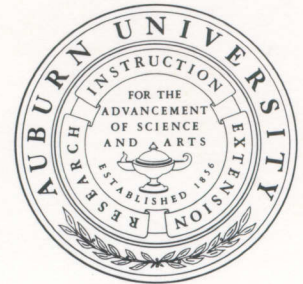

ALABAMA
AGRICULTURAL
EXPERIMENT
STATION



ANNUAL REPORT 1985

ADMINISTRATIVE OFFICERS

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COVER STORY

Turfgrass research is an important segment of the Alabama Agricultural Experiment Station's research program, with emphasis directed in two general areas: (1) management of turf for home grounds, recreational areas, and public or industrial grounds; and (2) production and marketing of turfgrass as a commercial agricultural venture. One of the newest projects, and one that is making major contributions to successful use of centipedegrass, is an evaluation of postemergence applied herbicides for controlling annual grasses in established centipede. Results of this research are expanding the weed control practices available to turf managers.

FOREWORD



Significant changes in the organization and administration of agricultural programs at Auburn University were initiated during 1985. Under the new organization, the Agricultural Experiment Station reports to the Vice President for Research.

The School of Agriculture, Forestry, and Biological Sciences received a new name, the College of Agriculture. The changes also created a new School of Forestry and a new College of Science and Mathematics. The latter will include departments of Botany-Microbiology and Zoology-Wildlife, subject matter units that were originally in agriculture and which will include personnel with joint Agricultural Experiment Station appointments.

There will also be new leadership in administration of agricultural research. A new Director of the Agricultural Experiment Station will be named before the end of the 1986 fiscal year.

The purpose of these organizational and administrative changes is to enhance the effectiveness of the Alabama Agricultural Experiment Station in fulfilling its mission: "To conduct both basic and applied research

for the establishment and maintenance of effective agricultural and forest industries and to improve the quality of life in Alabama." This philosophy of service has led to significant advances in agriculture and forestry through the years, with advantages accruing to all citizens of the State.

Another constant is the dedication of the faculty and staff to fulfill this mission. This dedication is evidenced by the amount and quality of research findings that were generated in 1985. The research highlighted in this report is only a small sample of the total research program, but it does give a good cross section of the scope of research.

With a significant increase in funds, we were able to address several important needs in 1985; however, several years of reduced funds cannot be overcome in one or two years. For example, in the past 10 years the number of scientist years devoted to agricultural research has decreased about 10 percent. This simply means that we can address fewer problems. Problems facing agriculture today are more complex than in the past, thereby requiring more people and

funds to solve. Therefore, with reduced funding ahead, we must be highly selective in choosing and developing research projects to assure that quality research is maintained in areas that will result in the greatest benefits from the investment in research.

Since research is credited with returning dividends of 40 to 50 percent, most of us would want to increase, not decrease, the nation's investment in research. Food security is critical to this nation and agricultural research is the key to our food security. Agricultural research is a long-term process, and we must not allow short-term surpluses or price fluctuations to cause us to lose sight of the necessity of continuing such research.

The citizens of Alabama are the ultimate beneficiaries of research by the Alabama Agricultural Experiment Station. We are pleased to provide each of you an accounting for funds used for this research and a brief overview of the findings of selected projects. Your input into our research program is important and we would welcome your comments.

David H. Teem
Acting Director

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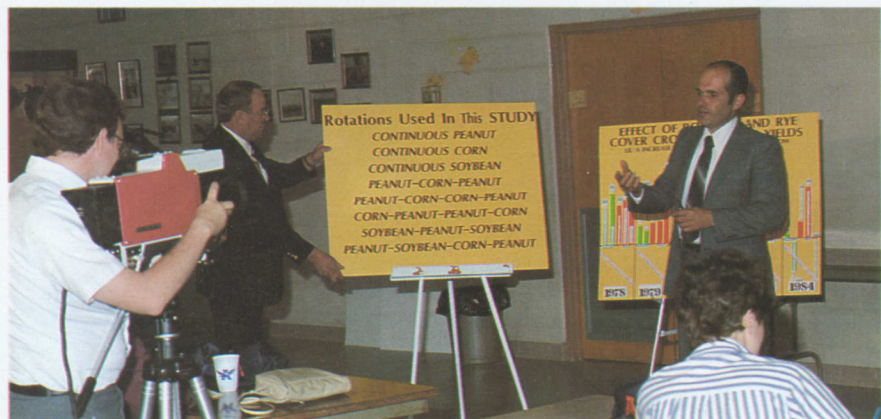
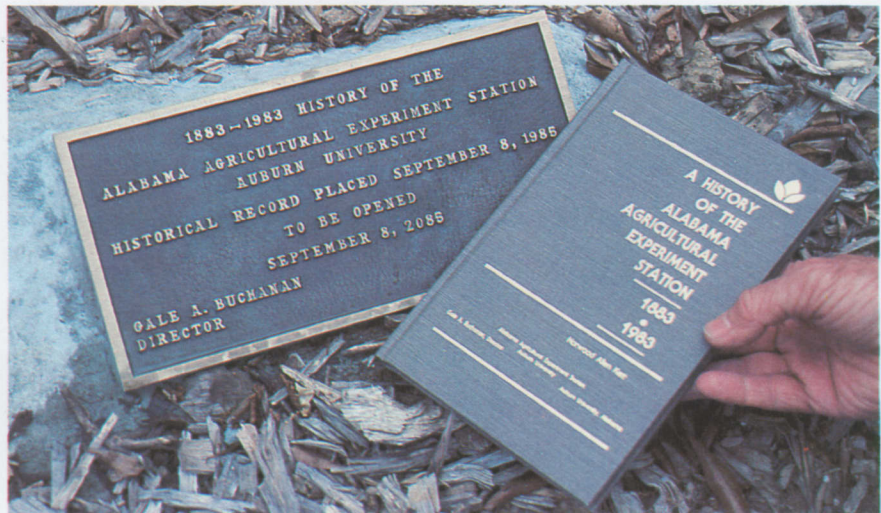
NOTEWORTHY EVENTS IN 1985

Several special events occurred during 1985 to call attention to the research programs of the Alabama Agricultural Experiment Station and to recognize current and past accomplishments. These included a reception to announce publication of a history of the Station, sponsorship of international conferences, a press conference to announce significant new research findings, all-commodity field days at outlying units, and participation in the Sunbelt Agricultural Exposition.

Publication of the 100-year history of the Alabama Agricultural Experiment Station was heralded by a reception held September 8, 1985, on campus. Auburn friends from around the State were joined by agricultural research leaders from as far away as Washington, D.C., at the event hosted jointly with the Department of History to recognize the Station's service since 1883 and to honor the book's author, Dr. Norwood Kerr. A feature of the occasion was the burying of a time capsule containing a copy of the history and other information about the Experiment Station in front of Comer Hall.

The press conference held to announce significant research findings was a first for an outlying unit of the Experiment Station system. Held at the Wiregrass Substation, the conference featured reports from the research team that had developed practical rotations of peanuts, soybeans, corn, and small grain to reduce problems from nematodes and improve overall productivity. The findings were widely reported by weekly and daily newspapers and television stations in the affected area and by regional farm publications.

TOP: A copy of the 100-year history of the Alabama Agricultural Experiment Station was among the materials placed in a time capsule to be opened on the Station's 200th birthday. CENTER: Even the TV reporters wore Auburn caps while reporting from the press conference at the Wiregrass Substation. BOTTOM: Results of crop rotation research got wide attention through daily and weekly newspapers, area television stations, and farm magazines that covered the spring 1985 press conference.





dealing with soybeans, grain crops, horticultural crops, livestock, forages, and cotton. In addition, the 1985 Commodity Conference held by the Alabama Farm Bureau Federation included crop and livestock tours to the Tennessee Valley Substation. Other outlying units held traditional field day programs covering field crop, horticultural crop, and livestock research to update area farmers on Experiment Station work underway in each area of the State.

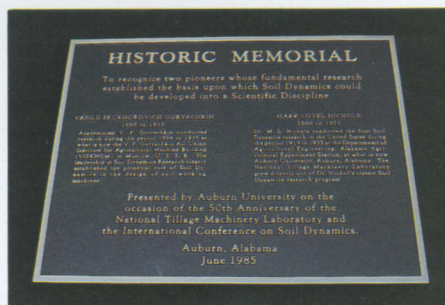
Auburn's agricultural exhibit at the 1985 Sunbelt Agricultural Exposition in Moultrie, Georgia, presented a comprehensive review of research in the area of animal and dairy sciences. An exit survey conducted by agricultural economics and rural sociology faculty and students revealed that visitors to the 40- x 80-foot tent display were impressed with the quality of work depicted. Live cattle and swine were used to illustrate various types of research.

The most important things to report for 1985, of course, are findings of research conducted to support Alabama's agricultural and forestry enterprises. Carrying out such a research program has been the mandated mission of the Alabama Agricultural Experiment Station since its establishment in 1883, and the need for service-oriented research has never been greater than it is under today's tough economic conditions. Success of this research program is documented by selected findings reported by subject matter on the pages that follow.

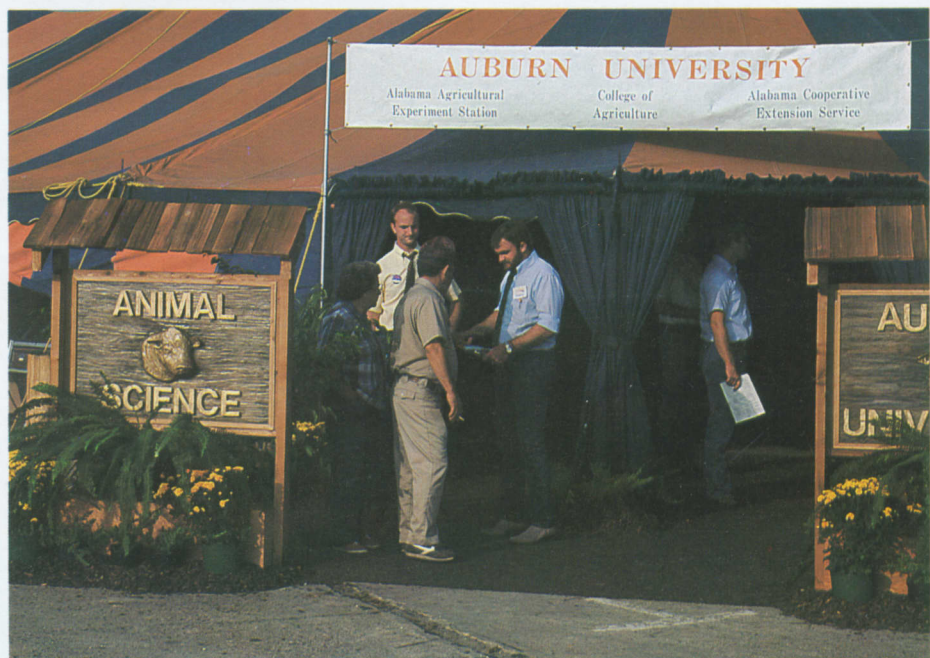
World authorities on soil dynamics gathered on campus last June for an International Conference on Soil Dynamics and for celebrating the 50th anniversary of the National Tillage Machinery Laboratory. The Alabama Agricultural Experiment Station joined the USDA Tillage Machinery Laboratory in sponsoring the event, which drew more than 100 participants from 22 nations. A highlight of the conference was unveiling of a plaque honoring the late M.L. Nichols, Auburn agricultural engineering faculty member who played a major role in development of the Tillage Lab, and his Russian counterpart, the late V.P. Goryahkin, for their pioneering efforts in development of the science of soil dynamics. Bronze plaques were cast for hanging at the Tillage Lab and at the Moscow Agricultural University in Russia.

The other international event cosponsored by the Experiment Station was an International Symposium on Nursery Management Practices for the Southern Pines, held during August in Montgomery. Other sponsors were the School of Forestry and the International Union of Forestry Research Organizations. The 155 registrants, representing 10 nations, heard presentations by world authorities which were published in a 606-page proceedings that will likely become the recognized source for information on pine nursery management practices.

All-commodity type field days were held at the Sand Mountain and Tennessee Valley substations to offer area farmers an opportunity to review research on several crops and livestock during a single visit. Several hundred farmers attended these events that had research reports and tours



TOP: Field day programs drew large crowds to substations during the year. CENTER: A plaque honoring contributions of the late M. L. Nichols was unveiled during the International Conference on Soil Dynamics held in June on campus. BOTTOM: Animal science research was featured in Auburn's exhibit at the Sunbelt Agricultural Expo in Moultrie, Georgia.



Zoology-Entomology

Research in zoology-entomology has continued to address significant problems which impact upon broad constituencies throughout Alabama. Studies in the basic life science area of parasitology and protozoology have yielded new information relative to the biology of the parasite organisms *Cryptosporidium* and certain other coccidia. This provides additional information which is basic to improved treatment of infected domestic animals.

The entomology program has generated new findings which relate not only to insect pest management in major agronomic crops and livestock but also to control of pest species in the home. Prominent findings have been generated relating to biology and control of soybean and livestock insect pests as well as the ever present cockroach.

Auburn's wildlife research program continues to be recognized as one of the most outstanding in the region. Recent findings provide the basis for improved management practices for mourning dove and wild turkey.

