburn researchers found this to be the case in efforts to control tarnished plant bugs, a major pest of cotton. Preliminary research findings indicate that using beautiful wildflowers, such as verbena and fleabane, along roadways may provide sufficient natural trap crops to delay the timing and reduce the number of tarnished plant bugs in cotton.

Research by rural sociologists indicates that Alabamians favor maintaining clean water sources for recreation and wildlife. Other studies indicate a high degree of acceptance by Alabamians of the State Park System. Utilization studies further indicate that Alabama's state parks are widely used by tourists from out of state.

Developing alternative resources has long been a goal of the Experiment Station. This goal can also go hand in hand with efforts to better manage existing farm enterprises, as researchers found in the Sand Mountain area. The high concentration of poultry operations in that area has created a demand for utilization or management of litter from poultry houses. The area is also a growing center for vegetable production in the State. In tests at the Sand Mountain Substation, researchers have found that chicken litter makes an excellent organic fertilizer that produces higher yields and earlier maturity on broccoli and sweet corn than commercial fertilizers.

All the research information generated by the Experiment Station belongs to the public. Last year Experiment Station scientists published 490 technical articles, providing a broad base of scientific information for researchers both at Auburn and at research facilities around the world. Auburn researchers also published 20 Alabama Agricultural Experiment Station publications, and over 500 articles on Experiment Station research appeared in State newspapers. A new cooperative television and radio project with the Alabama Cooperative Extension Service brought research information to more Alabamians via electronic media.

With so diverse a research program, summarizing in an annual report is difficult at best. The following report represents only a highlight of research achievements; undoubtedly, researchers in every school and college on campus that conduct research under the auspices of the Alabama Agricultural Experiment Station could report other successful research findings.

Chicken litter, used as a residual fertilizer, produced larger, earlier maturing broccoli than commercial fertilizers.

FOOD ANIMALS

The Dairy Termination Program leaves younger, more optimistic dairymen in the State.

Animal research is undergoing a continual revolution as Americans demand increasingly lower fat and cholesterol meat products. At the same time, producers must be cognizant of meeting the demands of consumers without losing profitability. Thus, the age-old adage of producing the most for the least really hasn't changed, though it is 'clothed' a little differently. Researchers in the Experiment Station have made some significant progress in helping the State's livestock and fish producers thrive in these revolutionary times.

Basic research provides the building blocks of knowledge necessary for most practical scientific breakthroughs, but never before in the area of food animal research have the basic researchers been so vital. Auburn researchers are studying many of the growth and reproductive factors of both synthetic growth-enhancing chemicals and compounds produced naturally within the animal. How these materials interact could play a key role in the further development of fast growing, low fat, low cholesterol livestock that the public demands.

Auburn researchers are studying the proliferation of satellite cells in the muscles of rats and pigs to determine the interaction of growth-altering chemicals, exercise, and genetics. This understanding is essential to the future use of growth-altering chemicals in beef cattle and swine, both of which are heavily dependent on the heterosis obtained from genetic crossbreeding. To study the effects of exercise on cell growth, Auburn scientists developed a model system to allow rats to lift weights, thus inducing muscle growth in these animals.

Experiment Station scientists are studying a ribosyluric acid found exclusively in the red blood cells of beef cattle that may be used to protect food animals, and possibly human cells, from harmful oxidation. The ribosyluric acid is similar to a compound found in humans that is a defense against oxidizing agents. In laboratory tests, Auburn researchers have found that ribosyluric acid protected cattle, swine, and human red blood cells from toxic agents. The research team is working with hopes of developing similar compounds that will freely enter cells and offer protection from oxidation.

Hybrid may become standard for Alabama catfish farmers

Successful mating of male blue catfish and female channel catfish has not been easy, but it could become economically rewarding for the State's catfish farmers and fishermen. Auburn researchers have found that the hybrid produced by the two species is more efficient in feed conversion and grows faster than channel catfish grown commercially. The Auburn hybrid has about 15 percent more edible meat than channel catfish, primarily because of a smaller head.

These new hybrids are much more aggressive than channel catfish and are easier to catch with a hook and line. A tendency to swim and feed nearer the surface also makes the hybrid easier to harvest in commercial operations.

From a production standpoint, the hybrids are more tolerant than channel catfish of changes in dissolved oxygen in the water and less susceptible to diseases.

Nightly aeration pays off in commercial catfish ponds

Nightly aeration of catfish ponds pays off in terms of higher feed efficiency and subsequently lower feed cost and higher yields, according to recent Experiment Station tests.

Channel catfish ponds were stocked at 4,000 fish per acre and fed to a maximum daily rate of 50 pounds per acre. Three ponds were aerated 6 hours per night from May 30 until October 12, at a rate equivalent to 3 horsepower per acre. Three ponds served as unaerated controls, but emergency aeration was occasionally applied.

Harvest weight of fish averaged 4,293 pounds per acre in aerated ponds compared to 3,264 in unaerated ponds. The same quantity of feed was applied to all ponds, but fish in aerated ponds had significantly better feed efficiencies than fish in unaerated ponds.

Production data were expanded to larger ponds for a budget analysis. Net returns to land, management, and equity capital were $696 per acre for aerated ponds and $383 per acre for unaerated ponds.

Economics are studied for waste management systems

Agricultural economists working with a team of agricultural engineers, studied waste management systems for swine to determine the most economical ones. Microcomputer models were used to analyze various production phases and sizes, treatment/storage, distribution, and application systems. Six different sized feeder pig, farrow to finish, and feeder pig finishing operations were analyzed.

Nightly aeration of catfish ponds improves yields and lowers costs.

In tests evaluating pork production at levels between 50,000 and 170,000 pounds per year, feeder pig operations were below farrow-to-finish and finishing-out feeder pigs in terms of waste management costs as a percentage of the weighted average output value. Beyond the output range, feeder pig finishing operations achieved the lowest percentage, followed by feeder pig and farrow-to-finish systems.

Grass filter, storage pond, anaerobic and aerobic lagoons, recharge pit, and storage pit systems were evaluated for five farrow-to-finish operation sizes. Cost economies held for all systems as size was increased, with the aerobic lagoon (the highest cost system) showing the greatest cost sensitivity.

Dairy termination participants not necessarily unprofitable

Economists at the Experiment Station found that it was not necessarily debt or profitability that caused dairy farmers to participate in the Dairy Termination Program (DTP). About one-fourth had profitable or low debt operations but were terminating because they believed the future was not bright in dairy farming. Being of retirement age was given as a reason for DTP participation by about 27 percent of the dairy operators, with about 8 percent indicating low-profit operations. About 21 percent terminated dairying because of low-profit and high-debt operations, while another 15 percent were making a profit but had a high debt.

Although 60 percent of the DTP farmers had herds of fewer than 100 cows, 14 percent had 200 or more cows. Nearly one-third of the dairy operators indicated that after paying all debts, they would not have any funds remaining from the sale of cows and DTP payments. A debt-free situation was indicated by about 20 percent of the dairy farmers. Many experienced dairymen chose to quit, leaving the future of the dairy production industry in the hands of proportionately younger and less experienced, but more optimistic, dairy farmers.

Market demand increasing for aquacultural products

Since limited information is available on retail seafood marketing, Experiment Station

research was carried out to find factors most potent in the effect on the demand for seafood products.

The most important factors affecting retail grocery demand for seafood products were type and location of grocery outlet, species sold, and consumer tastes and preferences. Important seafood products in terms of volume and gross retail sales were catfish, ocean perch, whiting, and shrimp. Catfish accounted for 11 percent of dollar sales and volume. It ranked third, along with whiting, in terms of dollar sales, but was fourth in terms of volume. Catfish was the most widely handled fresh fish product.

Although the proportion of the market currently held by aquacultural products is small, potential seems to be high. Rising prices, general acceptance of catfish, and changing consumer tastes and preferences indicate that promotional efforts to increase consumers' awareness of aquacultural products would yield high returns.

