



A N N U A L R E P O R T 1 9 8 4



**ALABAMA
AGRICULTURAL
EXPERIMENT
STATION**

T H E C O V E R S T O R Y

An innovative study begun in 1984 at the Tennessee Valley Substation, Belle Mina, promises to provide detailed information about soil erosion that has long been needed. Twelve field plots equipped with devices to automatically collect runoff samples

and record continuous hydrograph will provide information on soil, water, nutrient, and pesticide movements from cropland. Comparisons will be made between different slopes of land and under different tillage practices. Weather information will

be collected and correlated with other findings. Information to be gained in the years ahead should be invaluable in designing production systems that will provide maximum protection against soil losses while producing economical yields of crops.



ADMINISTRATIVE OFFICERS

James E. Martin, President

Paul F. Parks, Vice President for Research

Gale A. Buchanan, Director

Alabama Agricultural Experiment Station

David H. Teem, Assistant Director

Alabama Agricultural Experiment Station

F O R E W O R D

This annual report to the people of Alabama is an accounting of the research carried out by the Alabama Agricultural Experiment Station during 1984. Though only a small portion of our work can be described here, this report does illustrate the many facets and breadth of our agricultural, forestry, and related research efforts.

The Alabama Agricultural Experiment Station was created by an act of the state Legislature in 1883 and charged with conducting basic and applied research to ensure a productive, successful, and permanent agriculture in the State. At no time since then have agriculture and agri-industries faced such serious problems as we face today. Nor has agricultural research ever been faced with such complex problems and unique challenges.

While a few unenlightened spokesmen attribute the dilemma of agriculture to 'over-success' of agricultural research and the unrestrained production of American farmers, the problems facing agriculture are far more complex. One of these problem areas is foreign trade, where the strong U.S. dollar creates an unfavorable balance of trade. Since about 35 percent of agricultural products are exported, this serves to drive U.S. farm prices down. At the same time, costs of production inputs continue to rise. Combine this with the old nemesis, weather, and declining land prices, and farmers are caught in a squeeze, seemingly from all sides. But the American farmer has an ally that no other farmer in the world can claim, a coordinated system of agricultural research spearheaded by state agricultural experiment stations.

There is little that research can do about the strength of the dollar and low commodity prices. But there is a tremendous opportunity for improving efficiency, thereby reducing input cost per unit of production. For example, our scientists are currently screening hundreds of breeding lines and varieties of soybeans. If we could find and develop one with greater resistance to pests and drought, higher yielding capabilities, and better adaptation to minimum or no-tillage cultivation, we could dramatically reduce the input cost of soybeans. The same is true for other crops.

A visiting scientist at Auburn University recently said, "In much less time and at a fraction of the cost of putting a man on the moon, a National commitment to agricultural research could provide the technology to increase production enough to make \$1.50 per bushel corn and \$4.50 per bushel soybeans profitable for farmers to grow." In essence he was saying that a National research effort that combines basic scientific studies with adequate applied research could solve most of agriculture's problems. Unfortunately, we don't have this strong National commitment, and there are those in powerful positions who appear to be more interested in eroding than building our system of agricultural research. This situation makes it more important for those of us charged with conducting agricultural research to be more resourceful and diligent in our work.

We desperately need to develop a wider range of commodity opportunities for Alabama farmers. One of the most promising is in aquaculture. About 70 percent of the fish and aquacultural products consumed in the United States are imported, at a cost of about \$3 billion annually. Thus, we have an available domestic market. Alabama and surrounding Southeastern States have a favorable climate and ample water supply for producing fish. Already Auburn scientists have made significant contributions to the State's catfish producers, and the potential to further develop this and other aquacultural enterprises in Alabama is tremendous.

Development of the State Farm Market System by the Alabama Legislature provides the basis for renewed research effort to develop several vegetable and fruit crops. Such crops fit into either small or large farming operations. The development of new cantaloupe, plum, and watermelon varieties and work to support renewed interest in blueberries and strawberries are examples of areas in which researchers from Auburn are helping build the State's fruit and vegetable industry.

My single greatest concern is that available resources limit us from fully exploring all of the opportunities that appear on the horizon. Progress of research projects is reviewed frequently to ensure that resources are expended in the most productive ways, and to make sure that each project contributes to the overall research mission of the Alabama Agricultural Experiment Station. The first step in obtaining adequate resources is to develop an understanding of how this Experiment Station's research efforts in agriculture, forestry, home economics, and resource management contribute to the well being of every man, woman, and child in this State.

We appreciate your dedicated support and pledge our continued efforts to maintain and improve our research capabilities. We are confident this effort will lead to a better life for all Alabamians.

Gale A. Buchanan, Director



C O N T E N T S

Foreword	3
Horticulture	5
Botany, Plant Pathology, and Microbiology	7
Agronomy and Soils	9
Forestry	11
Agricultural Engineering	13
Poultry Science	15
Fisheries and Allied Aquacultures	17
Animal and Dairy Sciences	19
Zoology-Entomology	21
Animal Health	23
Home Economics	24
Agricultural Economics and Rural Sociology	25
Director's Research Award	27
Research on Display	28
Financial Statement	30

*Information contained herein is available to all
persons regardless of race, color, sex, or
national origin.*

A summary of 1984 horticultural research at the Alabama Agricultural Experiment Station emphasizes the practical information being made available to Alabama horticultural producers. The use of this research-generated information allows growers

to produce high quality foods and ornamental plants for Alabama consumers. Both producers and consumers benefit from better production, marketing, and processing methods, and from new horticultural crop varieties developed.

The productive life of peach orchards in the Southeast has declined and often is only 7 to 10 years. One factor responsible for this decline is the syndrome known as peach tree short life, a disease complex characterized by sudden death in late winter or early spring. Peaches usually are propagated on seedling rootstocks, but until recently little attention has been given to the rootstock cultivar used. Now there is evidence to indicate that rootstock is a major factor involved in the longevity. In an Alabama Agricultural Experiment Station study in cooperation with researchers in Arkansas, Georgia, North Carolina, and South Carolina, six of eight rootstocks tested resulted in poor longevity.

The rootstocks used in this study were Nemaguard, Halford, NC NRL-4, NC 152 Al-2, NA-8, Harrow W208, Lovell, and Siberian C. Loring and Redhaven served as the test varieties. Measurements included survival of the trees, fruit yield, and tree growth. Six years of data have been collected.

While no rootstock has been successful in eliminating peach tree short life, there have been noticeable differences. Redhaven on Siberian C and NA-8 showed the greatest tree loss during the 6 years, followed by Loring on Siberian C. Siberian C is the least acceptable of the rootstocks in the test. Nemaguard and the two North Carolina selections, NC NRL-4 and NC

Carolina Nugget Sweet Potato Released

Alabama sweet potato growers now have available a desirable new sweet potato variety. The Alabama Agricultural Experiment Station included the North Carolina line NC172 in its Foundation Seed Production Program because of its popularity with Alabama growers. As a result of this effort, the variety was released in 1984 by the North Carolina Experiment Station in cooperation with the Alabama Station, under the name Carolina Nugget.

The new variety has a unique foliage that is deeply cut with a dark green color and grows vigorously under adequate soil fertility and moisture. It performs well in soils from heavy sands to light Coastal Plains soils. In 3 years of replicated yield trials at the E. V. Smith Research Center at Shorter and the Chilton Area Horticulture Substation at Clanton, Carolina Nugget averaged 260 bushels of number 1 potatoes per acre, compared to 269 for Centennial and 296 for Jewel, the two varieties against which all other sweet potato varieties are compared for yield. Its roots are rosy colored and well shaped.

It is generally reported that Carolina Nugget requires less curing for storage than Centennial or Jewel varieties. Under good storage conditions, roots of Carolina Nugget remain sound and of high market quality for 6 months or longer. Tests by the USDA Vegetable Laboratory in Charleston, South Carolina, indicate that Carolina Nugget has a higher level of resistance to *Fusarium* wilt and southern root-knot nematode than Centennial. It compares favorably to the resistance of Jewel. Selections of Carolina Nugget are now being made for improved flesh color and consumer appeal.

Irrigation Keeps Container Plants Cool

High temperatures within nursery containers are often responsible for reduced root and shoot growth and poorer quality plants. The bottom line may be a longer production cycle and a lower market value. Only limited success in reducing high temperatures has resulted from the

use of reflective containers, nonreflective bed mulches, reduced pot spacing, and overhead shade.

Irrigating with overhead sprinklers may offer a practical solution to the problem, according to results of a 2-year study at Auburn. Applying irrigation during the day resulted in lower maximum temperature in the growth medium and plant canopy and greater growth of canopy and roots. Although the exact timing of irrigation to achieve maximum growth was not determined, results suggest that single applications applied 2 to 4 hours before time of maximum air temperature or split applications at 10:00 a.m. and 3:00 p.m. are beneficial. Because many of the container nurseries concentrated in south Alabama are already equipped with overhead irrigation, irrigation practices can be modified to economically control temperatures within the containers.