Control Being Sought for Threecornered Alfalfa Hopper

Until recently, the threecornered alfalfa hopper was considered to be primarily an early season pest that reduced soybean stands. New studies in Louisiana and Alabama, however, established that threecornered alfalfa hoppers are an important late season pest of soybeans. Since the economic threshold of one adult per sweep after pod set (established in Louisiana) is often exceeded in Alabama fields, research was begun to verify the threshold and develop control measures.

Threecornered alfalfa hoppers damage soybean plants by puncturing plant stems

and leaf petioles and removing sugars from the phloem. This damage typically occurs in a concentric ring around a stem or petiole, and is called a "girdle." The research underway is seeking a "weak link" in its life cycle where control practices would be the most effective.

Temperature is known to play an important role in regulating growth and mortality of the insect. For example, threecornered alfalfa hopper growth in a constant temperature of 85°F is approximately twice as fast as at constant temperature of 70°F. Mortality was decreased approximately 50 percent at 85°F compared to 70°F.

The impact of commonly used insecticides on predators of threecornered alfalfa hoppers has been emphasized in a 3-year field study. Assuming that an insecticide application for threecornered alfalfa hoppers was needed at or near beginning of pod fill, Lannate was found to be the most effective insecticide at reducing threecornered alfalfa hopper populations while minimally disrupting predator populations. Conservation of predators such as big-eyed bugs and spiders is important because of their ability to reduce pest populations.

A mathematical model of threecornered alfalfa hopper population growth is being developed to aid Alabama's soybean growers in predicting when threecornered alfalfa hopper populations increase to damaging levels.

Biting Midges Involved in Bluetongue Disease

Ceratopogonid midges, commonly known as punkies or no-see-ums, are the principal natural vectors of bluetongue virus (BTV) which infects cattle, sheep,

and white-tailed deer. Alabama Agricultural Experiment Station research singled out four species of these minute, blood-sucking flies as the most likely vectors of BTV in Alabama. One species is known to be involved in natural outbreaks of the disease, whereas two others have been found capable of supporting development of the virus following laboratory infections.

During the past year, the presence of an exotic serotype referred to as BTV-2 was confirmed in Alabama for the first time. Prior to this it was known to occur only in central Florida, where apparently it had been introduced from the Caribbean. Cattle in two Alabama herds infected with BTV-2 have exhibited classic bluetongue signs, including erosion of the muzzle epithelium and oral mucosa, lameness, abnormally small calves dropped near term, and aborted fetuses. These are the first clinical cases to be associated with this particular BTV serotype in North America.

Adult midges have been collected at known or suspected outbreak sites in an effort to isolate the virus from naturally infected flies and to determine which species are responsible for the current rapid spread of this virus throughout the State. The distribution of this virus is being monitored in cooperation with virologists and epidemiologists at the AU College of Veterinary Medicine and the State of Alabama Charles S. Roberts Veterinary Diagnostic Laboratory. Cattlemen are being asked to notify local veterinarians and appropriate State personnel when suspected cases arise so efforts can continue to help check the spread and incidence of this potentially serious disease of livestock and wild deer.

The threecornered alfalfa hopper is now recognized as a late season soybean pest.



Lead Poisoning in Mourning Doves Studied

Over 3 million mourning doves are harvested annually in Alabama, thereby providing considerable recreational and economic benefits to the State. The ingestion of spent lead shotgun pellets by mourning doves that feed in heavily hunted "dove fields" may be a threat to this activity. Results of Auburn studies indicate that ingestion of lead shot can be potentially harmful to mourning dove populations. Analysis of gizzard contents suggests that between 1 and 6 percent of the mourning dove population ingest lead shot.

In one experiment, four different groups of 25 doves each were maintained on a corn diet and were force-fed either 0, 1, 2, or 4 No. 8 lead shot. They then were housed in outdoor flight cages that contained suitable perches and overhead protection.

Mortality rates recorded during the 3-week experiment were 0, 24, 60, and 52 percent, respectively, for 0, 1, 2, and 4 shot ingested. The majority of doves that died did so when temperatures dropped below the freezing point. In another experiment, mated female mourning doves maintained indoors at room temperature on commercial pelleted feed were force-fed either 0 or 1 No. 8 lead shot. Treated females produced eggs with significantly higher embryonic mortality than control females even though no direct mortality of the females occurred.

Wild Turkey Reproductive Success Limited by Predators

Factors affecting wild turkey reproductive success were determined in an Alabama study completed in 1985. Hens that had been captured and instrumented with solar powered radio transmitters were monitored daily (during the nesting season) to detect incubation behavior and hatching. Poults were hand captured before they were 5 days old, fitted with tiny radio transmitters, and released with the hen. A total of 162 of 355 poults in 34 broods was instrumented and an additional 45 uninstrumented poults in four broods provided data on mortality soon after hatching.

Close monitoring of radios and field signs found that the loss rate in 38 turkey broods averaged 70 percent. More than



Close monitoring of poults found that management improvements to provide favorable brood habitat are needed for wild turkey.

92 percent of mortality of the instrumented poults occurred within 15 days of hatching. Loss rates of uninstrumented poults in the broods were not significantly different.

High poult losses, attributed primarily to predation, represent the greatest limitation on wild turkey production. The domestic dog ranked number one of the identified predators. Losses to dogs were due to predation on the hen before the poults were old enough to survive on their own. Raccoons and hawks were also important predators. When nest losses to predators are considered (averaging about 45 percent in Alabama), the overall impact of predation on reproductive success is heavy.

Hens which were relatively successful in raising broods frequented moist forest habitats that were more open, had taller herbaceous plant growth offering cover from predators, and were closer to roads and openings than did hens that were less successful in raising their broods. Poults less than 2 weeks old fared well in old fields with protective cover, but grazed pastures were good habitat for older poults. Since vegetative structure of the habitat apparently affects poult survival, management is needed to favor the growth of good early brood habitat.

Understanding Cockroach Biology Leads to Control

Cockroaches are important pests, particularly in the warm, humid environment of Alabama. Large outdoor cockroaches, such as the American and smokybrown, often live in sewers but may also invade homes and restaurants carrying pathogens and parasites with them.

Auburn research on cockroach survival and movement has shown that the single

most important factor that influences cockroach distribution is the availability of water. The smokybrown cockroach, for example, loses water through its cuticle at over twice the rate of other outdoor cockroaches and at over 10 times the rate of indoor species. Consequently, this species needs free access to drinking water and must live in humid shelters. Other species, like the indoor cockroaches, can survive in drier areas with much less free water.

Environmental factors such as temperature, humidity, and rainfall were found to influence outdoor cockroach movement. Rainfall in particular may decrease movement by up to 300 percent. Estimates of cockroach population and distribution around houses, necessary to evaluate control measures, must therefore be made over a several day period to take into account variable environmental conditions.

These physiological and ecological findings provide the basis for control systems based on habitat modification that will deny outdoor cockroaches their basic needs. This approach to control is especially appealing since its cost is low and, unlike most insecticides, will remain effective indefinitely.

Cockroach research emphasizes habitat modification that will deny outdoor cockroaches their basic needs.



Fisheries and Allied Aquacultures

Aquaculture, aquatic ecology, and fisheries management are the general areas of research at the Alabama Agricultural Experiment Station. In aquacultural research, the main thrust is to obtain information required for the support and promotion of the catfish farming industry. Also in progress is research on other species (tilapia, Chinese carps, freshwater shrimp, and freshwater lobster) that may play an important role in fish farming in the State in the future.

Research in aquatic ecology is planned to obtain information on Alabama's water resources in rivers and large reservoirs. These waters are valuable to a wide spectrum of users (industry, transportation, recreation, water supply), and good information is required if they are to be used wisely.

Recreational fishing is a major industry in Alabama. Its estimated value is in excess of \$250 million annually. Research in farm ponds, community lakes, large reservoirs, rivers, and on the Gulf Coast is being done to increase the economic return from Alabama's recreational fisheries resources while maintaining or improving resource quality.

A high percentage of the research in progress is planned to solve current problems that are limiting development, utilization, and economic return from Alabama's water resources (fish farming, industrial development, and recreational fishing). At the same time, some research effort is being invested in solving problems expected in the future.

Best Paddlewheel Design Identified

The efficiency of paddlewheels used as emergency aeration in catfish production ponds varied considerably depending on shape of the paddles and their arrangement on the hub supporting them. The tests were conducted in a large tank. A chemical was added to the water to remove the oxygen. The design and arrangement of the paddles were evaluated by determining the transfer coefficients during re-oxygenation.

Paddles with a triangular cross section were more efficient than rectangular, concave, or flat paddles. Flat paddles with holes drilled through their faces, flat pad-

dles with serrated edges, or flat paddles with holes through their faces plus serrated edges were no better in transferring oxygen than plain, flat paddles. At the same total paddle surface area, paddlewheels with 2-inch- or 4-inch-wide paddles were no more efficient at transferring oxygen than a paddlewheel with 6-inch-wide paddles.

A staggered arrangement of paddles on the hub (adjacent rows of paddles rotated 45 degrees) was better than a solid (side by side) arrangement of the paddles. Oxygen-transfer was greatest when the space between rows of paddles on the hub was 4 inches. A hub diameter of 18 inches was more effective than a hub diameter of 10 inches and just as effective as a hub diameter of 24 inches. Hence, the best design for a paddlewheel aerator was to mount 6-inch-wide, triangular paddles in staggered rows with 4 inches of space between rows on 18-inch diameter hubs

Operating conditions also influenced oxygen transfer. At a given paddlewheel speed, oxygen transfer increased with the depth to which paddles extended into the water. At a given paddle depth, the rate of oxygen transfer increased as the paddlewheel speed increased.

Selective Breeding Improves Catfish

Studies on the genetics of channel catfish indicate considerable potential for improving characteristics of commercial importance through selective breeding. Heritability, or the ability to pass characteristics from one generation to the next, for body weight, feed consumption, and feed conversion was 0.99, 0.70, and zero, respectively, for Tifton fingerlings and 0.67, 0.01, and -0.36 for Kansas Select fingerlings. Large dominance effects were evident for Tifton and large maternal effects were evident for Kansas Select. Kansas Select grew more rapidly, ate more feed, and had lower feed conversion than Tifton. Tifton expressed more phenotypic variability.

Genetic correlations between body weight and feed consumption were near 1.00. Genetic correlations between body weight and feed conversion were negative, indicating that faster growing catfish utilized feed more efficiently. Direct selection for feed conversion efficiency in

fingerling channel catfish would not be successful, but indirect selection for feed conversion efficiency via selection for body weight has potential.

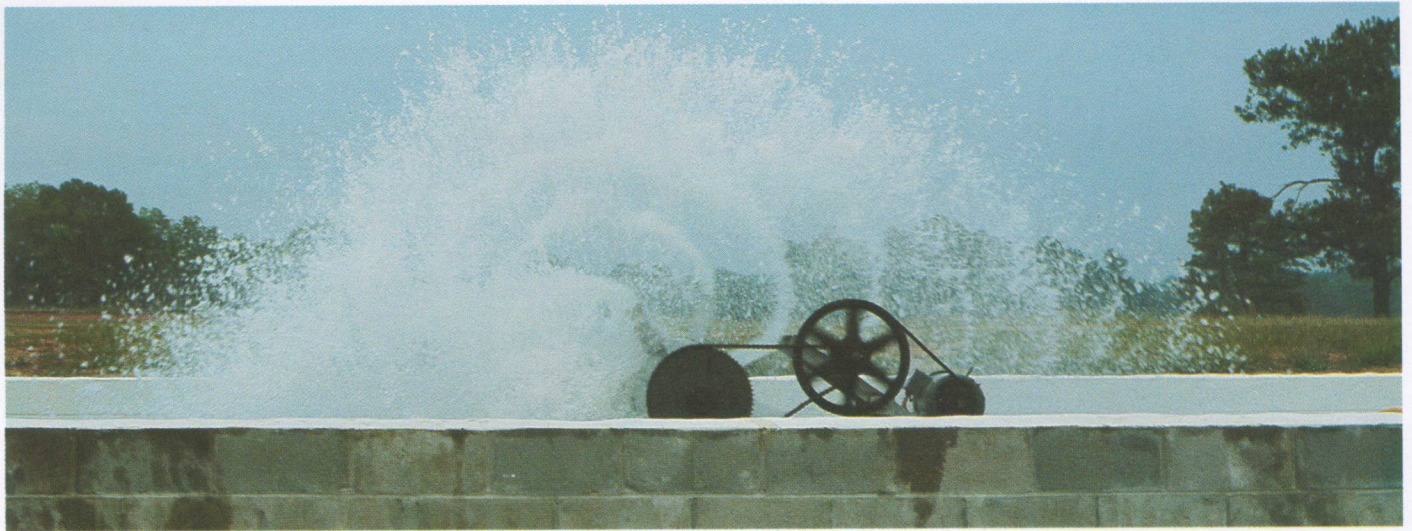
Methods of Disease Entry Identified in Channel Catfish

A bacterium that causes disease in channel catfish (*Aeromonas hydrophila*) gains entry into the body in two ways. Injured skin was found to be the primary one. Bacteria also gained access to the internal organs through intact skin and the digestive tract, but only under conditions of crowding and high temperature.