Cattle respiratory disease is caused by early stress

Bovine respiratory disease, believed to be caused by exposure to stress at weaning and sale, is the most common cause of illness and death in feeder calves. Research underway in the Experiment Station indicates that a hormonal response by calves to stressful management procedures is accompanied by a temporary depression in disease resistance.

Surgical procedures are frequently performed on feeder calves in the United States at or near the time of weaning and shipment. To test the effect of castration on immune function, 5-month-old beef calves were castrated using a routine surgical procedure. Laboratory testing on blood samples collected before and after castration detected a significant increase in the concentration of cortisol, a stress hormone, within 1 hour after surgery. This hormonal response was accompanied by a shift in the concentration of white blood cells.

By the next day, both the cortisol concentration and the white blood cell concentration had returned to normal levels. However, the function of blood lymphocytes was also tested in the laboratory, and a significant depression was noted on the day after surgery. This depression in lymphocyte function may represent delayed effects of the high concentration of stress hormone that was noted immediately after castration.

In a second study, 5-month-old steers were hauled in a stock trailer for 2 hours. Upon return to the animal facilities, these animals were infected experimentally with a small dose of two respiratory agents that are associated with feedlot pneumonia. Hauling for 2 hours caused an increase in stress hormone that was as great as the increase that followed castration. Experimental respiratory illness was more severe in the calves that had been transported, compared to control calves that were infected but had not been transported.

Matching breed and facilities beneficial for swine producers

The cost of purchasing or raising replacement gilts and the lower productivity of gilts compared to sows make longevity and lifetime production important economic factors in commercial swine operations. A recently completed Experiment Station study evaluated longevity and lifetime production of three types of crossbred sows (Hampshire-Landrace, Duroc-Landrace, and Yorkshire-Landrace) in two types of gestation facilities (pasture and confinement gestation stalls).

Eighty-seven percent of the Hampshire-Landrace sows, 78 percent of Duroc-Landrace sows, and only 70 percent of the Yorkshire-Landrace sows farrowed four litters. Little difference was seen in performance between the pasture and confinement systems when averaged across the three sow crosses. Within the pasture gestation system, Duroc-Landrace and Hampshire-Landrace sows raised a total of 6 to 8 additional pigs to 21 days than Yorkshire-Landrace sows in four farrowings.

Total pounds of pigs produced in four litters varied little between the breed groups in confinement gestation, but Hampshire-Landrace sows did produce 60 to 70 more pounds of pigs at 21 days than the other two groups of crossbred sows.

Results from this study indicate that commercial swine producers should match sow breeds with the type of facility on the farm. Farmers with a pasture gestation system should consider using Hampshire-Landrace or Duroc-Landrace sows, while farmers with confinement systems may want to use the Hampshire-Landrace cross. The Yorkshire-Landrace cross may be the least economical choice for either system.

Poultry housing design has effect on production

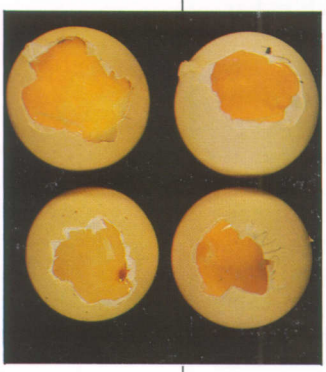
Research to compare relative energy efficiency and overall production efficiency of four different cold weather and four different warm weather broiler production systems was completed recently by an interdisciplinary team of Agricultural Experiment Station researchers.

Cold weather systems compared consisted of the following components: double curtains, double curtains with ceiling fans, single curtains with ceiling fans, and single curtains (control).

Warm weather systems compared consisted of the following components: Evaporative cooling fogging nozzles with full feed, evaporative cooling, fogging nozzles with limited feed restrictions, limited feed restrictions, and full feed with no fogging nozzles (control). Full feed means feed was

present at all times, while limited feed means feed was withheld for 30 minutes of each 4-hour period during the final 3 weeks of the grow-out period.

Gas consumption was lower in all treatments involving the double curtains. Gas usage was 24.2 percent lower in the double curtain treatment as compared to the single curtain treatment and was 39.0 percent lower in the double curtain with ceiling fans treatment as compared to the control. Ceiling fans alone resulted in a gas usage reduction of 11.6% when compared to the control. Total energy cost per 1,000 birds was lower in the double curtain with ceiling fans as compared to the other treatments. Using energy costs of $0.65 per gallon of LP gas and $0.065 per kilowatt-hour of electrical use, the costs per 1,000 birds were $68.13, $74.60, $80.20, and $86.76 for the double curtain with ceiling fan, double curtain, ceiling fan, and control, respectively. Most bird performance parameters were not significantly different for the treatments.



Reduced phosphorus proves costly for egg producers.

Reduced phosphorus levels can cost poultrymen money

Phosphorus, the most expensive major mineral in poultry feeds, is often fed at minimum levels to least affect feed cost yet improve shell quality. Producers can reduce phosphorus intake by 50 milligrams (mg) per hen per day and reduce feed cost as much as $50 per ton.

Research conducted at Auburn indicates that reducing phosphorus levels below approximately 700 mg per hen per day to improve egg shell quality is a misconception and should not be used as justification for feeding lower phosphorus levels. Producers feeding less than 500 mg phosphorus per hen per day may be increasing production cost because hens receiving marginal or inadequate phosphorus can have increased mortality, skeletal and shell problems, and reduced production.

Auburn findings indicate producers should feed a diet containing 0.7 percent phosphorus until peak production is reached or until feed intake levels off. Hens should then be fed 700 to 500 mg of phosphorus per hen per day depending upon hen age. Those levels are based on birds consuming average of 22 pounds of feed per 100 hens per day.

PLANT PRODUCTION AND PROTECTION

Data from nematode tests at the Wiregrass Substation were instrumental in developing Clandosan, a biological nematicide.

The record breaking late spring-early summer drought took a devastating toll on crops in some parts of Alabama, with the most damage occurring in the northern third of the State. Researchers used the dry weather to gain some valuable information. They found, for example, that computer models in cotton over-estimate the damage done to that crop by drought. They found heavier insect problems can often be managed in dry weather by using trap crops; of particular interest are the beautiful

wildflowers verbena and fleabane that are excellent hosts for tarnished plant bugs that frequently damage cotton.

Nematologists at Auburn played a key role in the development of Clandosan, a biological nematicide that uses a combination of urea and shellfish byproducts that stimulate soilborne fungi that attack nematodes. Since the banning in 1986 of the most effective and economical nematicides by the Environmental Protection Agency, growers have had few weapons with which to fight yield reducing nematodes. The new biological nematicide is both toxic to nematodes and harmless to man and the environment.

Future research in plant sciences will benefit from Experiment Station work on the development of cloning vectors for chloroplasts. Such vectors would allow scientists to insert genes into chloroplast to make photosynthesis more efficient, increasing plant productivity. A similar technique could be used to introduce the genes for resistance to photosynthesis-inhibiting herbicides into crop plants, allowing the use of herbicides that are currently phytotoxic to plants.

New method found to study plant bacterial diseases

Auburn researchers have developed a new approach to studying the relationship between plants and the pathogenic bacteria that attack and cause disease. By transferring the lux gene (a gene complex responsible for light emission of a bioluminescent bacterial species) into a number of commercially important pathogenic bacteria, researchers can follow the entry, movement, and activities of the bacteria in an infected host plant.

From measurement of the intensity of light emission, it is also possible to obtain an estimate of bacterial numbers at different times during infection and at different locations within the plant. This noninvasive method of following the progress of plant disease development presents scientists with a new and powerful tool for studying the disease process.

Old and new fungicides reduce peanut diseases

Peanut white mold costs Alabama peanut producers $10-15 million annually, placing it along with leafspot as the most troublesome peanut disease problems in the State. In 3 years of on-farm testing, researchers demonstrated that the fungicide Terraclor is still the best economic control for white mold, particularly under severe disease pressure. However, the insecticide Lorsban provided significant disease suppression and yield increases, which were greater than other insecticides also labelled for white mold control.

Researchers also evaluated new fungicides for control of white mold and peanut leafspot. In these tests, Spotless- and Folicur-treated plots outyielded standard Terraclor treatments by 100-400 pounds per acre and produced 600-1,200 pounds per acre more than untreated plots.