Irrigating with overhead sprinklers lowered maximum temperature in growing medium and plant canopy of container ornamentals.





Loss of trees on unadapted rootstock in research orchard illustrates the importance of choosing the right rootstock for commercial peach orchards.

152 Al-2, are resistant to root-knot nematodes but are susceptible to ring nematodes.

Halford rootstock, which is being used in some orchards that are prone to peach tree short life, appears to be equivalent to Lovell by the criteria measured in this study, but tree size may be reduced in some locations if Halford is used. Of the eight rootstocks tested, the data from this 6-year test indicate that Lovell and Halford are the best available for use in replanting Southern orchards that are prone to the peach tree short life syndrome.

Disease Resistant Cantaloupe

Disease is a major factor limiting production of cantaloupes in Alabama. Gummy stem blight, downy mildew, and powdery mildew are diseases that have caused severe crop losses in certain fields in Alabama. Although satisfactory control of gummy stem blight and the mildews may be accomplished with the proper application of organic fungicides during normal weather conditions, no control measure is effective during periods of high humidity and high rainfall.

The discovery that a wild melon introduced into this country as plant introduction 140471 is resistant to gummy stem blight led to an Alabama Agricultural Experiment Station cantaloupe breeding program that has developed disease resistant varieties that produce high yields

of excellent quality fruit. The latest release from this program is Aurora.

Aurora combines multiple disease resistance with good quality and large size fruit. It is a "jumbo" type melon with resistance to gummy stem blight, downy mildew, and powdery mildew. Superior to the current varieties of its type in yield, quality, and disease resistance, it is adapted for growing throughout the Southeast where mildew and blight are serious disease problems.

In replicated trials at the E. V. Smith Research Center, Shorter, over an 8-year period (1977-1984), Aurora produced an average yield of 34,246 pounds per acre. This compares with 29,387 pounds for Gulfcoast, 28,570 for Chilton, 23,561 for Edisto 47, 23,152 for Mainstream, and 19,665 for Planters Jumbo. Its fruit size averaged 4.19 pounds, larger than the other melons except Edisto 47 (4.37 pounds).

Maintaining Fern Quality

New Auburn results showing that ferns will maintain their quality under low light conditions without additional fertilization point to potential savings for retail garden centers. Many garden centers maintain greenhouses for holding and fertilizing foliage plants prior to sale because of the belief that quality will drop rapidly when liquid fertilizer is stopped and plants are moved into low light conditions. But this did not happen in the Alabama Agricultural Experiment Station tests.

Previous research established benefits of acclimatizing foliage plants under low-light levels before they enter the home environment. This research indicated that plants held under low-light levels during acclimatization might require less fertilizer than plants held under high-light conditions. Thus, holding ferns in low-light conditions prior to retail sales rather than in a well lighted greenhouse could potentially benefit both the garden center operator through reduced costs and the consumer with plants better adapted to home conditions.

The newest study compared (1) growth of ferns with liquid fertilization and two slow-release fertilizer programs, and (2) post-production quality of the ferns when held under interior low-light conditions or in the greenhouse. Liquid fertilization was as good as the slow-release programs during the 16-week normal production period.

In the post-production study with no additional fertilizer added, little growth occurred on ferns moved to the low-light conditions, while ferns in the greenhouse continued to grow. After a 6-week holding period, however, ferns held in the low-light interior environment were greener than those held in the greenhouse, and those grown with liquid fertilization were as green as those that had received slow-release fertilization, regardless of the post-production holding treatment. Plants held in the low-light conditions actually improved in color and consumer desirability with no additional fertilizer added.

Aurora variety is the latest disease resistant release from the cantaloupe breeding program.



BOTANY, PLANT PATHOLOGY, AND MICROBIOLOGY

Research in the areas of botany, plant pathology, and microbiology deals with several interdisciplinary aspects of plant science and microbiology. Agriculturally related research and training have traditionally centered about areas of plant pathology and weed science, with particular

emphasis given to the study of fungi and nematodes pathogenic to Alabama crops and to physiological studies on the mode of action of herbicides and the ecology of weeds. The department maintains a large reference collection of fungi and higher plants and is also extensively in-

involved in the study of fungal toxins (mycotoxins) and biostatistics. A recently initiated program in biotechnology, the application of new genetic and biochemical developments in plant and microbial systems, promises to impact significantly on agriculture.

Crop Rotation for Nematode Control

Root-knot nematodes are among the most damaging pests of peanuts. There are no tolerant varieties of this crop to these nematodes, consequently their control has been based on the use of nematicides. The recent removal of key inexpensive nematicides from use by farmers and rising costs of production have made imperative the research for other means of managing root-knot nematodes. An 8-year study of selected cropping sequences conducted at the Wiregrass Substation has shown that rotation of peanuts with 2 years of corn, or a year of peanuts followed by a year each of corn and a nematode-tolerant variety of soybean, effectively maintained root-knot nematode populations at low levels. In contrast, planting peanuts every year resulted in an almost explosive development of the nematode. The study also showed that a cover crop of rye consistently increased yields of succeeding crops of soybeans or corn as compared to yields with winter fallow.

Fighting Soybean Stem Canker

Stem canker of soybeans is a serious disease problem. In 1983 it caused an estimated \$17 million in damage in Alabama even though only 30 percent of acreage was infested. Prompt work by the Alabama Agricultural Experiment Station identified Tracy-M, Braxton, Bay, and Dowling as having resistance, and these were used for immediate relief in affected areas. They also were used as breeding lines to develop more and better varieties.

Resistant varieties did not develop disease, but unfortunately they did allow development of the fungus that causes stem canker. The implication of this finding is that even though the farmer may not have disease on his resistant variety, this does not mean that he has eliminated the disease, nor does it mean that he can plant a susceptible variety the next year.

Crop rotations proved to be successful in maintaining root-knot nematodes at low population levels in peanut soils.

Further research has indicated that the fungus has a limited time during which it can infect and continue on to form disease. Preliminary studies have indicated that spray programs with systemic fungicides applied over the row in a band during this infection period can protect the soybean plant at reasonable cost. Other research indicated that no-till cultivation systems intensify stem canker severity, although this effect can be reduced by late planting. The Auburn research has made it possible to grow soybeans even in areas infested with this devastating disease. Future research should allow Alabama's soybean farmers to almost forget that stem canker ever existed.

Keeping Flowers and Pods on Soybean Plants

Shedding or abscission of flowers and young pods seriously limits soybean yield potentials in Alabama. Research underway using light and electron microscopy is expected to pinpoint the critical stages of development when most flowers and pods are shed from plants. Other studies are determining whether these abscised flowers and pods are structurally different from those that are retained.

Results of light microscope studies revealed that most abscised flowers con-



Light microscope studies are providing information about the problem of soybean flower abscission that limits yield.

tained young embryos surrounded by a developing food reserve tissue or endosperm. Large numbers of starch grains were present in these flowers at polli-





Cogongrass (left) presents a more distinctive appearance than torpedograss (right), but both are becoming serious pests in much of Alabama.

nation and fertilization, indicating cellular food reserves were adequate for cell growth. However, the starch grains disappeared rapidly from developing seeds during early embryo development, particularly during the critical stage when most flowers abscised. Disappearance of starch was observed in both abscised and retained flowers.

Learning About Cogongrass and Torpedograss

Cogongrass and torpedograss, perennial, rhizomatous grasses which were introduced into the Gulf Coast of Alabama early in this century, are becoming increasingly troublesome. They are found extensively in the Gulf Coast counties with scattered populations occurring as far north as Montgomery and Lee counties. On a world-wide basis, cogongrass is ranked 7 and torpedograss 54 among the "worst weeds." Details about the grasses and their response to herbicides have been obtained in Alabama Agricultural Experiment Station research to provide the basis for dealing with the pest plants.

Cogongrass typically flowers in early to mid-July but may flower in the fall following burning or mowing. When in flower, cogongrass is easily recognized by its fluffy white blooms. A typical cogongrass plant will produce approximately 3,000 seeds, of which approximately 90 percent may germinate immediately upon

being shed from the plant. Its distribution pattern in Alabama suggests that it is spreading predominantly in a northeasterly direction by windborne seed. Another possible avenue of spread is from rhizome- or seed-contaminated ornamental nursery stock and turf originating in the Mobile area. Cogongrass appears to be easily controlled by cultivation and is primarily a problem in noncultivated areas, especially along highway rights-of-way.

Unlike cogongrass, torpedograss is not very distinctive. Normally an erect and wiry grass, it may present a low, creeping growth habit. Torpedograss flowers and produces seed throughout the summer but the seed are not viable. Its spread appears to be primarily through nursery stock and turf along the Gulf Coast. Unlike cogongrass, torpedograss is not controlled by tillage; in fact, tillage tends to increase its rate of spread.