Lesions observed in experimentally infected fish were compared to those seen in acute and chronic natural infections. Acute lesions were associated with both natural and experimental infections. Acute and chronic infections by *A. hydrophila* in channel catfish can be differentiated by the presence of heavy deposits of stainable-iron pigment associated with lipofuscin in the liver and the spleen of fish with chronic infections.

Trophy largemouth bass are available for harvest in West Point Lake, a result of the 16-inch minimum size limit.





Comparison of different paddle shapes, sizes, and arrangements on the hub provides the design for most efficient paddlewheel operation.

Commercial Catfish Food Has High Quality

A study comparing four commercial brands indicated that fish feeds available to farmers in Alabama are of high quality. In the study, four commercial catfish feeds collected from fish farms in Alabama, a positive control (Auburn formula), and a negative control (low quality plant protein), each containing approximately 32 percent protein and 2.8 kcal of digestible energy per gram, were fed to catfish in ponds for 18 weeks. Weight gain was equal among the commercial and positive control feeds, but lower for the negative control. Average fish size at harvest (1.0 pound) and feed conversion (1.36 feed to grain ratio) were good.

Method of Vaccinating Affects Disease Protection

Success of vaccination for the fish disease caused by the bacterium *Edwardsiella ictaluri* depends on the method utilized and characteristics of the material used. In a field experiment carried out during winter and spring (February-May), fingerling channel catfish were vaccinated with *E. ictaluri* by intraperitoneal injection with either sonicated or whole cell preparations and by immersion using the same preparations. Following challenge, mortality of the fish vaccinated by immersion in the sonicated preparation was 11.8 percent, whereas mortality in

the groups immersed in whole cell bacterin, injected with the whole cell bacterin in adjuvant, or injected with sonicate was 24.6 percent, 57.9 percent, or 41.7 percent, respectively. Although the fish vaccinated by immersion with the sonicated bacteria had lower antibody titers than those vaccinated by the other methods, the immersion vaccines were more protected against challenge with the pathogen.

West Point Reservoir Fishing Improved

Restricting the harvest of largemouth from West Point Reservoir to fish 16 inches in length or larger significantly improved the quality of fishing. Results of fishery and limnological investigations conducted since 1976 on West Point Reservoir indicated that some restriction in the harvest of bass was necessary; consequently, a 16-inch minimum size harvest was imposed in April 1983. The rationale for this decision was that because of low bass recruitment and high

fishing mortality, the percentage contribution of bass to total standing crop was low (i.e., less than 20 percent); this in turn resulted in rather low levels of feeding on prey species, particularly large gizzard shad. As a result, most prey populations were less than dynamic with few young-of-year being produced.

Allowing large bass to accumulate as a result of the length limit was expected to reduce the abundance of shad, which would result in increased reproduction of this species. With more young shad in the lake, the recruitment and growth of bass should increase. In addition, the structures of both the black crappie and bluegill populations were expected to be improved.

During 1985, the measured catch rate of bass was 0.5 fish per hour of directed fishing effort. Before the length limit was imposed, catch rates never exceeded 0.2 fish per hour and averaged only 0.1 fish per hour. Additionally, the percentage of harvestable size bluegill in the population has improved from 20 percent to approximately 40 percent.

Home Economics

Home economics research during 1985 focused primarily on nutrition and foods and consumer affairs. Within the nutrition area, significant time was devoted to identifying important dietary considerations for growing adolescents as well as to better understanding the relationship of vitamin E and exercise to physical health.

Work in consumer affairs continued in

such areas as quality control testing of fabrics for upholstered furniture, the effects of a farm wife's external employment on the family economy, and barriers to affordable housing. These recent research endeavors, like others in home economics at the Alabama Agricultural Experiment Station, seek to improve the quality of life for Alabama families.



Permeability of fabrics was found to vary greatly among finishes.

Comfort and Protection Measured on Textile Finishes

The permeability of certain clothing fabrics has important comfort and health considerations for consumers, according to continuing research on textile finishes. This research assessed apparel fabric in relation to comfort, the movement of chemicals into and through them, the effectiveness of the fabrics as barriers to harmful environmental agents, and the impact on energy utilization.

The permeability of fabrics was found to vary greatly. For example, a 100 percent cotton with a fluorochemical finish (e.g., water and oil repellent) had the highest air permeability, while a 100 percent polyester fabric with an acrylic acid finish (e.g., some flame retardants) had the lowest. Generally speaking, higher air permeability levels are associated with more comfortable fabrics, particularly in warm or hot weather.

Related research on the diffusion rate of a variety of fabrics showed that diffusion rate varied with fabric, finish, and sometimes with pressure level. In comparisons of polyester material, the fabric with the fluorochemical finish had the highest diffusion rate. With cotton fabrics, however, the highest diffusion rate involved fabrics with acrylic acid finishes. Typically, higher diffusion rates are indicative of greater penetration of aerosols through the fabric.

Problems in Nutrition Affect Adolescent Health

American diets typically have excessive amounts of sodium and insufficient quantities of potassium. Such a chemical imbalance has been linked to both heart disease and hypertension. Since eating habits of adolescents are poor, attention has been directed to the sodium and potassium intake levels of this age group. Recent research with teenage girls indicated a sodium intake level of 2-3 grams per day. This amount of sodium is not particularly high and, as such, is generally good news for the health of these adolescents. Potassium intake (through fruits and vegetables, for example) was 1-2 grams per day. Since 2 grams per day is recommended, the data confirm that adolescent diets provide low levels of potassium.

Other research in adolescent health focused on the problem of anemia and the nutritional factors that affect it. Fortunately, a recent study showed that adolescent females have higher levels of iron in the 1980's than did an earlier sample of adolescents in the 1970's. Results on the intake of vitamin B6 and folacin, both

related to anemia, are less promising. Vitamin B6, for example, was found to be deficient in 13 percent of the girls studied. These girls appeared to be missing some of the good sources of vitamin B6, such as liver, meats, whole grain products, eggs, bananas, and fresh vegetables. Folacin, found in leafy green vegetables (cooked only a short time) and some fruits (e.g., oranges), was found in lower than desired levels in 65-75 percent of the adolescents tested. When the same adolescents were tested over a long time, adolescent females with low folacin levels at age 12 also had low levels at age 14.

This research has provided new and valuable information on the nutritional food intake of adolescent females. Southern diets, for example, have been assumed to be good sources of vitamin B6 and folacin and excessive in sodium. The new results, however, showed these assumptions to be incorrect for adolescent females. Although sodium intake was not excessive, there was a clear problem with low consumption of folacin and vitamin B6. No doubt, a greater consumption of unprocessed foods, fruits, and vegetables would improve this situation.

Results from nutritional research identified problem areas resulting from eating habits of typical adolescents.



Poultry Science

By action of the 1984 Alabama Legislature, funds were made available to complete Auburn poultry science facilities that were begun in 1977. This action further provided for continuing appropriation to develop the poultry program in keeping with the industry's rapid growth in the last several years. With completion of new structures and renovations now taking place or anticipated, funds will be available for equipment needs, personnel, and day to day research, teaching, and extension requirements. Valuable and needed research areas will be begun or expanded as identified by the department and its industry advisory committee.

NIR Measures Poultry Body Composition

With increased importance being placed on value added products in poultry meat, body composition has added meaning. The demands for less fat on the carcass is placing pressure on primary breeders and researchers to develop rapid and eco-

nomical methods of fat determination and then changing composition by breeding, nutrition, or other means.

Since standard methods for chemical determination of body fat, protein, moisture, and ash are time consuming, near-infrared (NIR) reflectance spectroscopy was tested for this purpose. These findings indicate that the more rapid NIR techniques are useful for estimating fat and moisture content in whole poultry carcasses and may have application in estimating composition of further processed or restructured poultry products.

New Feeding System For Broiler Breeders

Feeding broiler breeder flocks under floor management has traditionally been a compromise situation in which female nutritional requirements are met and males simply eat the same feed. Under this management, the males eat too much of the feed that is too high in protein for their needs. The result is overweight males, with accompanying foot and leg problems which cause declining repro-

ductive efficiency by 40-45 weeks of age when even higher sperm numbers are needed for the aging hens. The bottom line, of course, is reduced productivity and lowered profits.

This problem can be a thing of the past, thanks to a dual feeding system developed at the Alabama Agricultural Experiment Station. The system relies on using different feeders for males and females. Female feeders were modified by inserting a plastic pipe in the grill, which makes the openings too small for the large males to feed. For the males, a pan type feeder is placed 16-18 inches high between waterers. This height prevents feeding by females, so males can be fed the kind of feed needed.

Research has shown that protein requirement for the broiler breeder male is considerably less than that of the female. The 15-16 percent protein level fed the female proved to be a detriment to age at sexual maturity and semen production in the male. A higher percentage of males fed a 12 percent protein ration produced semen than males fed higher protein rations. This was true of all male productive ages.

Based on Auburn research and industry trials, feeding no more than 4.5 ounces per male per day of a 11-12 percent protein feed with an energy level of 1,275 calories per pound will control body weight of the male and maintain high reproductive efficiency.

The installation of two feeding systems, one for the female and one for the male, has proved to be a simple and relatively inexpensive way to manage breeders on the floor. It is the first management system developed to allow producers to manage males in floor type breeder flocks as a separate entity, and the U.S. broiler breeder industry is rapidly converting to it.

Sodium Zeolite Improves Eggshell Quality

Eggshell defects continue to increase costs of egg production and subsequently increase consumer prices for eggs. Efforts to solve this problem include a series of experiments in which sodium zeolite A (SZA) was fed to commercial Leghorns

A new feeding system developed at Auburn permits separate feeding of male and female broiler breeders managed on the floor, which improves performance and reduces feed cost.



and gave significant improvements to egg-shell quality in both young and old layers.

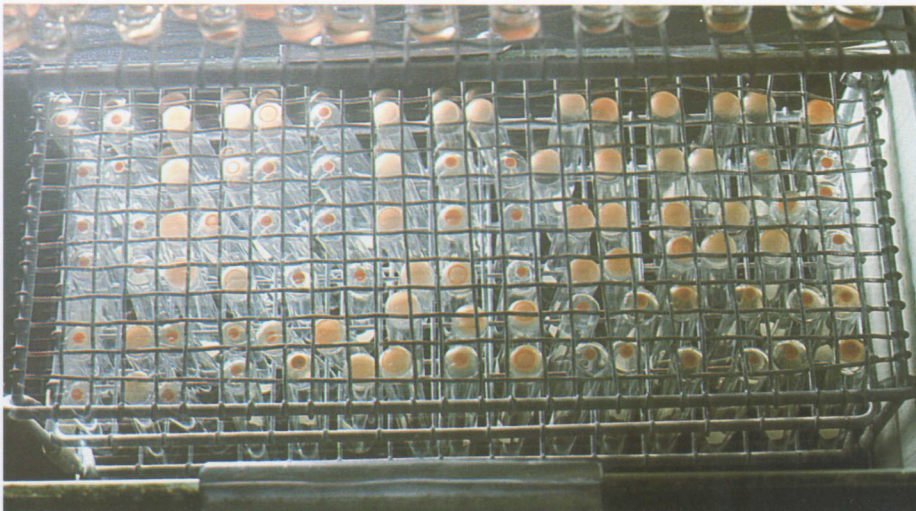
Sodium zeolite A is a crystalline hydrated aluminosilicate of alkali and alkaline earth mineral elements having infinite 3-dimensional structure. The major characteristic of SZA is its ability to gain and lose water reversibility and to exchange mineral elements without major change in structure. In the tests, it consistently improved shell quality even when hens were under optimal conditions and fed the best diets possible. Industry studies indicated that SZA can reduce breakage from thin shells up to 30 percent. Thus, its use will have a significant impact on the commercial egg industry.

Method Diagnoses Bursal Disease Virus

Being able to rapidly diagnose specific disease conditions and immune status is important in health management of poultry. Therefore, Auburn research gives emphasis to perfecting rapid and less expensive diagnostic techniques for use by the poultry industry.

The latest development is a system for measuring and quantitating antibody to infectious bursal disease virus (IBDV) and reoviruses. Identified as KELISA (kinetic-based enzyme-linked immunosorbent assay), the computer assisted technique was

Adding sodium zeolite to layer rations offers chance for reduced egg shell problems.



Blood typing research at the Experiment Station provides the basis for tests to determine genetic susceptibility to Marek's disease in broiler stock.

found to be more sensitive, faster, and used less reagents than previously utilized ELISA's.

The KELISA was used to determine (1) the most efficacious vaccination program for stimulating higher more durable antibodies against IBDV in breeder pullets; (2) the natural decay rate of maternal antibody in breeder progeny; and (3) the most opportune time for immunizing breeder progeny against IBDV.

Cross reactivity between several field and vaccine reovirus strains was also determined using KELISA. The CO₈ virus was found to be in a different serotype than the other five reoviruses. Therefore, if the CO₈ virus is used for immunization, it should be combined in a bivalent vaccine with one of the other five reoviruses for more broad coverage.

Blood Typing Studies Aid Broiler Industry

Blood typing research continued to provide needed technology for the commercial broiler industry. Substantially completed in 1985 were blood typing reagents that allow differentiation of *B* alloantigen genes segregating in three primary commercial broiler breeder lines that are employed in international broiler production.