Little-known bee holds key to blueberry pollination

Rabbiteye blueberry, the only commercial blueberry grown in the Southeast, has seen a remarkable upsurge in commercial and home cultivation this decade. Like all blueberries, rabbiteye requires bees to transfer pollen between plants to effect pollination. Recent research at Auburn, in collaboration with the USDA Southeastern Fruit and Tree Nut Research Station, documents the pollination value of a previously overlooked native solitary bee for fruit production by rabbiteye blueberry.

The southeastern blueberry bee, *Habropoda laboriosa*, masquerades as a small bumblebee, but in fact is a solitary, ground-nesting bee. The female is a specialist, relying heavily upon blueberry flowers for her offsprings' pollen and nectar provisions. In turn, this bee is a superior blueberry pollinator. Every second flower she visits, on average, matures a full-sized fruit on three varieties commonly planted in Alabama. Censuses of blueberry visitors reveal this fast-working bee to be frequently so abundant as to effect multiple visits per flower, assuring the maximum fruit set of nearly 60 percent for irrigated bushes.

In contrast, other bees that forage rabbiteye blueberry are too infrequent, or else fail to appropriately handle the blueberry's urn-shaped flowers to be effective pollinators. Methods and technologies developed during this study may provide insights into the pollination of vegetable crops whose flowers share critical features with those of blueberry, such as tomato, peppers, eggplant, and potato.

A little-known bee proves essential to maximum blueberry production.

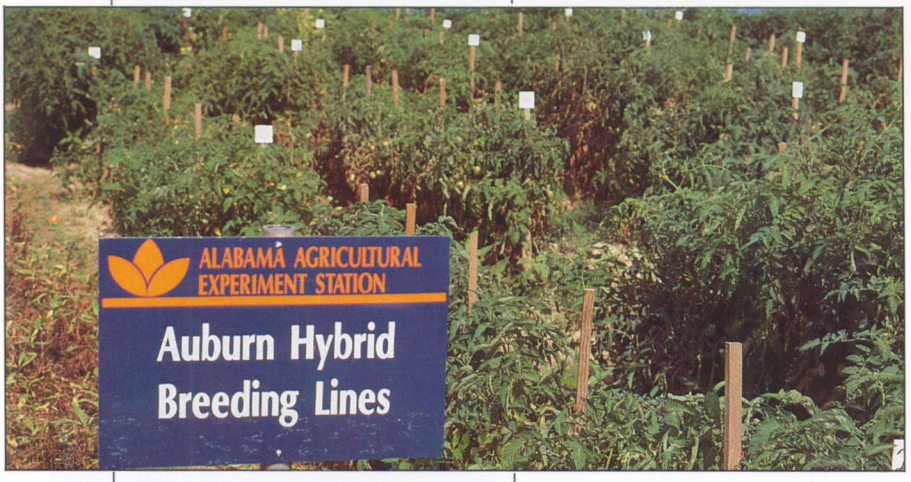
Fertilizer impurities too low to affect crops

The heterogeneity of phosphate rock can lead to the formation of impurity compounds in commer-

cial phosphate fertilizers. These impurity compounds are insoluble in water and contain metallic elements such as aluminum, iron, and magnesium. A series of greenhouse and field studies was conducted at the Experiment Station to evaluate the plant availability of phosphorus in commercial concentrated superphosphate (CSP) and monoammonium phosphate (MAP) fertilizers.

Fertilizers in the tests were manufactured from phosphate rock deposits in Florida, North Carolina, and Idaho. One CSP fertilizer was obtained from Morocco. Water soluble phosphorus in CSP ranged from 77 to 92 percent of the total phosphorus, while water soluble phosphorus in MAP ranged from 81 to 96 percent of the total phosphorus.

Results of this project show that the level of impurities currently present in commercial MAP and CSP fertilizers is not influencing fertilizer performance.



Hybrid tomato varieties may increase fruit set in hot, humid weather.

Winter grazing affects spring tillage program

Winter grazing can have a tremendous influence on tillage needed prior to planting corn. Data from the first year of a tillage system test at the Experiment Station indicate that when corn is planted into killed rye that has not been grazed, no tillage (82 bushels per acre) or no tillage with in-row subsoiling (87 bushels per acre) will result in higher grain yields than disking only (69 bushels per acre), chiseling (72 bushels per acre), paraplowing (73 bushels per acre), or turning (71 bushels per acre).

When the rye was grazed during the winter months, deep tillage was needed to maintain respectable yields. Yields for the paraplow, turn plow, in-row subsoiler, chisel plow, no tillage, and disk only were 77, 66, 65, 60, 57, and 46 bushels per acre, respectively.

Irrigation findings to help small acreage vegetable farms

Research being conducted by a team of agricultural engineers and economists will better define appropriate technology and costs associated with irrigation of vegetable crops in Alabama. The team is concentrating on small acreage farms with rolling topography. Although several types of irrigation technology are potentially appropriate, the 1988 study focused on small acreage, hard hose travelers.

The hard hose traveler now being field evaluated has a 400-foot-long hose with a 1.5-inch inside diameter and costs approximately $5,000. Annual fixed and operating costs which are also a function of pumps, pipes, and operating time will be determined.

Maximum recommended inlet pressure and nozzle size resulted in a flow rate of 65 gallons per minute. This flow rate will provide adequate water for about 10 acres of vegetable crops. Other variables that have been characterized include travel speed, discharge pressure, and flow rate variability. These factors will be combined with sprinkler wetting pattern data to simulate application rates and uniformity.

Hybrid tomatoes set fruit despite hot, humid weather

High day and night temperature conditions, prevalent in the summer months in Alabama, severely limit tomato fruit production. High temperatures disturb many processes in the flower, such as pollen development, pollen germination and tube growth, ovule development, fertilization, and fruit initiation. Experiment Station research indicates that hybrids of several varietal selections have higher heat tolerance than parent varieties, indicating that fruit set can be improved genetically.

In second-year field evaluations, hybrids and parent lines were rated for their ability to set fruit at the Wiregrass Substation in southeast Alabama. Summer daily maximum temperatures ranged from 88 to 100°F and the daily minimum ranged from 60 to 74°F in July and mid-August.

Flowers were collected at biweekly intervals and the percent pollen fertility was determined. Flowers collected from tomato plants during the hottest period of the summer showed a lower pollen fertility as compared to flowers collected earlier or later in the season. Only during the hottest period of the year did the pollen fertility of the entries become limiting.

Large fruited commercial varieties such as Flora-Dade produced

few or no fruit from July to mid-August, while lines from the Asian Vegetable Research and Development Center (Taiwan) and small fruited varieties such as Red Cherry produced many fruit although their size was smaller than normal. Lack of fruit formation could be attributed in large part to decreases in pollen fertility. Small fruited varieties showed the least effect of temperature on pollen fertility and subsequent fruit set.

Researchers evaluate small grain diseases

Small grain varieties were evaluated for disease incidence and severity at 11 locations in the Experiment Station System. Leaf rust and Septoria leaf and glume blotch generally were the predominant diseases on wheat and triticale cultivars; incidence of loose smut was high on EH 8600 variety wheat at every location.

Loose smut disease was also prevalent on Citation, Coker 227, Coker 820, and Harpool oats in tests in northern and central Alabama; otherwise, oat entries generally were disease free in statewide variety tests.

Low levels of stripe, spot blotch, and net blotch were found on each of the barley cultivars planted in tests in northern and central Alabama.

Seventeen fungicide treatments were evaluated for control of foliar diseases on McNair 1003 wheat at the Gulf Coast Substation in southwest Alabama and Sand Mountain Substation in the northeast part of the State. All fungicides tested at the Gulf Coast Substation gave good to excellent control of leaf rust. Septoria glume blotch developed late in the tests, but incidence of the disease was significantly lower in most of the fungicide-treated plots than in the unsprayed control plots.

Yield increases associated with fungicide treatments ranged from 6 to 17 bushels per acre. Diseases did not develop in the tests at the Sand Mountain Substation.