In competition experiments at Auburn, yields of common bermudagrass were reduced in the presence of both weed species, but particularly by torpedograss. Once established, two to three heavy applications (3 to 5 pounds per acre) of glyphosate will eradicate cogongrass and torpedograss. Cogongrass and torpedograss are not likely to become quantitatively important components of the weed flora in north Alabama, but they could become a serious problem in the south, particularly in noncultivated areas such as orchards, yards, and pastures.

Atrazine Resistance Sought

Triazine herbicides such as atrazine (Aatrex®) and simazine (Princep®) kill weeds by disrupting the chemical reactions of photosynthesis. This same disruption also occurs in certain crop plants, which prohibits the use of these effective herbicides in sensitive crops. Therefore, research at the Alabama Agricultural Experiment Station is seeking information about how atrazine resistance may be developed in selected plants.

Recent findings have shown that a small family of soil- and water-dwelling bacteria which carry out a form of photosynthesis is also killed by triazines. Furthermore, if these bacteria are cultured in the laboratory on a medium containing atrazine, forms of the bacteria can be isolated which are resistant to the triazines. These triazine-resistant bacteria are in many biochemical ways directly analogous to the triazine-resistant weeds which have appeared all over the world in areas where triazine herbicides have been used repeatedly over a long period.

As a follow-up to the laboratory findings, a search was made for naturally occurring, triazine-resistant forms of these bacteria in mud from a pond which had received runoff from atrazine-treated cropland over a number of years. It was possible to show that such naturally resistant bacteria do indeed exist and have arisen, presumably, because of the selective pressure exerted over a long period by the inflow of atrazine into the pond.

The explanation for resistance in weeds is known. It is due to a small genetic change which affects one of the proteins essential for successful operation of photosynthesis. Auburn research has shown that in the triazine-resistant bacteria there has also been a small but important genetic change affecting a photosynthesis protein analogous to, but not identical with, that occurring in resistant weeds.

Because bacteria reproduce rapidly and are easy to handle, these atrazine-resistant cultures provide a unique opportunity for studying the comparative biochemistry and genetics of photosynthesis in higher plants and bacteria, as well as the mechanism of herbicide action. Looking further down the road, it is also conceivable that, through the rapidly developing techniques in genetic engineering, the gene for the altered protein in the bacteria could be transferred into a broadleaf crop plant such as soybean. Such a breakthrough would enable farmers to use a triazine for weed control in crops on which it could not normally be used because of the crop's innate sensitivity to the herbicide.

AGRONOMY AND SOILS

Crops and soils continue to receive major research emphasis at the Alabama Agricultural Experiment Station. Soybean growers can be encouraged by results of 1984 research that identified experimental genotypes with greater resistance to nematodes and disease and other

studies which showed potential weed control benefits from narrow rows. Opportunities for increased crop production by greater usages of lime and fertilizer also were noted in results, and a greater understanding of erosion effects resulted from other research.

Promising New Soybeans

Several promising experimental soybean genotypes were identified in multiple-location yield test plots in 1984. Top lines in Maturity Group VI yielded 9 percent more than the adapted cultivar Centennial; in Maturity Group VII, best new lines yielded 14 percent more than Braxton. Highest-yielding lines will be entered in the USDA Uniform Soybean Tests, for testing across the Southeast.

New experimental genotypes are being screened for yield, resistance to soybean cyst and root-knot nematodes, and resistance to stem canker. A broad spectrum of soybean germplasm was screened for stem canker resistance in the greenhouse. At least two types now grown in other parts of the United States were found to be susceptible to isolates commonly found in Alabama, indicating the potential for stem canker to spread to these areas.

Research on nematode resistance in soybeans has given variable results in past years, indicating that environmental conditions encountered during the year largely determine yield loss and the predominant species present. Currently available cultivars do not have sufficient resistance to produce high yields without fumigant nematicides in fields where root-knot or root-knot and soybean cyst nematode mixtures are a problem. The most resistant cultivars were Foster and Leflore, with resistance indices of 0.22 and 0.24, respectively, compared with 0.38, 0.60, and 1.01 for Braxton, Coker 368, and Ransom, respectively. Highest yields were obtained from cultivars with resistance to a broad spectrum of nematodes treated with a fumigant nematicide. A new cultivar adapted to Alabama is expected to be released in the near future.

Crop Rotations Boost Yields

Advantages of rotations, tillage systems, and double cropping on yields of soybeans have been known for many years, but recent research has provided some insight to reasons for yield increases. Including 1 year of grain sorghum on Sumter soils at the Black Belt Substation increased soybean yields the following year by 17 percent. Including wheat as a winter cover after grain sorghum and preceding soybeans increased the yield of soybeans by 27 percent. At the Sand Mountain Substation, soybean yields were lowest when corn was not included in the rotation. Populations of soybean cyst nematodes were highest also when corn was not included in the rotation with soybeans. Yield reduction of soybeans appeared to be mainly attributable to large infestations of nematodes.



Effects of different cropping systems are obvious: top—conventional tillage, soybeans-corn; center—conventional tillage, continuous soybeans; bottom—no-till, soybeans-corn.



The serious problem of soil erosion on Tennessee Valley soils is illustrated by large gully that formed between fall and early spring.

Advances in Soils Research

Relationships between soil erosion and reduction of crop yields continue to be highly revealing. In 1984 research, cotton yields on moderately eroded soils in north Alabama were 21 percent lower than yields on slightly eroded areas of the same soil. In southern Alabama, corn yields on moderately eroded soils were 23 percent lower than yields on slightly eroded soils. Significant yield reductions were also recorded for soybeans grown on moderately eroded soils in southern, central, and northern Alabama.

Dependent on the boundary conditions and on the temperature regime in a soil profile, it was shown that predicted water content profiles based on isothermal conditions differ greatly from those based on non-isothermal conditions. The effect of hysteresis in the soil-water retention curve tended to negate these temperature effects on predicted soil-water content profiles. Investigations of the effect of temperature on the soil's hydraulic properties showed that for a Norfolk sandy loam soil, the changes in soil-water pressure head with temperature were 2 to 3 times greater than predicted from theory. The hypothesis that (1) entrapped air, and (2) the greater than expected temperature coefficient for surface tension of the soil solution were the main causes for the discrepancy was contradicted by experimental evidence. Changes in hydraulic conductivity values were close to those predicted from viscosity changes, except at the lower water contents (0.10-0.15) combined with higher temperatures (104-112°F). In the latter case, differences were mainly attributed to vapor transport.

Soil fertility research continues to show

needs on Alabama soils for increased usage of lime and fertilizer. Approximately 41 percent of the soil samples tested by the Soil Testing Laboratory in 1984 needed lime; more than 60 percent needed both P and K. Although long-term studies continue to show no response to P and K on soils with high levels of residual P and K, an increasing number of soils are testing medium or lower in each of these elements.

New experimental soybean genotypes are being screened for yield, resistance to soybean cyst and root-knot nematodes, and resistance to stem canker.



Row Spacing and Irrigation Affect Soybean Weeds

Research conducted at the Wiregrass Substation shows the competitive ability of common cocklebur and sicklepod with soybeans depends to a large degree on soybean row spacing. Decreasing soybean row spacing from 36 to 6 inches resulted in significantly lower weed weights and higher soybean yields when a constant soybean population was maintained across all row spacings. This resulted in part due to increased weed mortality in narrow row soybeans compared to soybeans planted in conventional 36-inch rows. The row spacing advantage was evident in both irrigated and nonirrigated treatments. Drought conditions reduced total weed and soybean weights in nonirrigated treatments but did not affect the row spacing-weed competition relationship.

Common cocklebur proved to be more competitive than sicklepod with soybeans when both weeds emerged simultaneously. Delaying weed emergence by as little as 1 week enables soybeans grown in narrow rows to gain a competitive advantage over both weeds. Comparison of the relative competitive ability of weed species under different cultural and environmental conditions provides information which can be used to make economic decisions in crops grown using postemergence weed control measures.



Herbaceous weed control in pine plantation using a combination of Oust® and Velpar®.

Forest Biology Findings

Forest biology research in 1984, which included a diversity of topics, resulted in several significant findings.

- Results of an Alabama loblolly pine seed source study led to recommendations for use of source-specific material for regeneration. As a general rule, material can be moved approximately one degree north of the source and have greater productivity than local material.

- Research in forest soils resulted in the development of a portable tool suitable for taking bulk soil samples in rocky or clay soils. The location of many forestry research plots makes such a portable tool an extremely valuable addition to the forest soil scientist's repertoire.

- In studies on the reclamation of land surface mined for coal, it was found that rehabilitation methods cheaper than those required by current regulations may produce as good or better results.

- Studies in young pine plantations have identified specific herbicides which are efficient in controlling herbaceous weed competition with little negative effect on pine. Other herbicides show considerable promise for site preparation treatments in the flatwood regions of South Carolina, Georgia, and Florida.