Matings devised at Auburn produced progeny in the United Kingdom showing that the *B⁹* haplotype of Line M conferred truly high susceptibility to Marek's disease (MD) confirming results of a direct blood typing test devised earlier at the Alabama Agricultural Experiment Station. This result not only gave much credibility to determining genetic susceptibility to

MD by direct serological testing of *B* haplotypes expressed on erythrocytes, but helped the multinational firm distributing Line M to reduce troublesome MD mortality in the third-world countries by eliminating *B⁹* from the line.

New Coccidiosis Vaccine for Turkeys, Broilers

Several years work culminated in 1985 with the completion of a vaccine for the control of the four most important species of turkey coccidia. The product is being manufactured commercially and is now being used by one or more companies in the most important turkey producing states in the United States. Controlling coccidiosis in turkeys by immunization looks particularly promising because of the relatively long growing period of turkeys, usually 15-20 weeks.

Other coccidiosis research reinvestigated the feasibility of controlling the disease in broilers with a vaccine that has been on the market for more than 30 years. This was studied despite the belief by some industry members that immunization of broilers is impractical because of the short life of most broilers, usually not more than 7 weeks. In a series of 24 pen trials (usually 50 birds per pen and 4 pens per treatment), monensin, the most widely fed anticoccidial drug for the past 14 years, was compared with chicken Coccivac[®]. Although performance based on weight gain and feed efficiency was slightly in favor of monensin, the two methods of control were not significantly different. There were no deaths attributable to coccidiosis in either treatment.

Animal and Dairy Sciences

Faculty of animal and dairy sciences conduct research which ranges from basic science such as genetic controls of muscle and fat cell development to applied research such as utilization of feed grains and forages by domestic animals. Animal research projects underway involve swine nutrition, beef cattle nutrition, swine and beef cattle breeding, nutritional biochemistry, physiology, dairy cattle nutrition, meat science, and growth biology. The research areas are designed to help the livestock industry produce healthful, high quality animal products for a profit by utilizing the natural resources available for production systems in Alabama.

Forages Prove Valuable As Feed for Sows

Forage rotational systems for sows were compared with a stocking rate of 12 sows per acre. Orchardgrass-crimson clover was the perennial forage comparison, Tifleaf-1 pearl millet was the summer annual, and rye-ryegrass-clover was used as the winter annual forage. Sows grazing these pasture systems got the bulk of their nutrients from pasture, requiring only 33 percent of the National Research Council levels for energy and protein from feed.

Digestibility studies determined that sows are capable of digesting over 50 percent of the fiber in high quality forage. Digestibility is limited to the hindgut of the sow through activity of the microorganisms.

Lactating sows were fed high and low fiber diets to determine the effects of dietary fiber on milk production, milk fat, and litter performance. Milk production did not differ at 7 or 21 days. Milk fat content was higher for the sows receiving the high fiber diet at 21 days of lactation. Litter performance traits were not different between treatments.

The net return per acre was \$268 when quality forage was utilized in sow production systems.

Selecting for Growth Improves Economic Traits of Swine

Genetic selection for swine growth rate at 200 days was evaluated with three



Sows grazing good quality pastures got the bulk of their nutrients from grazing, and the land devoted to pasture made good net return.

generations of Duroc and Landrace breeds. The results show that the line selected only for improved growth rate increased 8.1 pounds per generation more than the control line pigs at 200 days of age. This results in a 6.7-day reduction per generation between the lines in time to reach a market weight of 220 pounds. Carcass measurements from the pigs representing the select line for growth had less fat and more muscle. These results indicate that the simple selection for improved growth to 200 days results in lower production costs and improved carcass muscling. Results from this genetic selection study can result in improved profits if adapted by the swine industry.

Dairy Cattle Research Improves Production and Efficiency

New research findings indicate that branched-chain volatile fatty acids fed in lactating cow diets can result in improved milk production and efficiency by increasing dry matter digestibility and mi-

crobial protein synthesis in the rumen. Another new project that involves the bypass of amino acids through the rumen is expected to provide information which could reduce production costs by increasing efficiency of dietary amino acid utilization.

Results concerning alterations in the nutrient-partitioning hormones in early lactation have pointed out the importance of the hormones glucagon and insulin in dairy cattle milk yields. The insulin/glucagon ratio was found to decrease during the early period of lactation. Studies of the pituitary/hypothalamic axis in low- and high-producing dairy cows have contributed significantly to understanding the controls for nutrient partitioning and the role of growth hormone in high- and low-producing cows.

Milk production and grazing capacity were compared when cows continuously grazed either AU Oasis phalarisgrass or low-endophyte (6.6 percent) fescue during four 6- to 8-week trials over a 3-year period. Daily milk production, butterfat percentage, and daily gain were all higher

for the cows grazing the low-endophyte fescue when compared to AU Oasis phalaris. Phalarisgrass and low-endophyte fescue pastures are both satisfactory for lactating cows when compared to traditional ryegrass grazing.

Sorghum Silage, Grain for Cattle Finishing

Cattle finishing rations composed predominantly of sorghum silage and sorghum grain gave satisfactory results when fed to yearling steers during a 124-day trial. Urea, broiler litter, cottonseed meal, and whole cottonseed were compared as sources of supplemental nitrogen or protein. The results showed broiler litter, urea, or cottonseed can be effectively utilized as a source of nitrogen in predominantly sorghum silage rations if adjustments are made so that the energy contents of the diets are adequate.

A cattle finishing system that made extensive use of forage ahead of a short finishing period gave promising results in an integrated beef management project.

Desirable Carcasses, Competitive Cost from Forage-Grain Finishing

High forage utilization followed by a short finishing period gave promising results in an integrated beef cattle management research project at the Tennessee Valley Substation. Steers were evaluated for production traits under differing forage and grain finishing systems, with emphasis on forage utilization and short-term grain finishing. Cool season grazing included fungus-free fescue, and Tifleaf-1 pearl millet was the warm season forage.

When compared with corn for the short-term feeding phase, wheat was found to be a satisfactory substitute for corn in cattle rations for Alabama feeders. Feeding systems based on maximum forage and limited grain resulted in desirable carcass traits and competitive production costs.

Infected Fescue Damages Reproduction In Cattle

Heifer calves were assigned to pasture having 0-5, 51-60, or 88-98 percent of the fescue plants infected with *Acremonium coenophialum*, the fungus that causes fescue toxicity. During the winter, hay was fed that had levels of fungus infection similar to the treatment pastures.

Data for the first year showed daily gains of 1.5, 1.0, and 0.77 pounds, respectively, for the different levels of infection. The levels of *A. coenophialum* infection had a direct impact on reproductive traits. The heifers grazing on the 0-5 percent infected fescue had a 100 percent pregnancy rate, the 51-60 percent infection resulted in a 67 percent pregnancy rate, and the heifers on the highly infected fescue (88-98 percent) had only a 55 percent pregnancy rate.



Animal Health Research

A summary of 1985 animal health research reveals the emphasis given to practical aspects and basic knowledge that should provide new avenues for the treatment and prevention of diseases that affect food producing animals. Such research is important because healthy animals are necessary to produce high quality meat in an efficient manner for Alabama consumers. Research was conducted on health problems of cattle, swine, and poultry during the year.

Test for Chronic Respiratory Disease

Chronic respiratory disease and infectious sinusitis and air sacculitis are common respiratory diseases of chickens caused by mycoplasmal infections. Within limits of pathogenicity, *Mycoplasma gallisepticum* and *M. synoviae* are presently considered as the two most important species responsible for widespread pneumonia in poultry flocks. Control measures

aimed at interrupting the infectivity trends in poultry have been futile due to the ubiquity of the organisms and spurious serologic test results. There is encouragement, however, because of Alabama Agricultural Experiment Station research that is progressing toward the development of a sensitive and accurate serological test for the diagnosis of mycoplasmal infections in chickens.

To develop a reliable and sensitive diagnostic test system with purified anti-



Detailed laboratory study is a major part of the practical research efforts underway to develop new avenues for treatment and prevention of diseases of food animals.

sponses are optimally mobilized. Immune responses consist of antibody production by the host and a variety of cellular reactions that are concerned with removing infected cells from the host.

Results of the Alabama Agricultural Experiment Station project designed to understand how the immune system of cattle is able to destroy virus-infected cells found that virus-infected cells can be destroyed by a variety of mechanisms. While cattle seem to have the same basic immune mechanisms as humans, the relative importance of different aspects of the immune system appears to be different in cattle. Unlike humans who have a circulating cell that is able to kill virus-infected cells in the presence of antibody, cattle lack such a cell. However, after cells of the bovine immune system are stimulated, certain cells develop the capacity to mediate this function. A variety of cells can kill virus-infected cells, but in all instances the cells have to be cultured before they demonstrate this ability. Therefore, it appears that there is a fundamental difference in the way cattle and humans combat virus infections.

Effect of Pour-on Antihelmintics Reduced by Wetting of Cattle

The effectiveness of a pour-on formulation of the antihelmintic levamisole is reduced if dry animals are subjected to heavy rain for 6 hours immediately after treatment. If animals are wet when treated and subjected to 6 hours of rain following, the efficacy is seriously compromised. These findings are from studies that evaluated a pour-on formulation of levamisole when cattle were treated immediately prior to total body immersion in water and during rain. Results were based on pre- and post-treatment fecal egg counts in naturally parasitized cattle.

An additional study was conducted to compare the efficacies of levamisole, fenbendazole, and ivermectin on 205-day calf weaning weights when the cows were treated shortly after parturition. No differences were observed among the three antihelmintics in 205-day calf weight.

gens of *M. gallisepticum* and *M. synoviae*, monoclonal antibodies were developed against each of these mycoplasma species. By limiting dilution analysis and screening, stable heterokaryons producing specific antibodies were developed and expanded both as ascities producing tumors in pristane primed mice and in tissue culture flasks. The tissue culture supernatant fluid and ascitic fluid were purified and the immunoglobulins thus purified were tested for class and subclass specificity. This led to development of the specific polypeptides against which the monoclonal antibodies were developed and these antigens were found to be highly specific. Antigens at a concentration as low as 60 ng are still able to react with the specific monoclonal antibodies. Thus, a sensitive and accurate test for diagnosis of mycoplasmal infections in chickens appears to be possible in the research.

Place of Infection Affects Severity of Cryptosporidiosis

Studies were conducted in chickens to determine effects of *Cryptosporidium*, a

protozoan parasite of which little is known, on broiler weight gains, feed conversion, and carcass quality when inoculated into the lungs or into the digestive tract. Data indicate that severe disease infection of air sacs results from inoculation of large numbers of organisms into the respiratory tract. Infected birds gain less weight, have poorer skin color, and eat more feed than noninfected birds. In contrast, digestive infections do not result in significant disease, nor do they affect weight gain, feed conversion, and carcass quality significantly.

Immune Response of Cattle Different from Humans

Ideal immunity of infectious organisms consists of the host being able to initiate a variety of responses that will rid the host of the infectious agent, in a manner which does not damage the host, before the infectious agent is able to injure the host. Usually, this condition is not achieved and the infectious agent is able to injure the host before immune re-

Forestry Research

Forestry research in 1985 was characterized by change and by increased opportunities for future research progress. During the year, two positions became vacant in forest biology, providing the opportunity for expanding Auburn's leadership role in forest regeneration research, an extremely important research area. Recent data indicate that each of the Southern States is currently overcutting its pine resource. The overcutting is attributed to a lack of adequate regeneration on lands controlled by non-industrial private landowners. The southern state that can exhibit a positive move toward reversing this trend will have a definite advantage over other states in terms of attracting new and expanding forest industry. Previous Auburn research in forest nursery management and in silvicultural herbicides provides a base for excellence in forest regeneration research. An economic update in 1985 in-

Research on various forest nursery problems is providing needed information for an important segment of the Southeastern forest industry.

dicated that among Alabama's major industries, forestry and the forest-based industries are in the best competitive position for continued economic development.

External funding for forestry research increased substantially during 1985, up 36 percent over 1984. One of the grants received in 1985 was a CSRS special, 3-year research grant in wood utilization. Under the grant, a team of scientists representing timber harvesting, forest biology, forest measurements, and forest economics will assess the silvicultural effects of various timber harvesting systems and make recommendations for improvement.

The U. S. Department of Agriculture established a new competitive grants program for forestry in 1985. For the program's first year, only one of every dozen proposals submitted was funded, and Auburn received one of these.

Forest Nursery Studies Addressed Several Needs

Post-emergence herbicide studies were conducted with lactofen, fomesafen, and PPG-1013 at several southeastern forest nurseries. These herbicides appeared safe on pine seedlings even at double rates. A postemergence study on sand pine indicated no injury with pendimethalin or ethalfluralin.

Research on root growth potential (RGP) of loblolly pine showed that irrigation in October and November increased January RGP. Root growth potential was positively correlated with root-collar diameter and root weight.

Findings from seed efficiency research indicated that efficacy in southern pine nurseries can range from as low as 40 percent to as high as 92 percent. The median value was near 66 percent.

Studies involving eight half-sib families showed the importance of family sowing on seedling uniformity. Average root-collar diameter of family-sown seedlings decreased as average date of emergence was delayed.

Research on chilling requirement of loblolly pine indicates that, for certain sources, chilling requirements for successful cool storage may be less than chilling requirements for bud break.