Early weed control aids young pecan tree growth

Auburn researchers found that total chemical control was the most effective way to control weeds in newly established, nonbearing pecan trees. They also found a significant impact of irrigation on both weed and tree growth.

Second-year growth was considerably greater than the first year's for all treatments. The diameters of irrigated and nonirrigated trees increased from 40 percent for untreated trees to more than 90 percent for trees undergoing total chemical control.

Total growth over the 2-year period shows total chemical control treatments in both irrigated and nonirrigated trees provided increases in diameter over twice that of untreated trees, under which mowing was used for weed control. Mowing, a practice used in many young orchards, was not beneficial because it did not control grasses. Irrigation provided a distinct advantage in the first year when rainfall was limited to 55 inches, but it had little effect in 1987 because the research area received 80 inches of rainfall that year.

Highly reflective mulches reduced populations of disease-carrying aphids and thrips.

Results suggest total chemical control provides more advantage for young pecan tree growth than mowing and disking, and total chemical control is especially important for nonirrigated trees. These early results seem to indicate that efficient orchard floor management beginning at planting can help trees reach production age faster.

Highly reflective mulches reduce pests, benefit crop

Tomato and summer squash research at the Experiment Station indicates that aluminum coated plastic mulch may reduce thrips and aphids, and subsequently lower the risk of virus diseases transmitted by these insects. In addition, the plastic mulches stimulate crop production by controlling weeds, conserving moisture and fertilizer, elevating plant temperatures, and increasing light intensity.

Squash mosaic and tomato spotted wilt are serious diseases of vegetables in Alabama. These viruses, which are transmitted by aphids and thrips, cannot be controlled by currently available insecticides. These insects feed on the underside of plants because of a sensitivity to light. By using the reflective mulches, researchers were able to 'bounce' light up under the plant foliage and discourage aphids and thrips from attacking vegetables covered with these materials.

Wheat variety tests demonstrate effectiveness of fungicides.

Isolating Omega-3 fatty acids from soilborne fungi could provide a future source of beneficial nutrients.

Americans are more health conscious today than ever before. Farmers and livestock producers, in addition to producing maximum yields at minimum costs, must produce nutritionally sound raw products. The other side of the coin is that Americans must be able to recognize and most efficiently use these more nutritional foods, and for a majority of consumers this is not the case.

Auburn researchers, for example, demonstrated that carbohydrates, often avoided by dieters, are essential to maintain adequate endurance levels. Low carbohydrate diets for females can be self defeating, according to the Auburn study, because women on these diets have decreased physical and mental performances when compared to medium and high carbohydrate diets.

Though adding fish oil rich in Omega-3 fatty acids to catfish diets gave the food fish an unpleasant odor and may not be acceptable to consumers, other forms of these fatty acids that have reduced incidence of heart disease may be usable. Auburn researchers are currently trying to isolate from fungi an alternative source of Omega-3 fatty acids. At least one of the fatty acids in Omega-3 is known to occur in certain groups of primitive fungi. Unlocking an alternative source of Omega-3 could provide a more abundant and usable form of this nutritionally important fatty acid.

The increased emphasis on proper human nutrition extends from the elderly to infants — even pre-

mature infants according to one Auburn study. Due to technological advances, the survival rate of premature babies has gone up dramatically in recent years. One problem of premature babies is eye damage, since the eye continues to mature after birth. Auburn researchers, working with scientists at the Cullen Eye Institute in Texas, found that dietary selenium is vital to eye development and to preventing eye damage due to over-oxidation. Experiment Station researchers were even able to determine that selenomethionine is a better source of selenium than selenite or selenocystine. This multi-disciplinary study is also looking at the possibility of soil applications of selenium for soybeans as a method of getting needed selenium into foods for infants.

Lean beef tastes good and is more economical to grow

Experiment Station scientists recently established the compositional and value differences in carcass components (closely trimmed retail cuts, ground beef, waste fat and bone) between typical and lean carcasses.

Lean beef carcasses had greater yields of retail cuts, ground beef, bone, and total available product for retail sale than typical carcasses. The typical carcasses had a higher percentage of trimmable fat than lean beef carcasses. Assuming average per pound market prices for each component (retail cuts, $3.40; ground beef, $1.50; waste fat and bone, $0.05), there was a net difference in carcass value of nearly $70. This difference was largely accounted for by more muscle mass in the lean cattle. A companion study has shown that there was no difference in the sensory traits of tenderness, juiciness, or flavor between the two carcass types.

Since there was a value difference between typical and lean beef carcasses of nearly $70 in favor of the leaner carcasses and there was no difference in the desired eating qualities, selection of lean carcasses by the packer, using the constraints set forth in this study, is one method of providing consumers with the leaner product they demand.

Dietary riboflavin sufficient for physically active females

Riboflavin is one of the B complex vitamins found in numerous foods, but Americans receive it primarily from milk and other dairy products. Riboflavin has many functions in the body, most notably the production of energy. Riboflavin needs are also related to the amount of muscle a person has, thus, an increase in either muscle mass or energy expenditure could result in an increased need for riboflavin. Because of these relationships (muscle mass and energy expenditure) it may be possible that physically active persons have higher riboflavin needs as compared to those more sedentary.

This question was studied recently by researchers in the Experiment Station. Nutritionists looked at the riboflavin status of a group of female athletes (varsity tennis players and track athletes) as compared to an untrained group of females of similar height, weight, and age.

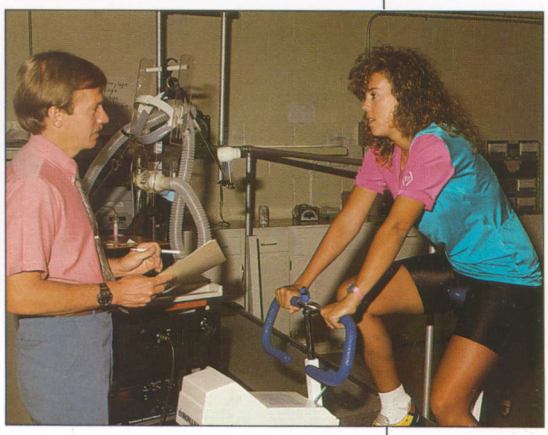
Results showed that athletes had less body fat and consumed more riboflavin and calories in their diet than did other females. However, when riboflavin intake was expressed as riboflavin intake per calorie consumed, the athletes and nonathletes were equal. Riboflavin activity in the blood of both groups was within the range expected for adequately nourished people, however, the values for the untrained group were slightly better than for athletes. The same was true for riboflavin excretion in the urine. Both athletes and nonathletes excreted a normal amount of urinary riboflavin, but the untrained females excretion was more normal than the athletes.

This study indicates that females who are very physically active can maintain adequate riboflavin status through dietary intake alone. No unusual or large supplements are needed, Thus, adequate consumption of dairy foods would meet a physically active person's need for riboflavin.

Oatmeal and whole wheat are ideal sources of manganese

Manganese is known to be an essential trace element for humans and animals. Knowledge concerning the biological availability of manganese from plant foods is important since most of the manganese in human diets is supplied from plant sources. Manganese content of animal foods is low. Manganese present in plant sources may not be totally available for absorption, and hence, utilization may be low. Bioavailability can be defined as the extent to which a chemically present nutrient in the diet can be utilized by humans or animals.

To establish data for the bioavailability of manganese from different protein sources, Auburn researchers fed rats diets based on casein, soybean meal, whole wheat



Dietary riboflavin proves sufficient for female athletes.