- Four years of data following plantation establishment showed the growth of loblolly and longleaf pines exhibited exceptional responses to herbicide treatment for weed control. Compared to untreated trees, longleaf with 2 years of herbaceous weed control were larger in height and diameter by 135 percent and 32 percent, respectively. Loblolly was 59 percent taller and 113 percent larger in diameter.

- Forest nursery studies during 1984 identified additional herbicides which are extremely safe on pine seedlings while providing improved weed control. In research on root growth potential of loblolly pine, as seedling density increased new root growth decreased, and root growth potential was positively correlated with seedling survival.

- Studies with nursery sowers indicated precision sowing can increase seed efficiency by reducing the cull percentage.

- The importance of rapid seed emergence showed up in seed stratification studies. Root collar diameters of seedlings decreased 1 percent or more for each day seedling emergence was delayed.

F O R E S T R Y

Research during 1984 involved a variety of locations and studies within the overall umbrella of growing, harvesting, and processing timber. Forest engineering/timber harvesting research contributed to improved efficiency in forestry equipment main-

tenance, repair, and replacement. In addition, research emphasis was continued in developing mechanized systems for first thinnings in pine plantations. Forest biology studies produced significant developments in several areas.

Economical First Thinning Methods

Results of efforts to develop mechanized systems for first thinnings in pine plantations have completely reversed the opinion of many individuals in Southern forestry on this topic. Before results of this research became available, it was generally assumed that, because of small piece size, mechanical thinning in pine plantations would be uneconomical and could only be justified by silvicultural considerations. The current Alabama Agricultural Experiment Station results have not only shown that mechanical thinning systems can be economically justified in first plantation thinnings, but that such systems have improved safety and production records compared to manual methods. Future research will concentrate on improving the systems developed, as well as expanding the scope to consider second and subsequent thinnings.

Failure Rates, Repair Times Pinpointed

To evaluate forestry equipment management policies and improve the cost effectiveness of forestry equipment operations, failure and repair data have been collected on 23 crawler tractors. Data collected to date cover 674 weeks (range of 7 to 61 weeks per machine) and 12,707 hours worked (range of 135 to 1,688 hours per machine).

During the study period, 265 failures were observed, with the number per machine ranging from 1 to 54 and the average time between failures for machines with more than two failures ranging from 17.7 to 168.5 hours (average of 48.0 hours). During some downtime, more than one component was repaired, so the total number of repairs observed was 295. The number of repairs per machine ranged from 1 to 65, with an average of 12.8. Average time per repair ranged from 1.15 to 20.19 hours, with an overall average of 8.12 hours per repair.

In addition to the number of failures per unit, each repair was coded to represent the component responsible for the failure. Tracks represented a major trouble spot, with a 28.4 percent repair frequency, 48.7 percent of total repair time, and an average of 14.0 hours to repair. Time between track failures was 80.1 hours, considerably less than for other components. Cooling systems required more than 14 hours to repair, and represented 18.8 percent of repair time. Engine, frame, powertrain, and hydraulics averaged 6.7 to 7.9 percent of repair time.



Use of a precision sower was found to increase seed efficiency by reducing the cull percentage.

The performance of each machine was modelled so that comparisons could be made. Comparisons of time between failures indicated significant differences among manufacturers and companies, with less difference due to machine age. Comparisons of time to repair also indicated significant differences among

manufacturers and companies, but no significant differences among machine ages.

In addition to the data on groups of machines, each cooperator was provided machine availability and utilization, trends in time between failures and time to repair, and histograms representing the frequency of failure and time to repair.

Mechanical thinning systems developed at Auburn result in economical first thinning of pine plantations. Systems are safer and more productive than manual thinning.



AGRICULTURAL ENGINEERING

Research in agricultural engineering emphasized such areas as irrigation, soil erosion, soil tillage, animal waste management and utilization, and broiler litter management. Reports on individual projects empha-

size how computers and other high-tech approaches are used in agricultural engineering research to develop more economical and efficient methods of performing all agricultural operations.

Computer Designed Irrigation System

By taking advantage of computer assistance, an irrigation design system has been developed at Auburn to overcome special problems with center pivot systems in fields of irregular size or shape. Although a large center pivot system is less expensive per unit area than a smaller system, a design utilizing several smaller systems may irrigate more area in a particular field. The Auburn method, which utilizes an optimizing technique called mixed integer linear programming, will determine the most economical combination of different sizes of center pivot systems.

The first step is to determine the sizes of center pivots to be evaluated. An economic budget, consisting of the yearly fixed cost and the estimated operating cost, is created for each size pivot. These values will vary from field to field, depending on such factors as available water supplies, soil types, and topography. The average yield increase resulting from irrigation can be obtained by referring to controlled irrigation experiments for the region in which the field is located.

The next step is to enter coordinates of the field boundaries into the computer. This is done by laying a map of the field over a digitizing tablet and encoding points along the field boundaries. The field and surrounding area are then approximated by a rectangular grid of points. By utilizing the coordinates of the boundaries, each point is classified as being either inside or outside the field. The gross profit associated with irrigating the area represented by one grid point is obtained by multiplying the yield increase by the market price for the crop.

The computer program which utilizes linear programming techniques analyzes all possible locations for each size of center pivot. The possible locations are constrained by requiring that no points outside the field boundaries can be irrigated. In some cases the center pivots may overlap, and a point may receive two or more applications. To account for this, the program limits the yield increase to that of one irrigation, but the cost for each application remains constant. The

objective function is an equation which calculates the profit for the operation by determining the gross profit from irrigation minus the cost of the irrigation systems. The linear program maximizes the profit for the field by iteratively analyzing combinations of different irrigation systems until the optimal solution is found.

Non-point Source Pollution from Cropland

Excessive soil erosion and subsequent topsoil loss and non-point source pollution from cropland in Alabama have been a serious concern of farmers and conservationists for many years. The average soil loss from Alabama cropland ranges up to 8.8 tons per acre per year.

Over the last two decades, tillage practices in large areas of the United States have generally trended from conventional tillage to some sort of conservation tillage. Although conservation tillage is a relatively new practice in Alabama, more and more farmers are adopting this practice as a means of conserving soil, water, and energy. To provide information needed by farmers, the Alabama Agricultural Experiment Station is studying different tillage practices including conservation tillage. These studies are evaluating effects of tillage systems on soil, water, nutrient, and pesticide movements from cropland.

With support from TVA, a pioneering study on soil erosion on Tennessee Valley soils was established and put into operation at the Tennessee Valley Substation. The study site was constructed with twelve 100-foot by 100-foot plots on 2 percent and 4 percent slopes. Each plot was equipped with a combination of H-type runoff flume, Coshocton wheel type runoff sampler, and two 20-gallon water collecting tanks. The runoff rates are recorded by an automatic recorder to obtain continuous hydrograph. A runoff sample is collected for every storm event and refrigerated for laboratory analysis of sediment, nutrients, and pesticides.

A pioneering study on soil erosion has been established at the Tennessee Valley Substation to provide information needed to overcome problems.



The site is also instrumented with a weather station. Most agricultural weather data are collected and recorded to an automatic data logger for analysis. These data include wind (direction and speed), solar radiation, ambient temperature, relative humidity, pan evaporation, and precipitation. Soil temperature and moisture content are also collected under different tillage practices. This study is expected to provide detailed information about soil erosion that will be of great value in the battle to save Alabama's soil resources.

Litter Management Important for Broiler Producers

Litter management is a critical problem for broiler producers because of the cost and scarcity of litter materials. Two aspects of the problem, moisture content and effect of chicks eating litter, are being studied at Auburn.

Litter moisture must be controlled because (1) litter that is too wet can lead to health problems from excessive ammonia production and growth of disease organisms, and (2) excessively dry litter results in a dusty environment which can cause respiratory problems. Litter moisture is primarily controlled by ventilation, which in turn controls the relative humidity of air in the broiler house. Thus, litter moisture is directly related to relative humidity. In studies to determine the equilibrium relation between air relative humidity and litter moisture content, fresh pine shavings at 10, 25, 30, and 35 percent moisture had equilibrium relative humidity of 59, 96, 97, and 98 percent, respectively. As complete data on litter-manure mixtures are obtained, automatic control systems can be designed for poultry house ventilation.

The effect of chicks eating litter was determined in a series of feeding trials

comparing balanced and unbalanced rations containing 0, 2, 4, or 6 percent fine wood particles (geometric mean diameter of 1.25 millimeters). Results showed no performance differences at 4 weeks of age for birds fed rations containing 0, 2, or 4 percent litter. However, birds fed 6 percent litter were 0.22 pound lighter (1.75 vs. 1.97 pounds) and had 20 points poorer feed conversion (1.76 vs. 1.56). Broilers were also grown on litter in floor pens where they could eat litter material as desired. Litter materials were fresh pine shavings, small fresh pine shavings particles (diameter 1.25 millimeters), and large pine shavings particles (larger than 4.76 millimeters). No differences were found in bird performance or gastrointestinal tract weight. This indicates that, from a nutritional standpoint, litter particle sizes are not a major concern. Thus, it may be feasible to address some other litter management problems by manipulating litter particle size.