Models Developed to Project Growth, Yield

Volume equations (board foot and cubic foot) have been developed using Forest Service (RRE) survey data. Findings show that different species groupings, different model forms, and larger sample sizes will result in improved model predictability. Models to predict changes in bole length have also been developed from RRE data. These models predict bole length as a function of diameter, site, old tree class, average bole length, a competition variable (basal area of trees the same size or larger than the current tree), and a bole length-site interaction. These models have been assembled in a SAS program which will provide estimates of future tree characteristics (for trees with a DBH \geq 5 inches) based on current tree



and stand values. The models in the projection system include diameter increment, bole increment, and mortality.

Modern Sawmill Management Results in Maximum Profit

Two sawmill studies conducted during 1985 tested the empirical applicability of a new approach to sawmill conversion efficiency improvement analysis. One study found that a mill could realize a profit increase of 9 percent by limiting sawlog input to logs with small-end diameters of 7 inches and larger. In the other study, there was a 17 percent increase in profit when the mill restricted input to logs with small-end diameters of 9 inches and larger. In addition, the study mills could realize considerable increases in profit by eliminating unnecessary log overlength and by reducing green lumber target sizes to conform with industry standards. The studies indicate that modern management science techniques can be consistent with a sawmill owner's primary objective of maximizing profits.

Vegetation Management Improves Pine Yield

A completed survey of 43 existing loblolly pine growth studies provides long-term comparisons of pine yield under varying levels of hardwood and herbaceous vegetation. Data show a strong in-



Controlling hardwood and herbaceous vegetation resulted in large increases in pine growth, with major response being in stem diameter growth of pines.

verse relationship between pine yield (volume or basal area) and the proportion of total stand basal area in hardwoods. Consistent trends were found across the South. Ten-year-old herbaceous vegetation control studies show double the total cubic-foot stem volume for treated plots compared to check plots. Major response is in stem diameter.

Pine release studies during 1985 showed promising results with hexazinone + DPX-6376, glyphosate + DPX-6376, and glyphosate + AC-252,925. Results from herbaceous screening studies on sweetgum, sycamore, and cottonwood indicate that although AC-252,925 and terbacil damage all species, AC-252,925 provided good weed control.

In pine herbaceous screening trials,

early season applications of sulfometuron methyl provided the best weed control while the opposite was true for AC-252,925. AC-252,925 without surfactant caused seedling stunting the first year, but symptoms were no longer apparent the second year. Oxyfluorfen in combination with sulfometuron methyl gave acceptable weed control and good pine tolerance. A tank mix of glyphosate and sulfometuron methyl was effective against broomsedge without damaging pine seedlings.

Preliminary results of pine competition control studies indicate that the use of chemicals in forestry operations increases survival, produces better growth, and provides real rates of return on investment in excess of 10 percent per year.

Agronomy and Soils

A better understanding of soil and the production of food, feed, fiber, oil, and turf crops is being sought in agronomy and soils research by the Alabama Agricultural Experiment Station. Crop and weed science research deals with plant physiology, plant breeding, crop production, and weed control. Soil science research includes the study of chemical, physical, and biological properties of soils and how to modify these properties for maximum production. These interrelated studies provide a basis for understanding the complexities involved in crop production and soil management, and thereby make possible the introduction of new concepts in agriculture.

Good Weed Control in Minimum-Till Beans

Successful weed control systems for soybeans produced under minimum tillage were identified in 1984-85 research at the Wiregrass Substation. Good sicklepod control resulted from use of Lexone® applied preemergence (3/8 pound active ingredients per acre) followed by a postemergence-directed application of Lorox® (1/2 pound) plus 2,4-DB (1/4 pound active per acre). Sicklepod control was excellent in minimum-tillage systems utilizing two new herbicides: Scepter® applied preemergence at 1/4 pound active ingredient per acre and chlorimuron ap-

plied preemergence at 0.06 pound. All systems described also received a pre-plant incorporated application of Treflan® plus Surflan®, applied in a 15-inch band in the drill row for control of annual grasses. Treflan and Surflan were incorporated with the RO-TILL® basket attachments. Also, all systems received Paraquat® as a postemergence-directed spray in the middles to serve as the common cultivation. All treatments were evaluated in both full-season and double-crop soybeans, and in both 30-inch and twin 9-inch row patterns, both centered on 30 inches.

No differences were found between the two row patterns for any variable eval-

uated. All minimum-tillage systems, except those using Scepter, produced good soybean seed yields and moderately good net returns to land and management. Scepter reduced seed yields when applied preemergence at ¼ pound active ingredient per acre. Additional research has shown that Scepter did not adversely affect yields when applied preemergence at ½ pound followed by the same rate applied postemergence over the top.

Full-season soybeans produced higher net returns than double-crop soybeans. Additional returns from wheat in the double-crop soybeans did not offset decreased soybean returns from lower yielding later plantings and increased weed control cost (due to use of the more expensive Roundup instead of Paraquat).

Nitrogen Fixation in Soybeans Advantage in Southeast

Nitrogen fixation by soybeans allows Southeastern growers to produce acceptable yields without adding N fertilizers. This is especially important because soils of the region supply little N for crops. The role of nitrogen fixation (the process by which certain bacteria enter the soybean roots in the seedling stage and pro-

vide the plant with nitrogen from the air) in production of soybeans was evaluated in 1984 and 1985 research which determined the amounts of atmospheric nitrogen fixed by soybeans grown at nine locations in Alabama. The technique involved measuring the plant dry weight and total nitrogen content of stems, leaves, petioles, pods, and beans at physiological maturity.

Large amounts of atmospheric nitrogen were fixed by soybeans, averaging 193 pounds N per acre across five cultivars and nine locations. Nitrogen fixation accounted for an average 73 percent of the total nitrogen in the crop. Thus, the nitrogen fixing system in soybeans is capable of producing high yields of protein without application of fertilizer nitrogen. This is a particular advantage for farmers in the Southeastern United States, in contrast to the situation on prairie soils of the Midwest where soybeans obtain only about 40 percent of their nitrogen from the air.

Centipede Usefulness Improved by Research

Centipedegrass continues to grow in popularity, with research providing improvements in cultural practices, seed production, and varieties.

In a 3-year study evaluating numerous postemergence applied grass herbicides, sethoxydim was shown to be a safe and effective herbicide for controlling annual grasses in established centipedegrass. The material was labeled for this use in 1985. Work is continuing to establish the herbicide's safety to seedling centipedegrass and allow labeling for use in newly seeded turfs. Another breakthrough in weed control occurred when research found that sulfometuron could be used to selectively remove bahiagrass from centipedegrass. Sulfometuron also controls a wide range of annual grass and broadleaf weeds and will improve greatly the weed control practices available to turf managers.

Several promising experimental centipedegrass genotypes have been identified from the same material source which produced the new variety AU Centennial. These genotypes are being evaluated for their turf potential at Auburn and at other locations from Virginia to Texas. Efforts are also under way to produce self-fertilized seed from these selections to further increase diversity within the species.

Research on seed production practices has shown that yields can be enhanced on infertile soils by applying 40 to 60 pounds of nitrogen per acre and by ceasing mowing after July 15.

Amounts of atmospheric nitrogen fixed by soybeans amounted to 193 pounds of N per acre, averaged over five cultivars and nine locations. This heavy N fixation is especially important to farmers in the Southeast, where only small amounts of residual N are available in soil.



Forage Breeding Adds Superior Varieties

AU Dewey birdsfoot trefoil is the most recent variety release for the forage breeding program of the Alabama Agricultural Experiment Station. Released in February 1985, it has a high yield potential when grown in monoculture or in mixed swards with grass. It also has excellent stand persistence.

In grazing trials, pasture mixtures of AU Dewey and grass gave high average daily gains and good beef production per acre. AU Dewey is expected to be best adapted to northern Alabama. It is not adapted to the Lower South where warm season perennial grass competition is severe. Certified seed of AU Dewey should be available within 3 years.

Seed increase of AU Triumph tall fescue has progressed to the point that seed should be available throughout the Southeast in 1986. In continuing varietal development with several species of clovers, orchardgrass, bahiagrass, and tall fescue, progress has been made in selecting for fringe areas of adaptation. Lines of a giant ball clover and of several fescues selected for the Lower Coastal Plain are in the seed increase stage. Lines of orchardgrass

AU Dewey trefoil, the newest Auburn forage variety release, has a high yield potential when grown in monoculture or in mixtures with grass. It produced good beef gains in north Alabama grazing trials.

and bahiagrass selected specifically for northern Alabama are also being increased. New varieties from several of these advanced lines appear probable in the near future.

Legume Cropping Systems Provide Part of Corn's N Needs

Early maturing winter legumes can be used as a sole N source for summer crops which have a low N requirement and a relatively late optimum planting date. However, these legumes do not provide sufficient N for corn which has to be planted early and has a high N requirement. The fertilizer nitrogen requirements for corn grown with and without legumes in rotation were established in research at the Wiregrass and Sand Mountain substations. Cropping systems were (1) fallow-corn-fallow-corn, (2) clover-corn-clover-corn, (3) fallow-soybeans-fallow-corn, and (4) clover-soybeans-reseeded clover-corn.

At the Wiregrass Substation, fertilizer N requirements for corn production systems 1, 2, 3, and 4 were 180, 120, 180, and 60 pounds per acre, respectively. At



Legume cropping systems provide part of corn's need for nitrogen, thereby reducing fertilizer cost.

the Sand Mountain Substation, cropping systems changed yield levels, but had no effect on N fertilizer requirements. Yields peaked with 120 pounds N per acre, and yields for treatments 1, 2, 3, and 4 were 110, 123, 132, and 155 bushels per acre, respectively.

Narrow Rows, Early Planting Give High Grain Sorghum Yields

Row spacing and planting dates had a tremendous effect on yields of non-irrigated grain sorghum in research at the Prattville Experiment Field. Highest yields were made in narrow rows planted in April and May.

As row widths decreased from 36 to 18 inches, per acre grain yields increased as much as 1 bushel per 1-inch reduction in row width. Row widths used were 18, 24, 30, and 36 inches. Yield differences between the narrow and wide rows were greatest for planting dates that resulted in highest yields.

Planting dates were mid-March, April, May, June, and July. Highest yield for the March, April, May, June, and July planting dates were 82, 102, 80, 52, and 48 bushels per acre, respectively. The rapid drop in yields between the May and June planting dates suggests that grain sorghum may not be an economical grain crop for double cropping systems that require late planting dates in central Alabama.



Horticulture

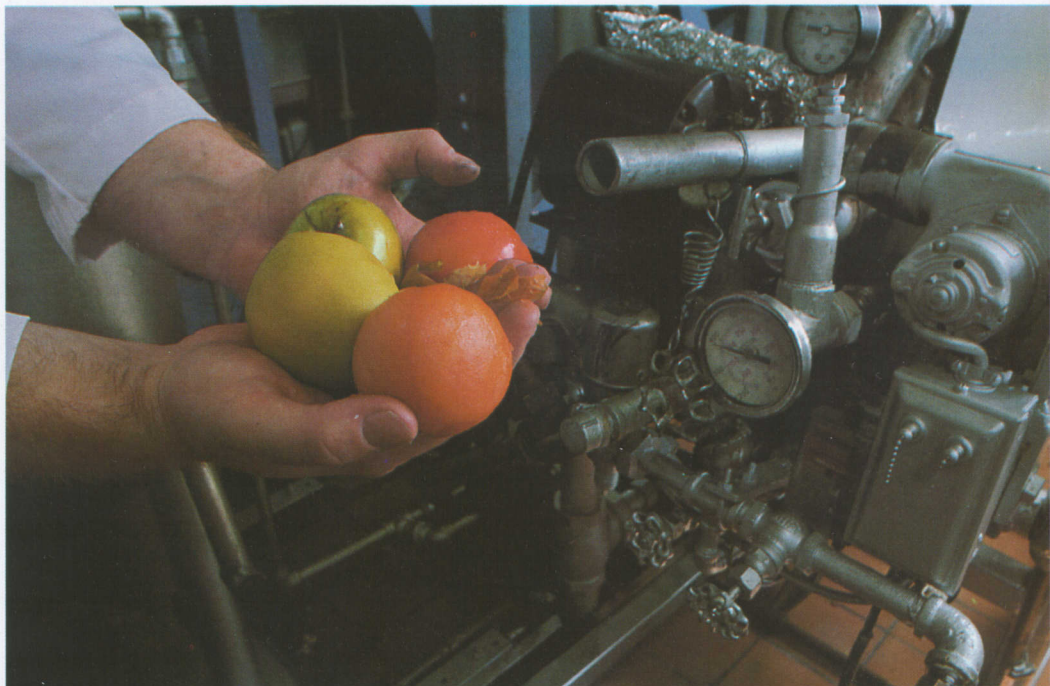
Growers, processors, and consumers are all served by horticulture research at the Alabama Agricultural Experiment Station. The diversity of horticulture is reflected in the major research accomplishments in 1985: the culmination of many years of food processing research in the patenting of the thermal blast peeling process; evaluation of innovative methods of intensive vegetable production; establishment and evaluation of small fruit plantings; disease and nematode control on ornamental plants; evaluation of trees for landscape use; and evaluation of methods of preventing freeze damage to container-grown azaleas.