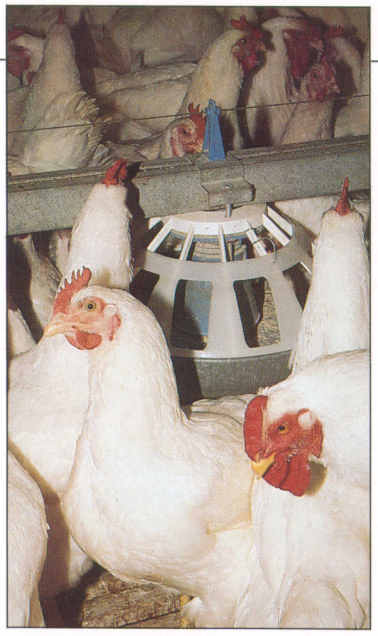
flour, or oatmeal for 21 days. Within each group, different levels of manganese ranging from 0 to 8 parts per million were fed. At the end of the 21-day feeding period, the deposition of manganese in bone was analyzed to calculate the bioavailability of manganese. By comparing the slopes of the manganese content in bone obtained from rats fed soybean meal, oatmeal, and whole wheat flour to that of casein, a slope-ratio was calculated to determine the bioavailability of these protein sources relative to casein.

Results indicate that the manganese contained in the soybean protein allowed for the least deposition of manganese in the bone, followed by oatmeal and whole wheat. While these results show that manganese bioavailability from oatmeal was low compared to casein, only the soybean meal showed a significant decrease in bioavailability. Oatmeal and whole wheat protein diets showed no significant decrease in manganese bioavailability. Many cereals contain significant amounts of oatmeal and whole wheat and results from this study indicate that manganese bioavailability from these sources is excellent.

Reducing poultry salmonellae lowers human disease threat

Salmonellae are a group of bacteria (over 2,500 serotypes) found throughout nature, especially in the animal kingdom. Often, salmonellae are associated with a gastrointestinal disorder in humans known as Salmonellosis.

Poultry, like other livestock, may be exposed to salmonellae organisms during the growout phase of production. Birds harboring salmonellae in any one flock, though usually few in numbers, represent a source for cross-contamination during commercial processing.



Mature broilers show resistance to disease-causing salmonellae bacteria.

Experiments are being conducted at the Experiment Station to determine factors, such as genetics, feed and water withdrawal stress, and dietary supplement with probiotic and milk products, associated with salmonellae colonization rate of broilers prior to processing. A high level of cecal colonization was observed when day-old-chicks were inoculated with salmonellae organisms. However, adult broilers (6 weeks of age) were resistant to colonization when orally challenged with salmonellae typhimurium, indicating an age related to colonization of salmonellae organisms.

Determining natural resistance by chicks to salmonellae organisms represents a first step in lowering the incidence of transmission of salmonellae organisms to humans.

Safety considerations urged for pre-cooked roast beef

Current changes in consumer demand have resulted in increased production of processed meat items that are high in quality, convenient to prepare, and carry a high retail price. Several new meat items are being produced throughout the country that are unlike the majority of 'typical' processed meats. One such item is sliced, pre-cooked roast beef. This product is different from other ready-to eat meat items in that it contains lower salt levels, is uncured, and is heat-processed to a lower internal temperature. The resulting product is suitable as an entree but has comparatively short shelf-life and lacks antimicrobial agents that act against specific food pathogens.

Auburn researchers found that potassium sorbate was not an effective antimicrobial agent to use with pre-cooked, sliced roast beef. Secondary heat treatment was found to be effective in controlling micro-organisms, but created some problems with purge (free water in the package) and color of the product. This study indicates that extreme care should be exercised in product handling and inventory management to insure that prepackaged, sliced roast beef is high in quality and safe to consume.

Dietary lysine is essential to lowfat poultry products

Alabama's poultry industry is increasing its production of value added products. This growth is dependent upon the consumer's perception that poultry products are high in protein and low in fat.

Research at the Experiment Station on the feeding of marginal lysine to broilers before marketing revealed that growth was not affected. Reduced lysine, however, did reduce carcass meat, particularly that on the breast, and increased skin and fat.

Lysine is a component of all proteins, however, the amount in feed given to meat birds is normally less than the known dietary requirement. This lysine is heavily committed to forming muscle during growth. Lysine is expensive but warranted when viewed in terms of product yield and quality.

By increasing quail populations in the State, researchers hope to create new interest in the sport and increase hunting lease values for landowners.

Increasing agricultural production and maintaining a clean environment is a dilemma that has been faced by farmers and livestock producers for years. It is a problem that will grow worse in the future because of a dwindling number of farmers and increased intensity in production from those who remain, plus the increasing urbanization of rural areas. In the Sand Mountain area of the State, for example, over 60 percent of the water in Lake Guntersville has contaminant levels above the National guidelines. Environmentalist predict, if the current trend continues, the lake will be unusable for fishing and recreation within 10 years.

Other areas of the State are similarly concerned about pollution of lakes and streams from runoff, and perhaps more potentially dangerous, the pollution of ground water sources. Recent Experiment Station research indicates that agricultural pesticides are not a major contributor to pollution of streams by runoff of rainwater from farmland. Similar testing of pollution in West Point Lake indicates the primary source of this contamination is effluent from sewage treatment plants and not agricultural pesticide runoff.

In the Sand Mountain area researchers are conducting a series of tests to find the optimum utilization of chicken litter. This litter, which is a combination of wood shavings placed on the floor of chicken houses and chicken manure, is high in phosphates and nitrates — potential groundwater contaminants.

Auburn researchers have found that high rates of chicken litter used as organic fertilizer in late fall produced higher yielding, earlier maturing crops of sweet corn and broccoli than plots using commercial fertilizers. Comparable studies are being conducted to evaluate chicken litter use on winter wheat, fescue, other vegetable crops, and ornamentals.

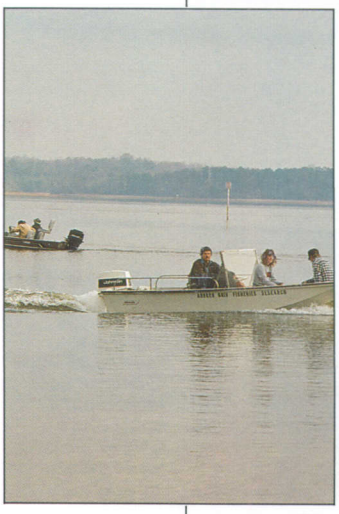
Auburn researchers are also concerned about aesthetic aspects of the environment. In an ongoing test of over 100 shade tree varieties, Experiment Station researchers found that Autumn Blaze, Aristocrat, Cleveland Select, and Capitol varieties of flowering pear trees may be more suitable to certain landscapes than the popular Bradford variety. Bradford flowering pear trees also have a problem with limb splitting, which is less severe in some of the newer varieties.

Increased organic matter threatens West Point Lake

Few reservoirs have been as intensively studied as West Point Lake, located on the Chattahoochee River just 50 miles downstream from Atlanta. In 1976, one year after impoundment, a study was begun by Experiment Station researchers to measure the effects

of nutrient enrichment of this lake as it aged.

The amount of carbon produced by phytoplankton has increased dramatically in the past few years. This increased productivity was apparently caused by nutrient enrichment of the lake waters resulting from a significant rise in volume of treated sewage effluent and urban runoff associated with expanded urbanization of the Atlanta metropolitan area.



Water quality tests indicate future problems for West Point Lake.

One consequence of an increase in organic matter production within the lake is a decline in dissolved oxygen needed to support aquatic life. If this trend of increased productivity continues, there could be a reduction in fish habitat and an increased risk of fish kills in the lake and its tailwaters, especially during the warmest months of the year.

Fish population studies in crappie capital lake

Weiss Lake, located in Cherokee County, Alabama, is known throughout the Southeast as the 'crappie capital of the world.' The reputation is well deserved. Throughout the years, the reservoir has provided quality crappie fishing. However, in recent years fishing pressure, targeting crappie especially, apparently has increased. This increased fishing pressure coupled with an apparent decline in the number of crappie available for harvest has resulted in concern that the fish population is being exploited excessively.

Joint studies by the Experiment Station and the Alabama Department of Conservation and Natural Resources centered on understanding the extent to which anglers were harvesting the stocks. During the winter of 1987-88, over 703 crappie were tagged and released. As the crappie season progressed 108 tags were returned by anglers. Of the total, 53 percent were out-of-state anglers, a fact which emphasizes the economic importance of Lake Weiss to the area.

Adjusting the rate of return for tag loss and nonreporting of tagged caught fish, the crappie population appears to be moderately exploited. Data indicate that given the cyclic nature of crappie spawning in reservoirs coupled with an apparent increase in fishing on the lake, some regulation of harvest may be beneficial.