Arranging Chisel Tools for Energy Efficiency

Spacing and arrangement of chisel tools were found to affect energy efficiency of tillage operations. Results established that (1) the most efficient geometrical pattern is an approximate equidistant spacing of the chisels, with the distance between chisels being 5 to 6 times the individual chisel tool width; and (2) most efficient operation occurs when the tools are operated at a depth at least 1.5 times the individual chisel tool width.

Two different wedge-shaped chisel widths, 3-inch and 1-inch, were used in the study on sandy loam and clay loam soils. For each chisel width, three chisels were positioned in nine different geometrical patterns defined by an angle and

a radial distance with the center chisel as the reference. The specific draft (draft force per unit of soil cross-section disturbed) was highest, or least efficient, when all three chisels were side-by-side and spaced close together, probably due to a "bulldozing" action. The least specific draft, or highest efficiency, occurred when the two outside chisels were placed in front of and on either side of a third tool at a radial distance of approximately 6 times the chisel width (the angle formed by the two outside chisels with the center chisel was either 60° or 120°). The chisels are close enough in this geometry to cause some interaction without bulldozing action. Also, the specific draft for the three-tool system was influenced by depth of operation. The specific draft appeared to reach a minimum, or level off to a minimum, when the depth of operation was approximately 1.5 times the chisel width.

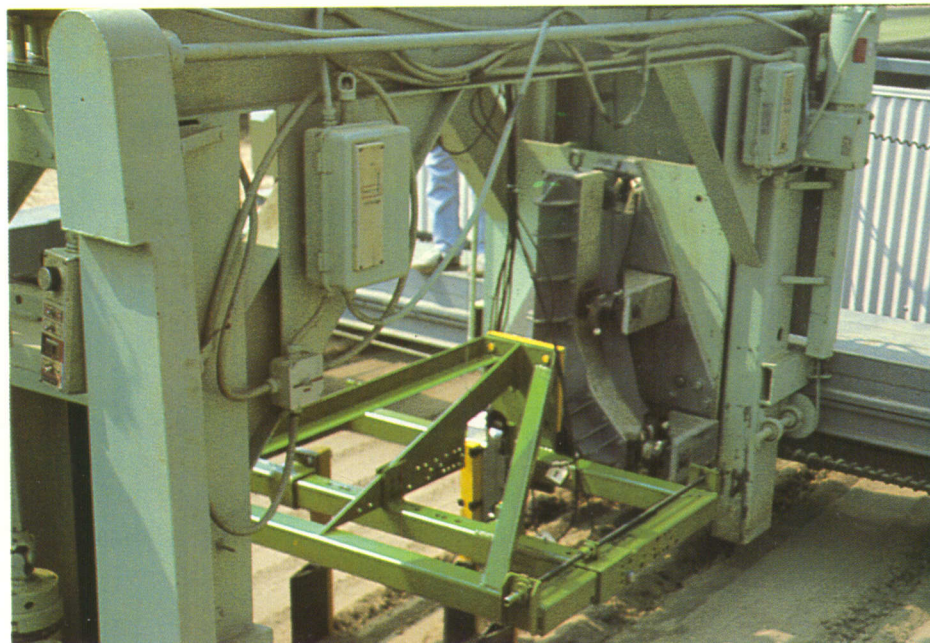
Energy Recovery from Swine Wastes

A pilot scale methane fermentation system operated at the Alabama Agricultural Experiment Station's Swine Research Unit has shown the potential energy production for swine production facilities using flushing waste transport systems. Net energy produced from the system amounted to approximately \$2.00 per produced pig per year.

The pilot scale system consists of an 18-inch vibrating screen for waste reconcentration and a 2,000-gallon fermenter for methane production. It produces methane from approximately 150 finishing pigs housed on a conventional slatted floor. During 1984, the methane generation system was operated for approximately 6 months and provided data on loss of potential methane production due to screening and the actual productivity of the solids fraction of the separated waste.

The loss of potential methane production across the screen was found to be approximately 40 percent due to the loss of dissolved solids and fine particulate matter. This is not prohibitive since the solids fraction remaining can be loaded into the fermenter at approximately twice the rate as unscreened waste due to the removal of inhibitory substances such as ammonia and organic acids. The reconcentration step also reduces the required volume of the fermenter by about 5 times. Data gathered on methane productivity values established the \$2.00 per pig value of energy production. The fermentation system being tested can be easily and economically retro-fitted to existing Alabama production facilities that use flushing systems by simply installing a collection pit, screen, and fermenter.

Proper placement of chisels was found to reduce drag, resulting in greatest efficiency of tillage operation.



Research in poultry science during 1984 emphasized the areas of reproductive and growth physiology, parasitology, pathology, immunogenetics, microbiology, virology, nutrition, and energy management. This program of re-

search not only deals with problems of immediate concern to the poultry industry, it also provides information that will be needed in the future. The value of these projects is indicated in the findings described.

more consistent semen producers than those fed high protein diets. In addition, mortality was less in males fed the low protein diets. Such findings allow savings in feed costs for the industry.

Aflatoxin Level and Poultry Performance

Various levels of crude aflatoxin obtained from a natural outbreak of *Aspergillus flavus* in corn were fed to commercial 2-week-old broilers and turkeys for 5 weeks. Levels as low as 100 p.p.b. in turkeys and 200 p.p.b. of AFB₁ in broilers were found to produce microscopic liver lesions and a depression in cell-mediated immunity. However, neither level affected weight gain, feed conversion, or immunity to Newcastle disease or *Pasteurella multocida*, and neither resulted in morbidity or mortality in either species. Therefore, poultry producers can safely feed corn contaminated with aflatoxin containing levels as high as 100 p.p.b. AFB₁. This is important since the FDA has recently raised the legal level for interstate shipment of aflatoxin in corn to 100 p.p.b. of AFB₁.

Grain Sorghum in Broiler Breeder Ration

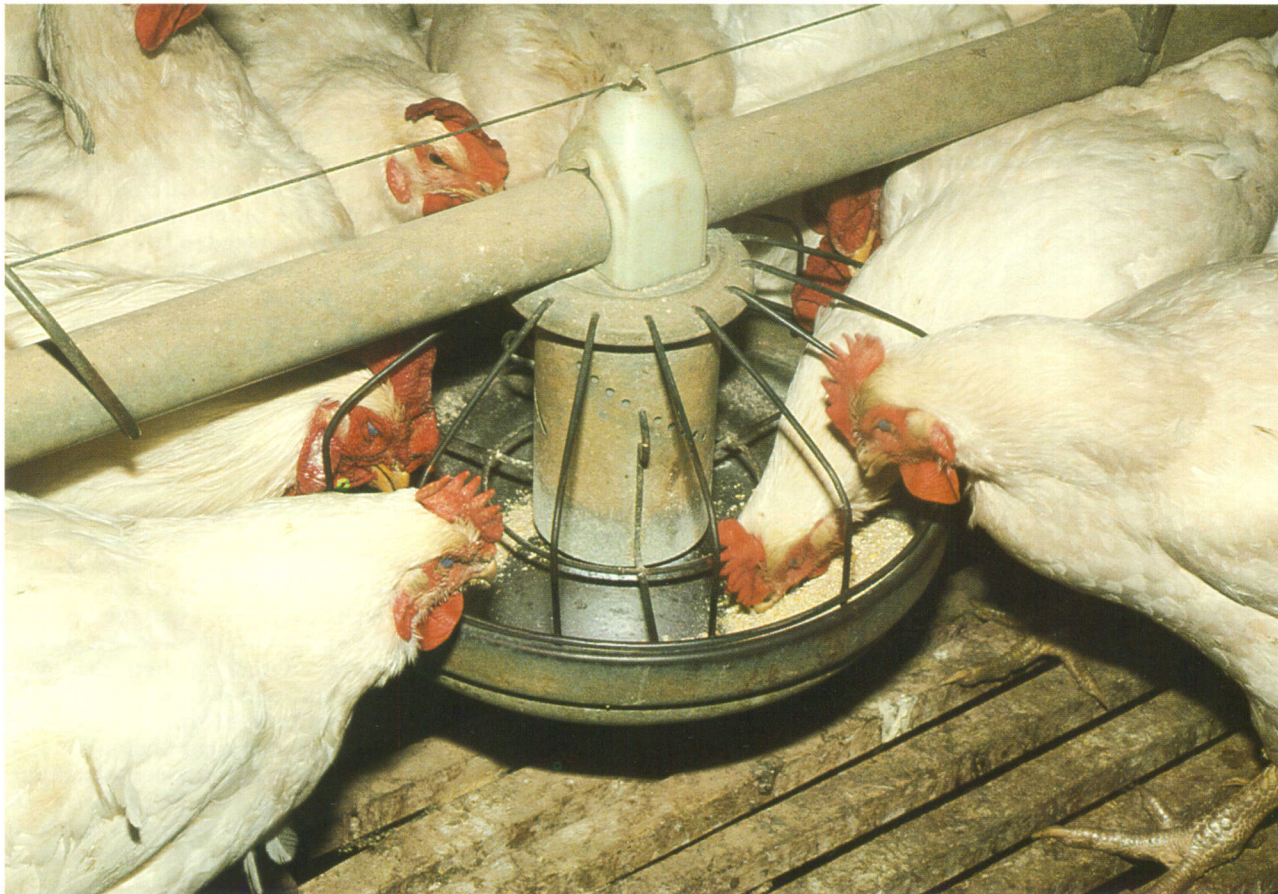
A series of experiments underway to determine the feasibility of using grain sorghum as the only source of grain for broiler breeders provides encouraging results. Performance of birds has been just as good with grain sorghum as with corn in the ration. Thus, there appear to be opportunities for greater use of Alabama-produced grain and lower poultry feed costs.