Thermal Blast Peeling Offers Food Processing Efficiency

A new peeling and shelling process, developed in food science research of the Alabama Agricultural Experiment Station, has been patented by Auburn University. The process, known as the "thermal blast process," allows more efficient utilization of many agricultural commodities. Interest shown by various segments of the food processing industry nationwide is evidence of the potential of this process in the food industry.

Peeling is accomplished by rapid heating under pressure of the outer portion of foods, followed by instantaneously releasing the pressure to actually "explode" the peeling away. Only the inedible outer portion of the food is heated and the heat does not penetrate to underlying edible tissues during the 4-20 seconds of heating in a closed, pressurized vessel when the food is subjected to infrared heat from the vessel walls and conductive heat from the superheated steam pressurizing medium. Thermal damage to the peeled product is minimal because (1) the speed of the process leaves little residual heat in the peeled surface, and (2) the evaporative cooling effect of the expanding steam leaves the product surface at a great velocity.

While most peeling processes are limited to particular types of foods, the thermal blast process is effective in the peeling of fruit and vegetable crops, coring of peppers, shelling of beans and southern-



The thermal blast peeling system developed and patented by the Experiment Station reduces product loss in peeling of many agricultural commodities.

peas, husking and silking of corn, popping of corn, skinning of onions, shelling of nut crops, skinning of beef and swine tongues, scaling and skinning of fish, and removing of shells from shellfish. When compared to conventional peeling processes the thermal blast process dramatically reduces product losses and damage to edible portions, reduces energy requirements, reduces processing waste streams which would require subsequent cleanup, and eliminates the need for caustic chemicals.

Potential Great for Small Fruit Production

The last few years have been a time of widespread interest in production of small fruit as a cash crop in view of the potential for high income per acre. In response to this interest, research in 1985 emphasized production of rabbiteye blueberries and strawberries.

Because of plant establishment problems with rabbiteye blueberries, research at the North Alabama Horticulture Substation evaluated the effects of different soil amendments and mulch (incorporated at the rate of 1/2 bushel per plant-

ing site) for establishment of blueberries. Peat moss amendment resulted in plants with more vigor and growth than other treatments. Pine bark and old decomposed sawdust resulted in better vigor and growth than the non-amended planting sites, but not as good as peat moss. There was little difference in plant growth or vigor due to pine straw mulch since all plants were trickle irrigated.

In an evaluation of 11 blueberry varieties at the Brewton Experiment Field in 1985, yields from the 1980 plantings varied from a high of 14,770 pints per acre for Tifblue to as low as 6,938 pints per acre for Delite. Tifblue, Premier, Climax, Woodard, and Powder Blue were the best performing varieties when yield, fruit size, and fruit quality were considered.

Strawberry research at the Chilton Area Horticulture, North Alabama Horticulture, and Tennessee Valley substations has concentrated on planting dates and systems, mulching systems, varieties, and weed control. The matted row system planted in late winter preceding the spring fruiting season has outyielded the fall planting and plantings on plastic. Yields of the 21 varieties evaluated ranged from 2,200 to 14,000 quarts per acre. The best



Container-grown azaleas were protected from freeze damage by irrigating to build up ice cover and continuing to irrigate during subfreezing and thaw periods.

performing varieties have been Sunrise, Earliglow, and Earlibell for early season varieties, Cardinal and Allstar for mid-season varieties, and Delite for the late season variety when considering disease problems and fruit yield, size, firmness, shape, color, and quality.

Correcting Poinsettia Molybdenum Deficiency

Research by the Alabama Agricultural Experiment Station has shown that a combination of low growing medium pH, low molybdenum supply, and use of susceptible variety influence the occurrence of molybdenum deficiency. This deficiency, characterized by leaf yellowing and marginal browning on plants just prior to the Christmas sales season, is often reported by Alabama growers. The economic value of the crop is significantly reduced by the occurrence of this unsightly injury.

Raising pH or applying molybdenum prevented symptoms in this study. Varieties Annette Hegg Brilliant Diamond and Gutbier V-14 Glory were most susceptible to molybdenum deficiency. Under the same conditions, Eckespoint C-1 Red

showed no deficiency symptoms. The most practical and effective method of preventing molybdenum deficiency of poinsettia is the incorporation of enough limestone in the growing medium to achieve pH 5.5-5.7 and weekly applications of a dilute molybdenum solution.

Woody Ornamental Research Benefits Alabama Nurserymen

Research conducted to evaluate new granular herbicides for control of prostrate spurge, a native summer annual that has become a major pest in container-grown ornamentals in the Southeast, showed that Rout® and OH-II® provided superior control 8 weeks after herbicide application compared to Ronstar®, the industry standard. Other tests showed these two materials to also provide better broadleaf weed control than Ronstar. Both Rout and OH-II were safe when tested on a wide range of ornamental plants.

A 3-year study of post-plant application of granular nematicides found that Nemacur®, Vydate®, Furadan®, and Temik® controlled lesion nematode on roots of

American boxwood. A combination of fall and spring applications provided season-long nematode control.

Four methods of winter protection were evaluated for container-grown azaleas: (1) unprotected; (2) covered with copolymer plastic film; (3) coated with a 1- to 3-inch layer of ice and irrigation discontinued; and (4) iced with irrigation continuing during subfreezing periods and thaw. Bark splitting was most severe with the iced (irrigation discontinued) and plastic covered treatments, less severe with the unprotected treatment, and did not occur with constant irrigation. Foliar necrosis, dieback, and root injury occurred only on unprotected and iced (irrigation discontinued) treatments. Only constant irrigation with subsequent ice accumulation protected azalea roots, stems, and foliage.

Plastic Mulch and Row Covers for Vegetables

Use of black plastic mulch and row covers provided a better plant-growing environment and improved vegetable crop yields and profits in research at the Alabama Agricultural Experimental Station.

Warm-season crops (watermelon, muskmelon, okra, squash, tomato, eggplant, and bell pepper) responded favorably to the support of black plastic mulch and row covers. Use of black plastic mulch increased yields of these crops 30 to 112 percent. Row covers, row tunnels, and floating covers also contributed to this increase in yield.

Row covers caused an increase in temperature around the plant-growing environment when ambient temperatures were much cooler. This caused a tremendous increase in plant growth early in the season when compared to plants grown in bare soil without row covers or black plastic mulch. As a result, these crops matured 2-3 weeks earlier than those crops which were grown under ambient conditions. Earlier yield allows for greater profits.

Cool-season crops (collard, turnip, kale, mustard, and English peas) which were intercropped with the warm-season crops produced satisfactory yields, resulting in a successful intercrop system. In general, results of these studies show that such intensive production methods offer chances for increased yield and profits, as well as a reduction in amount of land needed to produce either crop alone under the monoculture system.

Botany, Plant Pathology, and Microbiology

The extensive and diverse research programs in botany, plant pathology, and microbiology continued to address many significant aspects of plant science and microbiology during 1985.

Studies in plant physiology ranged from determining the effects of new generation fungicides on lipid metabolism of fungi to elucidating the mode of action of herbicides on higher plants. Flower and pod abscission in soybeans and the effects of environmental and pathogen stresses on development of soybean plants were investigated. Competitiveness of some major weed species was established, and taxonomic research continued to document the flora and fungi of Alabama.

Research in plant pathology increased understanding of the occurrence and development of the major diseases of peanuts, soybeans, horticultural crops, forage and grain crops, and forest trees, and identified effective control measures. The fescue toxicity problem was a major subject of research in both plant pathology and mycotoxicology, and research in mycotoxicology also involved fungal metabolites in corn, peanuts, and feeds toxic to experimental and domestic animals.

Microbiology research focused on molecular genetics of prokaryotes, viruses, and higher plants, the identification and pathogenicity of fastidious plant pathogens, and the characterization of nucleic acids of toxic fungi.

Genetic Engineering Potential Shown in Auburn Research

Plants with built in resistance to yield- and quality-limiting diseases have long been a goal of agriculturists, and there are many examples of success in this area. Now there is hope that this goal can be reached quicker and more completely, thanks to advancements being made in genetic engineering. Success in transferring of virus genes to plants in preliminary research at the Alabama Agricultural Experiment Station indicates the potential of genetic engineering.

The virus used in the Auburn research is the tomato golden mosaic virus, which belongs to the geminivirus group. Members of the group infect a wide range of

plants and cause diseases such as tomato golden mosaic, bean golden mosaic, cassava latent, beet curly top, maize streak, and wheat dwarf.

Geminiviruses are unique among plant viruses in several respects. They are the only viruses known to be composed of paired spherical particles, a property from which the name of the group is taken. They are also the only plant viruses to have their genetic information in the form of single-stranded DNA, which is replicated and expressed via a double-stranded intermediate that can be found in infected cells. Yet another unique feature of these viruses is that the genomes of several group members are divided between two DNA molecules (called A and B) of nearly identical size but different nucleotide se-

quence. Both of the DNA components (similar to small chromosomes) are required for infectivity, since each contains about half the viruses' genetic information.

Research on the function and expression of geminivirus genes (there are only six or so) employed a recently developed technique which allows genetic material to be introduced into the chromosomes of plant cells that can be regenerated into whole plants. Plants altered in this way are said to be transformed. Using a specially constructed vector (carrier) DNA designed by the Monsanto Company, the separately cloned DNA components of tomato golden mosaic virus were introduced into petunia cells. Transformed plants carrying either the A or B com-

Success in transferring of virus genes to this plant in preliminary research indicates the potential for use of genetic engineering to develop crop plants with built in resistance to damaging plant diseases.



ponent of the virus as a new genetic trait were regenerated, and these plants were normal in appearance. However, biochemical analysis indicated that viral DNA was released from the plant chromosome and replicated in the cells of A-containing plants, but not in B-plants. This indicates that the A-component supplies the information necessary to replicate itself and the B-component, and that B provides some function(s) required for symptom development.

Transformed plants flowered normally and were used in various crosses. Seedlings from crosses of A and B parents displayed a remarkable phenotype. One-fourth of the progeny of such crosses showed symptoms of virus infection—the proportion expected to receive an A-genome from one parent and a B-genome from the other parent. Biochemical analysis of symptomatic progeny confirmed that both A and B components were present and replicated in these plants. Other possible combinations of crosses (AXA, BXB) failed to produce progeny plants showing symptoms of the virus.

These results, which convincingly demonstrate that functional tomato golden mosaic virus genomes can be delivered into plants using transformation technology, provide a new method for the study of plant virus functions. The power of this technique lies in the fact that natural or modified genomes can be placed in every cell of a plant, regardless of whether they can produce active virus particles capable of spreading to other cells by the normal infection process. Viral genomes have been constructed which carry mutations at specific sites within viral genes. Introduction of these into plants should allow the determination of the function of each individual gene.

Much has already been learned about geminivirus replication using gene transfer technology. As the ongoing studies provide detailed understanding of viral gene function, it is hoped that the findings will suggest means for controlling these important pathogens.

Apple Bloom Suppressed by Sterol Inhibitors

The newest generation of fungicides classed as sterol inhibitor fungicides has been reported to affect apple trees like growth regulators. These effects were shorter trees, retarded shoot elongation, and leaves that were smaller, thicker, less flexible, puckered, and darker green.

Blooming of apple trees during 1983 differed among plots that had been sprayed with different fungicides during 1982 at the North Alabama Horticulture Substation. In fact, some trees sprayed with sterol inhibitor fungicides had no more blossoms than unsprayed check trees. Subsequently, older generation fungicides, i.e., carbamate (Dithane FZ®) and benomyl (Benlate®), were compared with the fungicides Baycor® and Vanguard®, which are sterol inhibitors. All fungicides were applied to Redspur Delicious apple trees at recommended rates for control of apple diseases during 1983. Apple bloom in 1984 was significantly lower after the season-long applications of Baycor or Vanguard than after use of the Benlate + Dithane FZ combination. These results indicated that season-long applications of Baycor or Vanguard apparently had a cumulative effect which was detrimental to apple bud formation and subsequent blooming the following year.

Fescue Diagnostic Center Helps Solve Toxicity Problem

Tall fescue is one of the most productive and best adapted cool season grasses in Alabama, but a recently discovered fungus known as the fescue “endophyte” produces a toxic substance in the grass that severely limits cattle weight gains. In addition to poor weight gains, affected animals may have lowered reproductive capacity and may lose feet or tails as part of the “fescue foot” syndrome. Since the fungus does not produce any symptoms on the infected grass, special tests developed at the Auburn University Fescue Diagnostic Center have been used to detect the endophyte in seed and pasture

samples. Through 1985, over 2,500 samples from 26 states and two foreign countries had been tested, and the endophyte was detected in 84 percent of all samples. In fact, most older stands of Kentucky 31 fescue probably are infected at a level which is damaging to livestock.

Data from farmer-submitted samples indicate that cattle producers can often detect this problem in their animals. Fescue samples from cattlemen who reported poor animal performance had an average infection of 75 percent, while samples from those who had observed no problems had only 57 percent infection. Samples from producers with problems like “fescue foot” or reproductive disorders had even higher levels of fungus. The statistics for horse owners were similar.