Pond pesticide testing helps evaluate environmental impact

A 2-year study recently was initiated by the Experiment Station to develop procedures for the testing of the effects of pesticides used on agricultural crops on plant and animal communities in ponds. The Environmental Protection Agency (EPA) is recommending this approach for the testing of certain toxic pesticides subject to run-off into small ponds after application. Information developed from the Auburn study will assist the EPA in formulating regulations for evaluating the environmental effects of agrichemicals before they are marketed.

The study was designed to obtain baseline information on the aquatic plant and animal communities in the first year and to follow this phase with pesticide application. In the second year, effects of the pesticide on the communities will be determined.

Results of the first year's work found that differences between zones within a mesocosm were most pronounced among plankton communities. Zooplankton abundance typically was higher in open water. During summer, differences between open water and shoreline zones were significant. Phytoplankton abundance was usually higher in the shoreline zone. Recirculation resulted in significantly higher plankton abundance on several dates, plus higher bluegill production. The treatment phase has been completed and researchers are now studying recovery of the systems.

Public supports farmers on soil erosion issues

A survey of over 3,000 household respondents was carried out by the Experiment Station to determine public perceptions of farmers environmental behavior.

More than 90 percent of the respondents felt that landowners are obliged to protect soil resources for future generations. Almost two-thirds of the sample felt that most farmers take good care of the soil. Nevertheless, about 57 percent thought that laws regulating excess soil erosion are badly needed. About 40 percent thought the government should pay farmers to practice soil conservation. A similar proportion supported applying financial penalties to farm operators who fail to adopt needed soil conservation practices.

Only about 25 percent thought soil conservation programs were carried too far. The public seemed ready to consider stronger steps to stem soil erosion, given the economic realities of farming.

Hunting is a big asset to Alabama's economy

In many instances, wildlife and the harvest of wildlife species through hunting in Alabama have been thought of only as by-products of forest management. However, preliminary findings from an Experiment Station research project indicate that hunting may be regarded as one of Alabama's major income generating

industries. Results have shown that individuals hunting in Alabama spend in excess of $677 million annually on hunting and hunting-related items. This is based on 1,800 responses to an Experiment Station survey of licensed hunters within the State.

The value of this industry to the State had not previously been accurately documented. This study demonstrates that wildlife in Alabama is one of the State's leading economic assets.

Biodeterioration in structures is a health and economic problem

Deterioration of carpets, wallpaper, and wallboard due to fungi is a serious problem of the hotel/motel industry in the hot-humid Southeast. Musty odors from the fungi render rooms unusable and the redecorating costs add substantially to operating costs. In many situations, wallpaper in newly built structures has to be replaced every 3-6 months. In many hotels the costs are several thousand dollars per day. Additionally, fungal spores in the air represent serious environmental and health hazards.

Experiment Station research has been done to identify the fungi involved in biodeterioration, learn what substrates are being used as a food source, and how to control the fungi. The majority of the fungi identified were Cladosporium, Stachybotrys, Penicillium, Alternaria, Aspergillus, and Ulocladium. Two new fungal species have been identified from these unique habitats. While these fungi have been found utilizing paper, natural fibers, wallpaper paste, and paint as substrates, some appear to be decomposing man-made vinyl wallpapers and synthetic carpet fibers.

Scientists are currently evaluating control strategies that include modification of the environment to reduce relative humidity and condensation problems. This work is being coordinated with building systems engineers. Another strategy being examined is the use of fungicidal products either applied directly to surfaces or incorporated into wallpaper and carpet materials.

Alternative Crops and Resource Use

Growth regulating chemicals have proven a boon for Alabama's nursery industry.

Experiment Station researchers are constantly seeking alternative crops and more efficient uses of natural and human resources. Though prices for most commodities are currently at a level that is profitable to farmers, the cyclical pricing nature of these goods mandates that researchers keep a constant vigil for new crops and products.

It is difficult to determine today what will be a major commodity in the future. When the catfish industry began in west Alabama in the mid 1960s, no one imagined it would become the seventh or eight largest agricultural industry in the State today.

The interest in commercial fruit and vegetable production in Alabama is growing

rapidly. An indication of this interest is the recent attendance by over 300 people to the State Fruit and Vegetable Growers Association in Auburn, which featured an address by Governor Guy Hunt. The Experiment Station is playing a key role in the resurgence of the fruit and vegetable industry in the State.

The Experiment Station recently released a new plum variety, AU Rubrum, which could become the dominant commercial plum variety in the State. Scientists are also seeking to expand the State's peach industry by developing varieties more suitable to growth in extreme south Alabama, where peaches could ripen earlier and fill a void in the market.

Increasing vegetable production and quality are vital to further development of the industry in the State. Already researchers are developing different mulching systems that take optimum advantage of Alabama's warm early spring climate and provide maximum protection against weeds and insect-vectored diseases. New varieties of sweet corn, potatoes, and other vegetables are screened annually by Experiment Station researchers at research facilities throughout the State.

Giant crayfish, often called freshwater lobster, look promising for Alabama catfish producers.

Just as important as finding out which new crops will work is finding out early which ones aren't suitable for production in Alabama. Such is the case of pepino dulce, a breakfast fruit, grown extensively in Mexico and California. While this high yielding fruit has tremendous market potential, Auburn researchers have found that it simply won't set a sufficient number of fruit in Alabama's climate to ever be an economic factor in the State. Similar studies are looking at the feasibility of growing kiwi fruit and fajoa. The first partial crop of kiwi fruit was harvested at the Experiment Station in 1988 and early indications are that it will be difficult and expensive to grow commercially.

Freshwater lobsters tested for growth in catfish ponds

Already freshwater shrimp are being grown experimentally in catfish ponds, now scientists are testing giant crayfish for use in the State's aquaculture industry. The crayfish look more like lobster, and taste remarkably similar to Maine lobster.

Several species of crayfish have been identified that may have potential for pond aquaculture in Alabama. One large species called marron, native to southwestern Australia, is capable of growing at a rate of one-fourth pound a year and reaching a maximum size of over 2 pounds. Crayfish grown in the United States usually reach a maximum size of about one-tenth pound in a year. Growth rates of marron in research tanks at Auburn during 1988 have been as good or better than growth data reported from Australia. Marron survived well during the winter but showed signs of heat stress during summer. Low salt concentrations were found to improve survival during summer months.

A second large crayfish, called the redclaw, from eastern Australia is also capable of reaching a pound in size. The natural range of the redclaw includes regions with summer temperatures at least as high as those found in Alabama. Research will continue on both species of giant freshwater crayfish in efforts to find new, high value crops for Alabama farmers.

Azalea flowering enhanced by growth retardant use

The nursery industry has grown steadily over the past three decades to become one of Alabama's top 10 industries. Much of this growth has been dependent on research-proven production practices, which allow nurserymen to increase volume and/or quality. One of the most potentially useful tools currently being tested by Auburn researchers is growth retardants.

Daminozide and chlormequat chloride are the principal growth retardants applied to florist azaleas. Delayed flowering and smaller flower size are undesirable side effects of daminozide, while delayed flowering and smaller plant size are undesirable effects of chlormequat chloride. Paclobutrazol, currently labeled as Bonzi, for use on poinsettia, is an effective retardant on chrysanthemums, many species of tropical foliage plants, and annual bedding plants. An Experiment Station test was conducted to determine the effectiveness of paclobutrazol in controlling bypass shoots of florist azaleas and to evaluate the chemical's effects on flowering.

Paclobutrazol, applied 38 days before cooling, effectively controlled bypass shoot development and increased flower number of Alaska azalea compared to an untreated control, while minimally influencing days-to-flower and flower diameter. Rates of 150 and 200 parts per million were most effective in controlling bypass shoots and increasing flower number of Prize azalea, while not reducing flower diameter. Days-to-flower was greater (47 days versus 44 days) at the higher rate. Daminozide was less effective than paclobutrazol in controlling bypass shoot development and enhancing flower number. Daminozide also delayed flowering and reduced flower size relative to paclobutrazol and the untreated control.