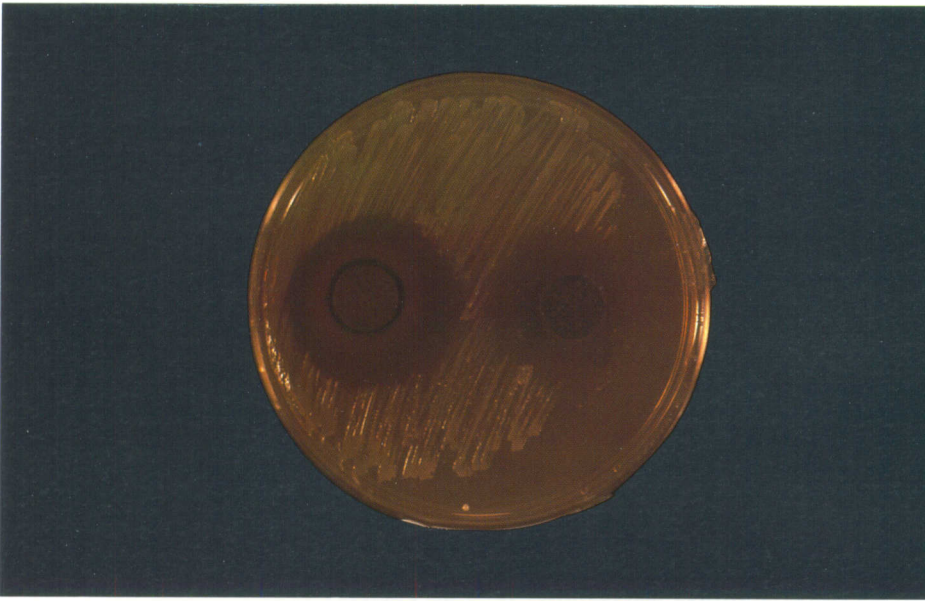
Reproductive performance, such as egg production, fertility, hatchability, shell quality, and body weight, was evaluated with standard size and dwarf broiler breeders. One experiment has been com-

pleted (52 weeks) and preliminary data have been obtained on the other experiments. Breeders fed the sorghum diets matured earlier and had a higher rate of production than did breeders maintained on the corn diet. In addition, body weights of breeders maintained on the grain sorghum diets were heavier than those maintained on corn diets. Grain sources did not affect fertility, hatchability, or shell quality. However, egg weights were slightly greater from hens fed the grain sorghum.

In other nutrition work, diets ranging from 9 percent to 18 percent protein were evaluated for broiler breeder males. Those reared and maintained on the lower protein diets matured earlier and were

Grain sorghum proved to be a satisfactory grain for broiler breeders in Auburn research, with body weight, maturity, and egg production favoring grain sorghum over corn rations.





Inhibition of bacterial growth by two fractions from the creosote bush indicates the potential value of this plant in animal health uses.

Fowl Cholera Bacterin Formulation

A fowl cholera bacterin that is superior to currently available bacterins for the control of this important disease was formulated at Auburn. Final field trials of the bacterin are being conducted by four large poultry companies in the State. Because fowl cholera now appears at an earlier age, the field trials are designed to determine the optimum age for immunization. As soon as these and other field trials are completed, the bacterin

will be made available for commercial distribution.

Providing adequate calcium to young pullets by the time they reach sexual maturity was found to be necessary for best layer performance.

In research that developed the improved bacterin, it was determined that a biodegradable, non-toxic adjuvant was necessary. The adjuvant selected was polyethylene glycol of low molecular weight. It was determined that this synthetic alcohol solubilized lipopolysaccharides from the surface of the *Pasteurella multocida* bacteria and exposed lipoprotein antigens on the bacterial membrane. The lipopolysaccharides (LPS) enhance the immune response, so the bacterin can be

considered to work with two adjuvants, the polyethylene glycol and the exposed bacterial lipopolysaccharides. Because the polyethylene glycol is biodegradable and of low toxicity, there are minimum side reactions following injection and the immune response is satisfactory.

Biological Activity of Creosote Bush

Organic solvent extracts obtained from the creosote bush (the desert plant, *Larrea tridentata*) were found to have potent biological activities against bacteria, fungi, viruses, and protozoan parasites. Because of the importance to poultry, the antiprotozoan (anticoccidial) activities of the solvents are getting special attention. The anticoccidial activities are evident in the sporozoite state of development. All fractions altered the surface morphology of the sporozoites of *Eimeria tenella*, the species that causes serious problems with coccidiosis in poultry. The anterior ends of the sporozoites were collapsed and the posterior ends were swollen. It was found that one of the fractions, nordihydroguaiaretic acid, had a potential use as a growth permittent because it improved weight gains at the 0.1 percent level in feed.

Calcium Level for Birds Approaching Maturity

The practice of waiting until pullets are laying at the 5 percent level to increase calcium to levels needed by laying hens can be costly. In new Auburn research, when dietary calcium was not increased at the proper time in the transition from pullet feed to layer feed, early maturing pullets showed an increase in feed consumption, body weight, and liver fat and a decrease in shell quality.

Mature hens fed diets containing inadequate calcium will quickly begin to eat excess feed, and this increased feed consumption has no beneficial effect on egg size or production. Since feed is several times more expensive than calcium, the extra calcium hens obtain by overconsumption of a calcium-deficient diet is costly. It represents an even greater economic loss because once hens become overweight they may continue to overconsume to support the increased growth, even when consuming diets that meet their calcium requirement.

The lesson learned from this Alabama Agricultural Experiment Station study is that young pullets need adequate calcium just prior to or at sexual maturity, not after. This is especially critical since an increase in liver and body fat deposition may occur in a short period.



FISHERIES AND ALLIED AQUACULTURES

Research in fisheries and allied aquacultures provides scientific support for three areas: (1) commercial fish production, (2) recreational and sport fishing, and (3) water resource conservation and use, all of which

are important to Alabama. Problems in commercial fish production are unique to this enterprise, so the research program is critical to success of the industry. Support for recreational fishing continues to be another

high priority item for the Alabama Agricultural Experiment Station, as evidenced by the projects discussed in this report. Best use of the State's water resources is of interest to all segments of society.

Anemia in Channel Catfish

No-blood disease, an anemia that can cause serious losses in commercial catfish production ponds, was found to be related to the presence of some naturally produced compounds in the diet. Although the disease appears related to feed, results of Alabama Agricultural Experiment Station findings indicate that the compound causing this anemia may be formed in the feed while in storage after it leaves the mill.

In experiments to study the cause of this problem, four groups of 100 channel catfish fingerlings (24 grams each) were fed four different diets. One diet contained 50 milligrams pterioic acid per pound of feed, the second diet contained one-third moldy feed, the third diet was a feed from a commercial farmer whose

fish had anemia while eating the feed, and the fourth diet was a freshly manufactured, control feed. At weekly intervals, 10 fish were killed and bled for hematocrits and blood smears. Fish fed the pterioic acid diet had significantly lower red blood cell counts than the control fish, and there were indications of erythrocyte injury and anemia. Moldy feed and the commercial feed did not cause dramatic blood changes. Fish fed the pterioic acid-containing feed grew slower than fish in other treatments.

Gizzard Shad Affect Bass and Bluegill in Ponds

Gizzard shad are a major component in most reservoir fish populations in the Southeast. For some time, fishery man-

agers have been interested in what effect these fish have on other fish in those populations, especially on largemouth bass. Research in response to this interest found an unfavorable effect on bass and bluegill in ponds. Research ponds of the Alabama Agricultural Experiment Station were stocked with appropriate numbers of largemouth bass and bluegills to generate balanced populations, and some of the ponds were also stocked with gizzard shad at a rate of 100 per acre. The shad successfully spawned.