Several key research findings are leading to a solution of the endophyte problem. First, it appears that the fungus is spread only by infected seed, so this is the logical point at which to prevent further infection. Although the endophyte has been greatly reduced by experimental fungicide treatments, chemical control may never be economical. On the other hand, storage of seed for at least 1 year was found to be a cost effective alternative to fungicides. The Auburn Fescue Lab has also been able to identify fungus-free seed fields of Kentucky 31 and other varieties which have been used as seed sources. As a result, seed tests have shown an increase in the amount of endophyte-free seed available to forage producers. For example, the percentage of seed samples that were endophyte free jumped from 52 percent in 1983 to 83 percent in 1985. Purchasers of seed can also benefit from recently enacted regulations which require seedsmen to test and label seed with the endophyte infection level on each bag.

Suppressed blooming of apple tree at left, in comparison to one at right, indicates effect of previous-year spraying with sterol inhibitor fungicides.



Agricultural Engineering

Agricultural engineering research at Auburn is characterized by applying basic engineering science and design to solve specific engineering problems in equipment, structures, and systems for food, feed, fiber, animal production, and forestry automation. Emphasis is on development of (1) cropping system technology for reducing soil sediment, nutrient, and pesticide losses; (2) irrigation optimization techniques for better utilization of equipment and operating procedures to maximize profit; (3) new technology for energy recovery from liquid animal waste; (4) a microcomputer control system for environmental control of poultry houses to increase bird performance and decrease maintenance and operating cost; (5) a basic engineering understanding of the soil compaction process caused by agricultural equipment wheel and tire traffic; and (6) improved engineering design processes in forestry automation.

Microcomputer Improves Control of Environment in Poultry Houses

Most poultry house environmental control systems use conventional electro-me-

chanical components that only maintain pre-set temperature or relative humidity. The need, however, is for a control system that allows some decision making and changes in controlled variables in response to changes in environmental conditions. This need can be met by a microcomputer based control system that has been developed in Alabama Agricultural Experiment Station research. The system can control temperatures in the brooding area, control ventilation based on outside weather conditions as well as house requirements, control a solar collector-biomass burner heating system, and predict brooding energy needs based on weather forecasts. Several items of basic design and operation criteria needed to operate such a system were determined in 1985.

Dew point temperatures are needed but are much more difficult to measure than are dry bulb temperatures. Weather data tapes for Montgomery were analyzed for patterns between early morning dry bulb and dew point temperatures to see if a dry bulb measurement could be used to estimate dew point for the day. Evaporative pad materials were tested for efficiency and the velocity at which water blows off the face of the pad. More basic information on the equilibrium moisture

relation between air and broiler litter materials was obtained.

Weather data and equilibrium moisture data information will be used to plan more efficient poultry house computer controlled ventilation schedules. Evaporative pad data will be used in the design of livestock computer controlled cooling systems for Alabama weather conditions.

Analytical Model Explains Traffic-related Compaction

Soil compaction by machines is recognized as a problem in production agriculture. However, the compaction loads imposed by machines on the soil and the distribution of these loads throughout the soil profile are neither well known nor understood. In cooperative research with the USDA-ARS National Soil Dynamics Laboratory, a six-directional stress state transducer was developed to measure compaction loads at a point in the soil caused by a moving tractor tire. The data obtained indicate that compaction is probably being caused in a different way than had been previously perceived. The results indicate that shearing stresses need to be incorporated into soil compaction models to assure accurate predictions of compaction.

Past soil compaction models have not accounted for all of the loads applied to soil by wheels and tires. A model that had been developed was expanded to include more of these loads. Data were collected for four distinctly different agricultural soils in Alabama—two sandy loams and two clay loams. The moisture content for each was selected to be representative of field conditions. Based on laboratory tests at the National Soil Dynamics Laboratory, the expanded model predicted soil compaction and soil bulk density within 4 percent of measured bulk density.

Cropping System Affects Sediment, Nutrient, and Pesticide Losses

Twelve erosion study plots became fully operational at the Tennessee Valley Substation in 1985 in a study to determine the effect of different tillage practices for



An analytical model developed to explain traffic-related compaction was found to predict soil compaction and soil bulk density within 4 percent of measured values.

cotton on surface runoff quality. The tillage practices include no-till with winter cover crop, spring till with winter cover crop, no-till without winter cover crop, and conventional tillage. The water quality factors analyzed include amount of runoff and losses of sediment, nutrients, and pesticides. Runoff samples were collected on 17 runoff storm events during the 1985 growing season. There was more runoff and sediment loss from conventional tillage plots (2.4 inches and 1,580 pounds per acre, respectively) than from no-tillage plots without cover crops (1.6 inches and 225 pounds per acre), no-till with winter cover (1 inch and 192 pounds per acre), and no spring till with winter cover plots (1.75 inches and 688 pounds per acre), respectively. Total precipitation during the growing season was 22 inches. Analysis of particle size distribution indicated that 60 to 70 percent of the total sediment lost from the plots were fine particles of clay (diameter less than 0.002 mm). Fine soil particles have been known as the major carrier of nutrients and pesticides.

Pesticides analyzed include Temik® (aldicarb) and Prowl®, applied April 22 and 23, respectively. High concentrations of Temik (up to 350 ug per liter) and Prowl (16.3 ug per liter) were found in the runoff samples of the first storm (May 2) after the application. Temik was not detected in the runoff samples of a storm that occurred 10 days after the application. However, Prowl was persistently detected through August. Nutrient losses were higher on conventional tillage plots than on conservation tillage plots, mainly because of high runoff and sediment losses from conventional tillage.

Irrigation Optimization for Maximum Profit

Water stress is a major contributor to decreased crop yields in the humid Southeast. Low soil-moisture holding capacities and non-uniform rainfall distributions are the major culprits in the reduced yields. Yields from rain-fed production are highly variable from year to year and range from maximum yields to none at all. One technique being utilized by many farmers is the addition of supplemental water through irrigation. Under humid conditions in the Southeast, irrigation does little to increase maximum yields but does increase yields during "drought" years. There are, therefore, two significant ef-



Irrigation research in 1985 included an evaluation of crop-yield variability and its impact on irrigation-selection decisions.

fects of irrigation on crop production: (1) increased average yields over several years, and (2) decreased variability of yields. These factors, along with cost of irrigation, must be considered in deciding whether to use irrigation.

Based on these considerations, major facets of irrigation have been examined in Alabama. Of particular concern in 1985 was the evaluation of crop-yield variability and its impact on decisions to select irrigation. An existing optimization technique called Minimization of Total Absolute Deviations was utilized to optimize the systems and crop selections. This technique provides the mechanism to define the amount of profit desired and to determine the least variable or risky manner to achieve that profit.

Early results from the study indicated that the most profitable choices for peanuts, based on today's economic situation, include irrigation with large center-pivot irrigation systems. By using smaller, more expensive systems, however, the amount of irrigated land could be increased and yield variability and financial risk decreased.

Energy Recovered from Liquid Wastes

Because liquid waste transport systems are used for most dairy, swine, and caged layer production facilities in Alabama and the Southeast, research is seeking an on-site energy recovery system which also

allows recovery of the solids for refeeding. Earlier research established methods for recovering the solids in liquid wastes for alternative feed ingredients, leaving the very dilute liquid fraction for alternative energy production.

A new technology for energy production using extremely dilute liquid waste was evaluated in 1985. This is a novel fermenter reactor technology that uses inexpensive, common synthetic media to retain biological growth while simultaneously allowing a much reduced treatment time and small, compact treatment vessels. This reactor technology has been called SPAG (Suspended Particle-Attached Growth) and is approximately 2 years old in concept.

The potential of SPAG reactors is great in that they allow a complete on-site waste utilization system for dilute flushed wastes: the solid fraction in refeeding, the liquid fraction in energy production, and the land application of the liquid effluents. This technology is clearly superior to conventional reactor technology in energy production. Based on results from the laboratory and bench scale studies, mesophilic digestion can be operated at hydraulic retention time of 2 days and thermophilic digestion of 1 day. This compares to 5- and 10-day hydraulic retention time for conventional reactors at thermophilic and mesophilic temperature, respectively. This reduces the reactor volume required by a factor of 5 and concomitantly reduces costs.

Agricultural Economics and Rural Sociology

The more than 20 active research projects involving agricultural economics and rural sociology underway at the Alabama Agricultural Experiment Station provided useful information to farmers, agribusinesses, rural residents, government, and other agencies during 1985. In response to the financial stress situation facing farmers, a survey was completed early in the year to determine the financial position of farmers.

A new project was begun to determine some of the significant characteristics of farmers who have experienced bankruptcy. Details of their financial status for the years prior to bankruptcy are being studied to gain insights into the major causal factors. A linear programming alternative was developed to aid credit agencies in scoring borrowers to determine if they would be good or poor credit risks. Also, in efforts to meet the growing present and future needs of farmers and agribusinesses in the area of financial management, research was strengthened in microcomputer applications and use.

Farmers and Suppliers Benefit from Exports

U.S. agricultural exports reached their peak in the early 1980's and have generally declined since that time. This is important to Alabama because farmers of the State are important producers of products that enter export markets and the

export of farm products is important to the Port of Mobile.

In an Alabama Agricultural Experiment Station study of the effects of agricultural exports on Alabama's economy, Alabama's export share of farm products was found to be almost one-fourth of the total value of agricultural production. Soybeans were the leader in exports, followed by poultry and poultry products and then cotton and cotton lint. Wheat and wheat products showed a dramatic increase in export share in 1982. If Alabama agriculture did not export, it was estimated that the gross state product would be reduced by 15 percent.

Much of the economic activity resulting from exports is generated by sales of insecticides, pesticides, fertilizers, farm machinery, petroleum products, feed, seed, and electricity and by hired labor. An additional economic benefit, referred to as "induced effects," is the purchase by households of groceries, automobiles, homes, televisions, clothing, and a wide variety of consumer goods which would be reduced if agricultural exports did not exist. In total, the estimated total economic activity generated by agricultural exports was \$1.206 billion in 1982, more than half the total value of cash farm receipts. Other than agriculture itself, the chemical and allied sector from which farmers buy their pesticides and fertilizers benefited most from agricultural exports.

Future Looks Bright for Sod Industry

A young and growing segment of Alabama's agricultural economy is the commercial turfgrass sod industry. Acreage data showed 5,450 acres in turfgrass sod production in 1983. Since little was known about marketing aspects, especially beyond the producer level, a study was carried out that gathered information from 20 producers, 200 households, and 22 landscape firms.

Sod markets were found to be dominated by large growers (over 250 acres in production), which accounted for 71 percent of total sales volume. Peak sales months were between April and September, and May and June were the two most important months. Pricing was carried out on an individual firm basis, with wholesale-retail differentials largely determined by the amount of sod purchased.

Although sod installation was a relatively new service offered by landscape contractors, 91 percent of the sod handled was installed. Bermudagrass and centipedegrass were the two most popular sod species, accounting for 75 percent of the sod installed. Most of the contracting firms had at least two major suppliers.

Findings of the study point to a bright future for Alabama's sod industry. With increased demand by both landscape contractors and household outlets, the acreage

Export of Alabama-grown agricultural products through the Port of Mobile represents an important economic activity. Soybeans have been the leader in agricultural exports from the State, followed by poultry and poultry products and cotton and cotton lint.





Azaleas represent a major sales item for Alabama's nursery industry. Growers expect sales to increase in the future, but at a slower rate than in past years.

Fewer Farmers Have Reduced Policy Impact

Auburn's portion of a regional project concerned with major issues facing agriculture identified farmers as a new minority. With the small number of farms remaining and the strong role of government in agriculture, the role of the consumer now overshadows the farmer in the nation's food policy. At the price of concentrated ownership and efficiency, farmers will increasingly rely on a broader public consensus that a viable agriculture is a vital and productive national resource that must be equitably maintained. The need for a sustainable agriculture will increasingly encapsulate a variety of political, economic, and environmental criticisms of agriculture. The study also found that farmers were being criticized for undermining the long-term viability of agriculture in terms of the abuse of soil and water resources.

Agriculture can call for a policy response by government that allows individuals to pursue a steady, sustainable career in agriculture, the orderly demographic replacement of farm operators, and a reasonable assurance of well being for middle-class farm families in the years ahead. A follow-up study is being carried out on a national basis to gain definitive insights of Americans about agriculture and the farmer.

Economic Analysis Reveals Narrow Profit Margin for Dairying

Dairy farms in Alabama have been declining in numbers for more than 20 years. Total milk marketed by Alabama dairymen has declined since 1970 and at present more than 50 percent of the milk utilized in Alabama is shipped into the State. And the future is uncertain for Alabama dairymen, too, according to cost comparisons between selected Alabama dairymen and those in other regions of the United States.

The comparison showed that Southern dairy farmers face narrowing profit margins. Variable costs per hundredweight of milk produced in Alabama averaged \$12.69, but varied from \$7.97 to \$15.43. Fixed costs averaged \$4.03 per hundredweight and varied from \$2.79 to \$5.28. Net returns per hundredweight averaged \$0.29, with the highest net being only \$1.73. Feed costs averaged 52 percent of milk receipts.

of sod should increase each year. Opportunities exist for smaller sod farms to expand their acreage to take advantage of economies of size in both production and marketing. The geographical concentration and majority of sod farms should remain relatively close to their markets, which are in or near the standard metropolitan areas of Alabama.