Flame retardancy improvement increases cotton marketability

King Cotton has made a resurgence in Alabama in the past few years. In addition to developing technology for growing cotton, Experiment Station researchers are also involved in finding new and better uses for the fiber.

Cotton can be made flame resistant by treating the fiber with certain organo-phosphorus compounds. Unfortunately, if ions such as calcium and magnesium are precipitated onto the fabric, as can happen in laundering, then the effectiveness of the organo-phosphorus finish may be negated. This effect is a serious one and has caused the reduction or elimination of cotton in certain end-uses.

During this past year, Auburn researchers examined how the mode of deposition of soluble and insoluble compounds on organophosphorus-treated cellulose fabrics affects flammability. The study examined an unfinished fabric and two with organo-phosphorus finishes. The salts were applied to the fabrics by laundering and by a padding and ion-exchange procedure to form calcium chloride and calcium carbonate. The fabrics were examined by elemental analysis, vertical test, oxygen index, scanning electron microscopy, and by pyrolysis and gas chromatography.

The latter work showed that pyrolysis products, such as carbon monoxide, carbon dioxide, and water were altered by the organophosphorus finishes. The two finishes examined, THPOH-NH3 and Pyrovatex CP, differ in chemical nature and in the way each reacts with cellulose. In this study, the Pyrovatex finish was affected the same, as far as flammability results are concerned, whether the deposition was by padding or laundering. The THPOH-NH3 finish, however, was affected adversely only by laundering. The difference is apparently linked to the fact that ion-exchange groups exist in the Pyrovatex finish, and thus the ion-exchanged calcium may play the more important part in negating the finish.

Soilborne diseases a threat to kiwi plantings in Alabama

Considerable interest has been shown by growers in Alabama and other Southeastern States for growing kiwi fruit. One of the four experimental plantings made by Experiment Station researchers was on lands previously in long-time peanut production. Following heavy summer rains, over 50 percent of this planting was lost to soilborne organisms that become problems in wet soils.

To solve this production problem, rotted kiwi roots were retrieved and used in laboratory studies to identify the pathogens. Pure cultures of fungi not previously known to attack kiwi plants were discovered. Researchers infested soils with these fungi to inoculate greenhouse grown potted kiwi plants. Within 6 weeks, the majority of plants in infested soil had died, but plants in uninfested soils (controls) continued to grow vigorously.

The Auburn test indicates that to reduce problems from soilborne disease problems, growers should make kiwi planting only in well-drained, light-textured soils.

Utilizing shellfish by-products could also benefit agriculture

Finding a way to utilize the by-products of Alabama's shellfish industry could provide valuable agricultural products from otherwise useless and contaminating waste materials. Experiment Station researchers have been screening bacteria to identify those which have the ability to degrade the material chitin, which forms a major part of the shells of crustaceans such as shrimp and crabs. Researchers hope eventually to turn this chitin waste into alcohol fuels, biological pesticides, and other useful fermentation products.

Soilborne diseases damage experimental kiwi plantings in the State.

Over 134 bacterial strains, representing 41 genera and 68 species have already been screened for the ability to degrade chitin. Others are currently being isolated from bat guano and marine sources, because it is believed that chitin degrading activity would be high in bacteria growing in these situations.

Those bacterial species showing a high level of activity are being tested in conjunction with yeasts and other microorganisms for alcohol production from chitin. Preliminary results from these fermentation experiments look promising. Future work will be concerned with optimizing production of chitinase and determining optimal conditions for the fermentations.

Off-farm employment helps both community and farm

Optimum utilization of rural human resources is critical to future growth of nonurban areas of the State. Experiment Station research indicates more and more farm families are employed at least part-time in off-farm jobs. A steady job market available to these people makes rural areas more attractive to industry.

A survey of 111 Alabama farm couples revealed that one-third of the men and one-half of the women held off-the-farm jobs. More than three-fifths of these employed farm family members were employed

full time, implying a significant time commitment for both spouses. For three-fourths of the husbands and wives, provision of a supplement to the farm income was the primary reason for the off-the-farm job. Over three-fifths of the men and women in the study were dissatisfied with their farm income, explaining the high percentage employed off the farm. However, one-half of the men and women were satisfied with their standard of living, a standard made possible by the additional income provided by off-the-farm jobs.

The Auburn study indicates that provisions of jobs in rural areas for farm family members enhance not only the area's economic productivity through those jobs, but the economic stability of the farm is also enhanced, creating a win-win situation.

Recycling industrial wastes provides a lime substitute

Experiment Station researchers are working with paper mills to recycle wastes that are piling up in landfills and waste lagoons. One waste is boiler ash, the residue left when wood bark, chips, and other materials are burned to generate electricity for paper mills.

Wood ashes have been used for several hundred years to improve soil fertility. Ashes are an alternative source of lime and provide plant nutrients, particularly potassium and calcium. Sludges from waste lagoons at papermills may also be spread or injected into soils to add organic matter as well as plant nutrients.

Tests at Brewton Experiment Field and on grower fields in Baldwin, Mobile, and Dallas counties have shown that boiler ash can be substituted for agricultural lime if equivalent rates are used based on the neutralizing value of the boiler ash. However, rates as high as two to four times that of agricultural lime may be needed. No detrimental effects have been recorded on crops at rates as high as 12 tons per acre in the Auburn tests.

FORESTRY

Researchers at the Atmospheric Pollutant Test Center manufacture ozone and acid rain and test the effects of these pollutants on the growth rate of pine seedlings.

Forestry research is a microcosm of the overall Experiment Station research effort. Forestry draws from the expertise of wildlife researchers in the College of Science and Mathematics to test forestry production practices that will also make the land more valuable for hunting leases. Ag engineers are a part of the forestry research team and play a vital role in developing more efficient timber harvesting equipment. Plant pathologists are working with foresters to develop genetically altered fungi that promise to provide a better root zone environment for pine seedlings, and subsequently increase the growth rate of young trees.

Forestry researchers at Auburn have completed the construction phase of a series of plastic chambers to house atmospheric pollution studies. The researchers manufacture ozone and acid rain and pump these pollutants into the 16-foot-tall plastic chambers to measure the effect on the growth rate of loblolly pines.

The manufacture of flakeboard and I-beams will allow the forest products industry to more efficiently utilize all of Alabama's forest resource. The use of sweetgum, poplar, and other species once considered 'trash trees' not only provides valuable resources for use in flakeboards, but also reduces the cost of eliminating these trees from pine stands.

Forest site preparation, deer habitat compatible

A study in the southern Piedmont is making it possible to ascertain differences in the quantity of whitetail deer browse associated with different mechanical site preparation treatments. A multidisciplinary team of researchers is evaluating loblolly pine performance differences among site preparation treatments.

Four site preparation treatments were compared over the course of four seasons. These, in order of increasing intensity, included harvest only; harvest and chainsaw hardwoods; shear and chop; and shear, rootrake, and burn. The two lowest intensity treatments are particularly significant since these are frequently applied by small nonindustrial private landowners, individuals that frequently lease their lands to hunters.

In general, the moderate intensity treatments, harvest/chainsaw and shear/chop, tended to produce the largest quantities of deer forage across all four seasons. These treatments also exhibited the greatest diversity of vegetation species, a factor which is also important for deer habitat. Based on total forage production and species diversity, these two treatments seemed to produce the best deer habitat in 5-year-old loblolly pine plantations. In addition, harvest/chainsaw and shear/chop site preparations yielded pine growth and survival as good as that of any other treatment.

These studies indicate that maintenance of good deer habitat is compatible with mechanical site preparation and, consequently, good timber management. This is a positive conclusion for small nonindustrial private landowners since they may be able to optimize the profits from their forest land through a combination of productive pine management and the selling of hunting leases.