In November of the two test years when ponds were drained, gizzard shad had dramatically influenced bass/bluegill dynamics. Fewer small bluegill were present in systems with gizzard shad and average size of young-of-the-year bass was smaller. Also, these small bass were less numerous (approximately 50 percent less).

Pale internal organs and abnormal intestines provide evidence of effects of no-blood disease, a problem apparently caused by a compound formed in feed while in storage.



By the end of the second growing season (after stocking), ponds with gizzard shad were not in classic balance. Bluegill reproduction was in some way hindered by the presence of shad. Even in ponds stocked at well below carrying capacity, which represented expanding populations, shad were able to influence bluegill reproduction.

Vaccinating Bass Against Tapeworms

In laboratory tests, a vaccine conferred a slight degree of immunity against the establishment of tapeworms in largemouth bass. More significantly, the average length of those parasites that became established was approximately one-half the size of worms in fish that had not received the vaccine. These results are promising for situations where the production of largemouth bass in hatcheries has been reduced by the presence of tapeworms in the brood fish.

Florida Largemouth Genes Introduced into Alabama Bass

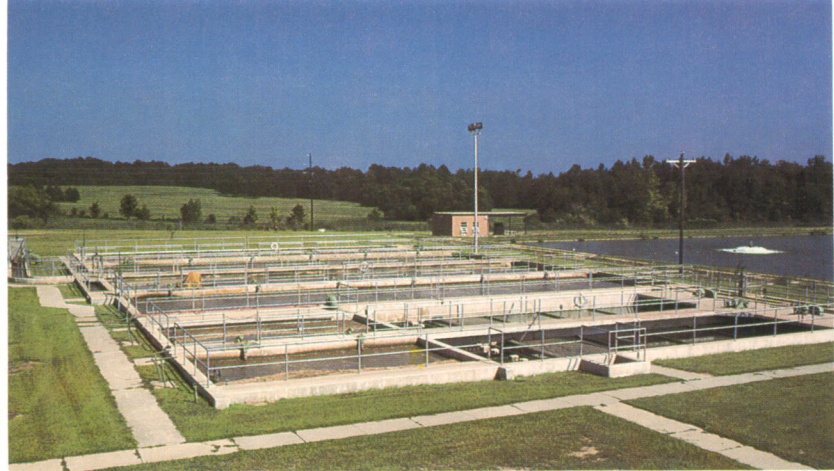
Research utilizing electrophoresis has demonstrated that genes from the Florida largemouth bass are added to the genotype of northern largemouth bass rather quickly when the Florida sub-species is stocked into waters containing the northern species. Further, repeated stocking of a smaller number of fish gave better results than a single stocking of a large number of fish. Transfer of the genes indicates that the two groups of fish intermix during spawning, creating hybrid offspring.

The northern species occurs naturally over much of the United States and has been stocked in those areas where it did not occur. The Florida sub-species is now being stocked in lakes and reservoirs throughout the country because some of these fish grow to a larger size than the northern species.

Papillomas Related to Water Quality

The safety of water supplies is of growing concern because of the increasing use and accumulation of various chemicals in the environment. The presence of a chemical carcinogen in the chlorinated effluent of the Tuskegee, Alabama, wastewater treatment plant was first suspected because of papillomas on black bullheads living in the final oxidation pond which receives the wastewater. Unlike previously studied bullhead papillomas, virus-like particles were not detected in these tumors. Papillomas later developed on caged black bullheads kept in the wastewater pond.

Mutagenicity of the effluent was de-



Development of papillomas on black bullheads growing in the final oxidation pond of the Tuskegee waste-water treatment plant was studied.

tected, and hepatic-enzyme induction occurred in channel catfish held in cages in the final oxidation pond. The prevalence of papillomas on wild black bullheads exposed to the effluent decreased after the chlorination rate was reduced. Approximately 50 percent of the channel catfish exposed to water entering the pond died in 8 hours because of chlorine toxicity.

How Acid-Rain Affects Ponds

Experimentally produced acid-rain conditions in earthen ponds at Auburn resulted in significantly lowered fish production in comparison with control ponds where there was no acid-rain condition. Sulfuric acid was added to ponds to simulate the effect of acid-rain. These results indicate that fish production in Alabama ponds also could be affected by acid-rain in a similar manner to that reported for ponds in the Northeastern United States where acid-rain fell. Production of fish was significantly lower in ponds with both severe and moderate acid-rain conditions.

Rain in Alabama is contaminated with strong acids, but not as badly as rain in the Northeastern United States. Furthermore, ponds in Alabama often are naturally acidic and must be limed to improve fish production. Application of agricultural limestone to ponds in Alabama will counteract the possible influence of acid rain.

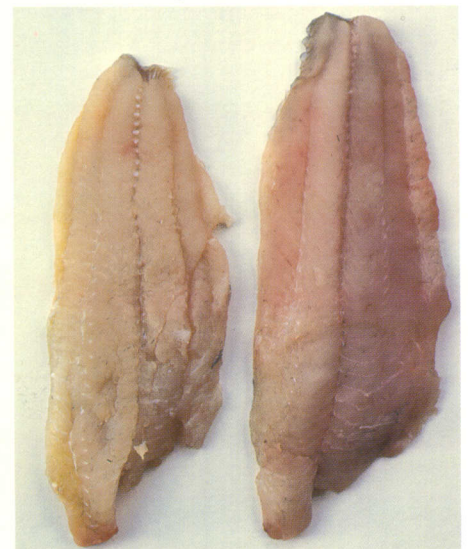
Maintaining Catfish Quality

Development of off-flavor is a serious problem for producers of channel catfish. One complicating factor is that there is no good method to determine the concentration of the off-flavor compound, geosmin, in the flesh. A sample of fish must be removed from the pond, cooked in a microwave, and tasted by workers in the processing plant. This detection problem may be eliminated with an Auburn-developed analytical method to measure the concentration of geosmin in catfish.

This research found that geosmin concentration in the muscle is a suitable objective test for off-flavor in pond-raised catfish during summer. An analysis procedure for quantitation of geosmin was developed that recovered about 88 percent of the geosmin from fish flesh. This level of success was highly reproducible in analysis of naturally occurring geosmin in catfish.

In studies with catfish, it was demonstrated that including corn gluten meal in the diet resulted in the accumulation of a yellow pigment in the flesh near the dorsal spine. The pigments responsible were identified as zeaxanthin and leutin, two carotenoids found in corn. Even when the corn product was included in the diet at levels as low as 4 percent, the yellow color developed. Feeding whole corn does not cause this problem. Although there is no detectable flavor associated with the pigments in the flesh, many customers find the color objectionable. This condition has led to some rejection of shipments of fish to wholesale outlets. Manufacturers have been advised to keep the concentration of these pigments low in feeds.

Yellow pigment in the flesh near the dorsal spine resulted from feeding catfish diet that contained corn gluten meal.



ANIMAL AND DAIRY SCIENCES

Meat animal research at the Alabama Agricultural Experiment Station combines highly practical studies, such as evaluations of forage species and breeding stock selection, with biochemical studies of such prob-

lems as excess fat deposition and genetic disease transmission. In all cases, however, the aim of this research program is to help Alabama reach its potential as a livestock producing state.



Biochemical studies of a potential lethal genetic disease in dairy cattle are providing the basis for a blood analysis to identify carriers.

Biochemical Studies Contribute

A cooperative study with veterinary medicine indicates that growth hormone can stimulate milk production in dairy cattle and that a ruminally protected arginine may have potential as a diet additive to increase milk and meat production. These basic studies have much application to the cattle industry.

A major problem facing the livestock industry is the production of animals with excess fat. In efforts to reduce the fat in meat producing animals, Auburn research is seeking ways to alter the partitioning of nutrients away from fat tissue and toward muscle deposition. A compound called clenbuterol being evaluated was found to increase muscle percentage and greatly reduce the fat content in the carcass. The new compound is not yet available for commercial use, but research will continue.

A potentially lethal genetic disease in dairy cattle, associated with a deficiency of uridine 5'-monophosphate synthase, was studied in 1984 to determine if a blood analysis could be used to identify carriers of this genetic condition. The first phase of this research indicates that 3-ribosyluric acid in erythrocytes is lower in dairy cattle with the genetic disease. Current research is also evaluating other factors which might improve the detection of this genetic disease.

Metabolic studies on cholesterol suggest that polyunsaturated fats facilitate absorption of cholesterol synthesis when none is fed in the diet. Also, animals fed excess cholesterol adapt their metabolism to increased oxidation of cholesterol to bile acids followed by increased rate of excretion. These traits are often related to genetic differences.

Productive Forages Tested

A new birdsfoot trefoil variety, AT-P, may be a useful perennial legume in northern Alabama. It persisted well in association with orchardgrass or tall fescue under continuous grazing and provided good natural reseeding each year. Pasture of AT-P trefoil and orchardgrass provided higher average daily gains in the spring than Kentucky 31 fescue. A combination of AU-Triumph tall fescue and trefoil produced 589 pounds of beef per acre as compared to 681 pounds from Kentucky 31 fescue fertilized with 150 pounds of nitrogen. AT-P birdsfoot trefoil is not yet released and no seed are available.