Price elasticity of demand for sod was determined to be highly elastic. Thus, there appear to be opportunities for producers and landscapers to increase their sales by becoming more price conscious. A 1 percent reduction in price was found to be associated with a 1.8 percent increase in quantity demanded. Little advertising was used by sod producers, but advertising and consumer education offer opportunities to strengthen markets for sod.

Azalea Sales Increasing by Alabama Nurseries

Azaleas are an important part of Alabama's nursery industry. Data from 1983 showed azalea sales of \$15-\$17 million, which was about 16 percent of the State's total nursery sales. In a study of the economics of production and marketing, 32 azalea producers reported that azalea sales made up 22 to 100 percent of their sales. The 32 growers used a total of 342 acres to grow semi-dwarf and dwarf, indica, and other azaleas. Semi-dwarf azaleas accounted for 78 percent of sales.

Increasing family incomes, population growth, consumer preference for more leisure time, and new housing starts were found to be major factors affecting the demand for azaleas. The 32 growers

shipped azaleas to 21 states in the South, Southwest, Midwest, and East. The largest shipments were made to Texas. Selling methods involved salesmen, brokers, mail order catalogs, and trade shows, with most sales carried out at the wholesale level. Growers stated that retailing involved too many sales problems relative to revenue generated. Growers reported that sales had increased 5-10 percent annually. Generally the outlook for the industry was for continued growth but at a somewhat lower rate than for the past decade.

Position Selection Important for Center Pivot Irrigation

Fields in Alabama generally have irregular shapes and boundaries. This presents a problem in designing an economically effective irrigation system. Therefore, the technique of linear programming and use of grid points were used in researching the possibilities for more cost-effective irrigation system designs. Potential central pivot points for each grid point were evaluated for selected fields. A series of constraint equations described the relationship between possible pivot locations and the amount of water applied at all points in the field. Two strategies, one maximizing the number of pivots without allowing overlap and the other allowing overlap and a minimum deviation from one application, were obtained. In strategy one, nine center pivot systems were positioned which resulted in 57 percent of the land being irrigated. In strategy two, 12 center pivot systems of the same size were positioned, resulting in 63 percent of the land being irrigated with 5 percent being irrigated twice.

Honors

and

Recognitions

Director's Research Award

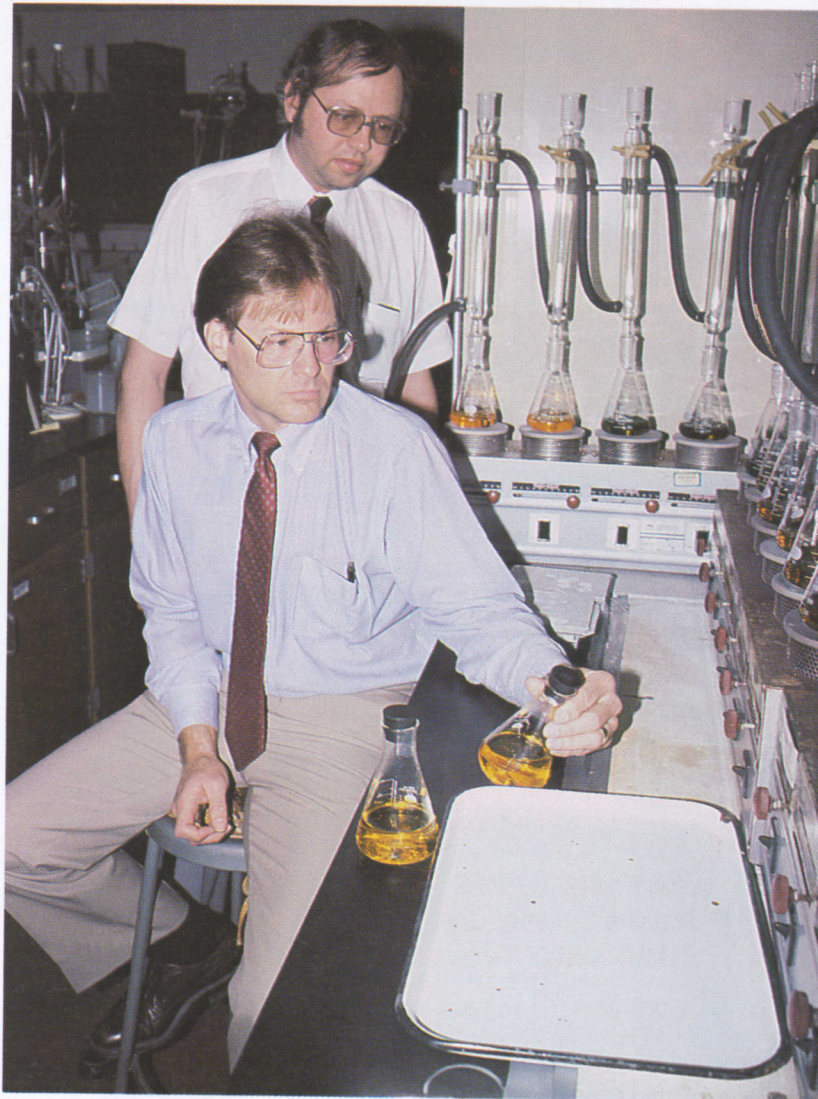
The Director's Research Award was begun in 1981 as a program for recognizing scientists who, during their careers at Auburn, have made exceptional contributions to the mission of the Alabama Agricultural Experiment Station. Two awards are given each year, one for Assistant and Associate Professors and one for Professors. Winners in 1985, selected from among the nominees proposed by individual departments, were John D. Weete, Professor of Botany, Plant Pathology, and Microbiology, and David T. Hill, Associate Professor of Agricultural Engineering.

Weete was recognized for his research in fungal physiology and biochemistry, with special emphasis on fungal lipid biochemistry, which has earned him an international reputation. His research since joining the Auburn faculty in 1973 has resulted in over 100 publications, including books, book chapters, refereed journal articles, and Experiment Station bulletins. He authored two highly regarded books, "Fungal Lipid Biochemistry," published in 1974, and a 1980 revision, "Lipid Biochemistry of Fungi and Other Organisms."

Weete's most recent research has centered on the biochemistry of sterols and their role in biological membranes. His choice of plant pathogenic fungi for use in these studies gave applied implications to this basic research. His research on the mode of action of sterol inhibiting fungicides has attracted international attention, and he is considered a leader in this important area of agricultural research.

Hill is conducting pioneering research in the area of thermophilic digestion of animal waste for methane production and the use of anaerobic filters in production of methane gas from liquid substrates. A strength of his research has been a strong interdisciplinary approach in cooperation with faculty in Animal and Dairy Sciences.

Since joining the Agricultural Experiment Station faculty in 1979, Hill has authored or co-authored more than 40 refereed journal articles. As a result of Hill's outstanding research and widespread reporting of results, Auburn is recognized as one of the nation's leading research institutions in his area of work. He received the FIEI Engineering/Young Researcher of 1985 award from the American Society of Agricultural Engineers.



John D. Weete (seated) and David T. Hill were selected to receive the 1985 Director's Research Award in recognition of exceptional contributions to the mission of the Alabama Agricultural Experiment Station.

Honors and Recognitions

Individual Recognitions

Numerous honors, awards, and other recognitions came to Experiment Station faculty and staff during 1985 in recognition of their individual research accomplishments and leadership in their fields of endeavor. Some of these are identified in the following list:

Troy B. Patterson—inducted into the Alabama Livestock Hall of Fame.

Thomas A. McCaskey—received certificate of appreciation for serving as Section Chairman of the Fifth International Symposium on Agricultural Wastes.

David G. Topel—received Scholar Award from American Society of Animal Science and European Association of Animal Production.

L.L. Lovshin—received Friends of Fish Culture Award from National Department of Works Against the Droughts, Brazil.

W.A. Rogers—received Special Appreciation Award from Catfish Farmers of America.

R.O. Smitherman—received Distinguished Service Award from Catfish Farmers of America.

J.J. Molnar—member Council of the Rural Sociological Society and Rural Sociological Society Liaison Committee, American Association for the Advancement of Science.

H.A. Clonts—nominated to the Research Staff for the President's Commission on Americans Outdoors by the National Association of State Outdoor Recreation Liaison Officers and National Recreation and Parks Association, and treasurer of the National Association of State Recreation Planners.

William E. Hardy—member Advisory Council of Southeast American Institute for Decision Sciences.

S.A. Edgar—received the Outstanding Alumnus Award from Sterling College, Sterling, Kansas.

G.R. McDaniel—First Vice President of the Southern Poultry Science Association.

Paul A. Backman—Associate Editor of *Peanut Science*.

David M. Bisaro—finalist in 1985 competition for National Science Foundation Presidential Young Investigator Awards.

Willard T. Blevins—Education Committee member, Southeastern Branch of American Society for Microbiology.

Elroy A. Curl—Archives and Awards Committee member, Southern Division of American Phytopathological Society.

Norman D. Davis—Fellow in the American Academy of Microbiology and member National Mycotoxin Computer Data Base Committee.

Urban L. Diener—Fullbright Lecturer-Research (Senior Scholar) at Campinas University, Brazil, and member of National Academy of Science/National Research Council of Science and Technology Support for Thailand and Mycotoxicology Committee of International Society of Plant Pathologists.

Robert T. Gudauskas—Executive Committee member and Plant Pathology Chairman, Southern Corn Improvement Conference.

Walter D. Kelley—Chairman of Southern Regional Development Committee 85-07.

Archie J. Latham—Associate Editor of *Pecan South*.

Paul A. Lemke—Editor of *Applied Microbiology and Biotechnology* and Chairman of Awards and Grants Committee for Society for Industrial Microbiology.

Gareth Morgan-Jones—Councilor of Mycological Society of America.

Curt M. Peterson—Chairman of Reproductive Abscission of Agronomic Plants Symposium, Crop Science Society of America, and Archivist of Alabama Academy of Science.

Rodrigo Rodriguez-Kabana—received Distinguished Service Award from Southern Soybean Disease Workers, President of Organization of Tropical Agriculture and Nematology, Councilor of Caribbean Division of American Phytopathological Society, and Associate Editor of *Plant and Soil*.

Bryan Truelove—Emeritus Associate Science Editor of *Weed Science*, Chairman of Monographics Committee and member of Coordination Committee of Weed Science Society of America and Constitution and Operating Committees, Southern Weed Science Society.

Clarence E. Johnson—received American Society of Agricultural Engineers Paper Award for paper published in *Transactions of ASAE*.

David S. Stringfellow—member of International Embryo Transfer Societies Research Subcommittee.

Charles R. Rossi—recipient of first Beachman Award for Research Excellence at Auburn University.

Ray Dickens—received Distinguished Service Award from Southern Turfgrass Association.

Wayne Clark—Executive Council of Coleopterists Society.

James Harper—Executive Committee of Society for Invertebrate Pathology.

R.P. Henry—Treasurer of Alabama Academy of Science.

A.H. Williams—Secretary of Alabama Academy of Science.

R.C. Tang—visiting professor at the National Chung Hsing University of Taiwan where he received a \$5,000 research grant from the Department of Forestry, Council for Agriculture, Republic of China, to fund a 2-day symposium titled "Utilization of Medium and Small Diameter Trees"; received a plaque from the Chinese Forest Products Association in recognition of his assistance in upgrading forest products research in Taiwan.

Honorio Carino—Vice Chairman of the Production Management Technical Committee, Forest Products Research Society.

Thomas Elder—Chairman of the Southeastern Section, Forest Products Research Society.

Warren Flick—Chairman of the Alabama Division, Society of American Foresters.

Bobby Lanford—Chairman of the Council of Forest Engineering and will coordinate the Council's 1986 National Meeting.

FINANCIAL

REPORT

1985

EXPENDITURES BY COMMODITIES YEAR ENDING SEPTEMBER 30, 1985

	APPROPRIATED FUNDS	ALL FUNDS
Beef Cattle	9.8%	13.6%
Cotton	1.8%	1.9%
Dairy Cattle	3.8%	4.9%
Feed Grain	3.7%	3.6%
Fish & Wildlife	5.5%	9.0%
Forestry	9.4%	8.4%
Fruits, Nuts, & Vegetables	10.6%	7.9%
Human & Resource Development	7.0%	5.0%
Ornamental & Turf	5.0%	3.9%
Pasture & Forage	2.6%	2.5%
Peanuts	3.1%	3.5%
Poultry	10.9%	8.4%
Soil, Lands, & Water	5.4%	4.7%
Soybeans	7.8%	7.7%
Swine	7.1%	8.6%
Other	6.5%	6.4%
	100%	100%

FUNDS AVAILABLE YEAR ENDING SEPTEMBER 30, 1985

Appropriated		
State	\$ 11,264,013	47.5%
Federal	<u>\$ 3,905,880</u>	<u>16.5%</u>
Total Appropriated	<u>\$ 15,169,893</u>	<u>64.0%</u>
Contracts & Grants		
State	\$ 469,018	2.0%
Federal	\$ 1,580,082	6.7%
Private	<u>\$ 1,842,680</u>	<u>7.8%</u>
Total Contracts & Grants	<u>\$ 3,891,780</u>	<u>16.5%</u>
Sale of Research Products		
	<u>\$ 4,629,781</u>	<u>19.5%</u>
Total Research Funds	<u>\$ 23,691,454</u>	<u>100.0%</u>



Produced by Department of Research Information
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