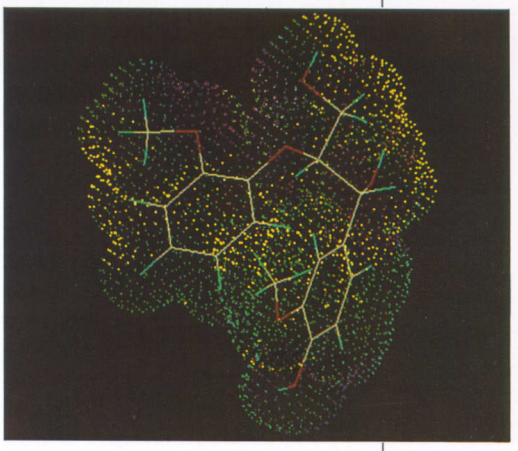
Reducing herbaceous competition important to pine tree growth

Auburn researchers are documenting how control of hardwood trees, versus herbaceous plants, affects pine plantation development. Having now completed a fifth growing season, results from the studies show that controlling herbaceous competition results in greater early pine growth than eliminating hardwood competition. Herbaceous weed control significantly increased growth of hardwoods as well as pines. Treatment of both herbs and hardwoods produced the greatest pine response. Continued data collection will define how these relationships change as the stands age.

Researchers are also conducting tests on the interactions of weed control and fertilization on forest growth, the effects of varied hardwood stand densities on pine plantation development, the effectiveness of several different methods of ground-based brush control techniques, and the identification of effective herbicides for forestry uses. Ongoing research such as this will continually improve the quality and quantity of information that landowners, foresters, and planners need to make silvicultural decisions.

Lignin models could change pulp, paper-making chemicals

Lignin is one of the chemical components found in wood, and its removal is the object of the various chemical pulping processes. While lignin has been extensively studied by a number of chemical methods, the current techniques of computational chemistry and molecular modelling have been applied only sparingly. The application of these computer-based technologies to problems in lignin chemistry are being addressed by Experiment Station researchers.



Lignin models help improve pulp and paper making chemicals.

Molecular modelling provides information on both the physical structure of molecules and the distribution of charge within the structure. Molecular geometry is important in the determination of the relative stability of a compound, while the presence or absence of electrons at various positions gives clues about how and where chemical reactions may occur.

These methods have been used to explore reactions with chlorine,

Early reduction of herbaceous competition is critical to overall pine tree growth.

related to the bleaching process, and the formation and reactivity of chemical intermediates required for the reactions of kraft pulping. These reactions are not strictly mediated by the charge at a given location, representing a sharp departure from current theory. If these trends continue to be found for lignin, alternative chemicals for bleaching and pulping may be identified that could reduce pollution loads or accelerate the reactions involved in pulping and papermaking.

Reduced pine growth studies in environmental chambers

Success of silvicultural treatments varies among different forest sites.

Recent information indicates a potential decline in the growth and health of southern pines. These observations, along with reports of forest damage in other parts of the country, have led to an increase in public awareness and intensified research efforts. Air pollution has been implicated as a causal or contributing factor to these declines.

As part of a long-term project, five intensive field research sites have been established throughout the Southern United States. One of these sites has been developed at Auburn University. Its purpose is to study the effects of acid rain and ozone on the growth and productivity of loblolly pine under controlled field conditions. Researchers in the Experiment Station are also using this facility for other basic studies of tree-stress physiology. Scientists from Auburn, Tuskegee University, USDA Forest Service, TVA, and NASA are participating in this and related projects.

Trees will be grown in modified open-top chambers for 3 years and exposed to acid rain and ozone at different levels, from clean to polluted. Exposures were started in May and continued through November 1988. These tests will begin again in March or April 1989.

Trees are measured monthly for height and diameter growth as well as other factors. Periodically, trees are harvested to reduce competition and are measured for biomass production and nutrient status.

Forest vegetation control improves pine tree growth

Experiment Station research conducted cooperatively with the forest industry and the U.S. Forest Service is quantifying the effects of various silvicultural treatments on pine plantation growth. These applications are applied soon after planting. The projects are region-wide (Virginia to Louisiana) on numerous sites, thereby allowing insight into how forest responses vary with site and stand characteristics.

These tests are now reaching 5 to 10 years of age, and the data collected are providing many interesting results. Recent findings show that control of grasses and other herbaceous weeds in a pine plantation's first growing season significantly increases subsequent tree growth.

In plantations 7 to 9 years old, 1 year of weed control increased pine height by 12 percent, diameter by 13 percent, and survival by 18 percent. A second year of herbaceous weed control further increased height by 6 percent, diameter by 7 percent, and survival by 2 percent over that obtained with 1 year's control. Combining these attributes (height, diameter, and survival), early weed control treatments more than doubled pine basal area of these stands at age 7 to 9.

These findings document that increases during early growth persist into mid-rotation. Future studies will continue to monitor these stands until the trees are ready for commercial harvest.

DIRECTOR'S RESEARCH AWARDS

Gareth Morgan-Jones, left, was named the Director's Research Award winner in the professorial category and Christine Sundermann, center, was selected the assisant/associate professor level winner. Shown presenting the awards is Director Frobish.

Dr. Gareth Morgan-Jones, professor of plant pathology, was the recipient of the 1988 Senior Director's Research Award. Dr. Christine Sundermann, assistant professor of zoology and wildlife science, was the winner of the 1988 assistant and associate professor level Director's Research Award.

Morgan-Jones is an internationally acclaimed authority on two groups of plant parasitic fungi that attack nematodes. His research was instrumental in developing the biological nematicide Clandosan, which can be used by peanut growers to replace two popular nematicides that were banned by the Environmental Protection Agency in 1986.

His research provided much of the understanding of the life cycle of the disease-causing agent in soybean stem canker. The disease, which once threatened Alabama's soybean crop, is now managed by a combination of crop management practices and varieties. These practices are based largely on the understanding of the life cycle and epidemiology of the causal agent that were defined by Morgan-Jones' research.

Sundermann's research contains elements of both basic and applied work. Her research on coccidian parasites has yielded immediate application, while her work with cell to cell recognition and interaction addresses the fundamental mechanisms involved with pathogenic organisms ability to attack healthy cells. Sundermann's research effort was vital in attaining National Science Foundation funding for the EPSCOR program at Auburn.

RESEARCH APPROPRIATIONS A GOOD INVESTMENT

Appropriations of the Alabama Legislature represent the major source of funding to finance work of the Alabama Agricultural Experiment Station. These appropriated funds also serve as a catalyst to obtaining research dollars from other sources to supplement State funds. The result, as noted from the accompanying financial statement, is a doubling of the financial base supplied by Alabama taxpayers through State appropriations. The contract and grants total of more than $5 million was a significant addition to the funds available for research in 1988.

Although it is difficult to determine returns from investments in agricultural research, data from several national studies provide guidelines for computing such returns. A summary of 21 U. S. studies indicates a return of 30-100 percent annually for long-term research on crops and livestock. Data on the multiplier effect of research spending establishes that each $1 spent for such research adds $9 to agricultural output. Moreover, this $1 investment adds almost $11 to the gross state product and more than 300 man-years of employment. Using this factor, Alabama's $26 million expenditure on agricultural research adds $234 million to agricultural output and $286 million to the gross state output — plus providing 7,800 man-years of employment for Alabamians.

Another important point about expenditures for Auburn's agricultural research is that these funds have a positive effect on all areas of the State. Not only are results used statewide, but the research dollars spent at 23 AAES locations throughout the State boost the economy of each of these areas.

ALABAMA AGRICULTURAL EXPERIMENT STATION
REPORT OF REVENUES
FOR THE FISCAL YEAR ENDING SEPTEMBER 30, 1988

APPROPRIATED FUNDS			
STATE		$13,064,363	49.2%
FEDERAL		4,006,527	15.1%
CONTRACTS AND GRANTS			
FEDERAL	2,095,213		
STATE	821,998		
PRIVATE	2,425,763	5,342,974	20.1%
AUXILIARY REVENUES			
SALE OF RESEARCH PRODUCTS	3,118,782		
DIAGNOSTIC SERVICES & FEES	243,755		
INTEREST AND ROYALTIES	263,548		
INDIRECT AND OTHER COST RECOVERIES	493,038	4,119,123	15.5%
TOTAL REVENUES		$26,532,987	100.0%