AU-Triumph, Auburn's new fescue variety that is more winter productive than Kentucky 31, was compared to fungus-infected and noninfected Kentucky 31 in a 3-year grazing study. AU-Triumph sup-

ported more steers (1.5 per acre) than noninfected Kentucky 31 (1.3 per acre). Daily gains and gain per acre for AU-Triumph, noninfected Kentucky 31, and fungus-infected Kentucky 31 were 2.09, 517; 2.16, 460; and 1.41, 368 pounds, respectively. It was also learned that gains on infected fescue were depressed nearly as much during the cool months of November, December, March, and April as during the warmer months of May and June.

Cimmaron alfalfa, *Serala sericea*, and AU Lotan *sericea* rotationally grazed and AU Lotan *sericea* continuously grazed were evaluated in a 3-year study. Average daily gains (pounds) for the four treatments were 2.20, 1.47, 1.83, and 1.85, respectively. Stocking rates were 1.3 animals per acre for the rotationally grazed treatments compared to 1.17 per acre for continuous grazing. Considering that these gains were obtained during the summer months, alfalfa and AU Lotan show tremendous potential as grazing crops. Gains on commonly used perennial grasses used in Alabama, such as bermudagrass and bahiagrass, average about 0.79 to 1.2 pounds per day. In addition, alfalfa and *sericea* require no nitrogen fertilizer.

Swine Nutrition and Breeding Advances

Corn has served as the primary feed grain for swine diets in Alabama, but alternatives to corn may result in greater profits for swine producers. Wheat, grain sorghum, and triticale are excellent alternatives to corn for swine diets. Recent Alabama Agricultural Experiment Station research shows that wheat and triticale have a greater feeding value than corn. Grain sorghum has 95 percent the feeding value of corn, whereas wheat has 105 percent the feeding value.

Beagle 82 triticale is a new variety which offers excellent promise as a feed grain for swine in Alabama. This grain contains nearly twice the level of lysine as corn and also contains higher levels of other amino acids. Current research findings indicate that Beagle 82 may contain slightly less energy than corn, but the total feeding value appears to be 103 to 104 percent that of corn. The high lysine level in Beagle 82 would lower the requirement for soybean meal and result in considerable savings in the cost of feed for swine producers.

Improving growth rate in pigs can reduce production costs and improve the efficiency of commercial and purebred swine operations. Genetic studies at Auburn show that intensive selection for growth can result in a 15 percent increase in weight over the control lines at 200 days of age. This translates into a 20-day



Current research is evaluating a compound called clenbuterol that has been found to increase muscle percentage and greatly reduce fat content of carcasses.

improvement for the select line to reach 220 pounds (market weight). The lines selected for rapid growth had longer carcasses and larger loin eye areas, but fat thickness was similar to that of controls.

The lines selected for greater growth were 7 percent more efficient when fed a high density diet and 2 percent more efficient when fed a low energy diet when compared to the control lines.

A pasture combination of AT-P birdsfoot trefoil and AU-Triumph tall fescue produced high beef gains in north Alabama steer grazing tests.



Z O O L O G Y - E N T O M O L O G Y

In keeping with the Land Grant mission of Auburn University, the research programs in zoology, entomology, and wildlife are continuing to address both basic and applied research problems. The entomology and wildlife research programs are unique within Alabama. In addition to contributing research findings of a basic nature, scientists within these

programs also generate timely research information relating to current problems which exist within the State. Significant progress has been made relative to insect pest management on soybeans, peanuts, cotton, livestock, and selected vegetable crops, as well as management of the total wildlife resource of the State.

Vigorous basic research programs

in cellular biology, molecular genetics, physiology, and marine biology have generated new findings concerning basic processes which govern living organisms and their environment. These efforts also may provide the basis for improved management of pest species, more efficient production of food and fiber, and conservation of resources.

Waterfowl Management

A study by Auburn's wildlife scientists at the Eufaula National Wildlife Refuge indicates that mallards and American wigeon wintering in Alabama engage in different activities depending on the particular ecology of each species. Wigeon, because they feed on aquatic plants low in nutrients, spend nearly twice the time feeding (57 percent) as mallards that prefer highly nutritious seeds and corn. Mallards increased feeding time as weather got colder, but still rested for about half of every day. Courtship activities of mallards were most intense in November and December and highest for wigeon from December through February. Time spent in all activities, especially feeding, varied with habitat types.

Results indicate that management of wintering waterfowl should focus on providing quality, diverse wetlands. This will ensure that a variety of habitat types are available to meet requirements that differ sharply between species.

Managing the Tarnished Plant Bug

The tarnished plant bug, a key pest of cotton in northern Alabama, has been found to move into cotton from wild host plants. Although over 300 hosts have been identified, most of the plant bugs that damage cotton probably emigrate from a single host plant, daisy fleabane. Emigration occurs as the fleabane matures, or when it is mowed. By incorporating a rare metal into host plants, it has been possible to mark large numbers of plant bugs for movement studies. The Alabama Agricultural Experiment Station studies showed that after hosts were mowed, the bugs quickly moved into nearby cotton, but remained in the crop only a short time. Laboratory studies have shown that cotton is actually a poor host for tarnished plant bugs. Using roadside vegetation management tactics designed to alter the abundance and maturation time of daisy



Waterfowl management research at the Eufaula National Wildlife Refuge is providing valuable information.

fleabane along highways appears to offer potential for insect management, and this possibility is being evaluated in cooperation with highway engineers and Auburn agronomists.

Cotton in Southeast Alabama

Although cotton has been "out of style" in southeastern Alabama for a good many

years, there is now renewed interest there in the crop. Because of the long growing season in southern Alabama, some producers have been able to successfully double-crop cotton following winter wheat harvest. This delays cotton planting past the normal planting date, which is thought to lead to increased insect problems. Studies begun in 1984 are providing preliminary information about insect

populations, damage, and yield in conventional and double-cropped cotton.

Boll weevil and bollworm populations were much lower than normal throughout the area in 1984. Weevil populations never reached the economic threshold in double-cropped cotton, apparently because conventional cotton acted as a trap crop for the low weevil population present. Bollworm populations remained low throughout the season in both production systems. The dry weather from mid-June to mid-July was much more damaging to the late-planted cotton than to the cotton in the conventional system. Yields were significantly reduced in the double-cropped cotton.

Saltwater Marshes Are Important Resource

Alabama's coastal environmental resources are of great economic importance. Although the State's saltwater marshes rank only eighth in area among 21 coastal states, Alabama's marine catch is second in value only to California. Therefore, information being gained in Alabama Agricultural Experiment Station research can be valuable in managing these important resources.

Since 1982, populations of animals in the marshes surrounding Dauphin Island, in Mobile Bay, have been monitored. Studies of the foraging behavior of blue crabs have shown this crab to have distinct requirements with respect to species and sizes of food items chosen from the marsh community. Several of the preferred food species, in particular fiddler

crabs and periwinkle snails, have been found to use saltmarsh cordgrass as a refuge from predation by crawling upwards during periods of high tide. Such behavior also may protect the snails from experiencing extremely high temperature on the marsh substrate. Saltmarsh cordgrass is one of the dominant plants in the saltmarsh, and it provides resident animals both a food resource and a protective cover from predators. Numerous snails, mussels, small fishes, and crabs inhabit the cordgrass community. These organisms use the decomposing grass as food and, in turn, provide food for larger fish, shrimp, and blue crabs which forage in the marsh at high tide.

Ecological studies in habitats which are of importance to commercially valuable species, such as the blue crab, are essential to successful management of the species. Additionally, monitoring of these communities is especially critical in the face of increased coastal development pressures.

Understanding the Lesser Cornstalk Borer

The lesser cornstalk borer is an important insect pest on many crops in the Southeast, but it is generally rated as the worst insect of peanuts. Thus, Auburn research that is providing an understanding of why lesser cornstalk borer population outbreaks in peanuts occur may allow prediction of these outbreaks. This should lead to much better control methods.

Soil moisture and temperature are now known to play an important role in the production of population outbreaks. For

example, lesser cornstalk borer adult females lay approximately five times more eggs at a four times faster rate when the average daily temperature is around 80°F. Also, small lesser cornstalk borer larvae, which typically live in the soil, will emerge when the soil in a peanut field is moist. This exposes the small larvae to predation by arthropod natural enemies, such as big-eyed bugs, which have been shown to reduce lesser cornstalk borer larval populations by as much as 60 percent.

Results of 1984 field studies indicate that lesser cornstalk borers have one to three generations during the peanut growing season, and that the abundance of lesser cornstalk borer eggs is proportional to the abundance of adult females. The number of medium-sized larvae resulting from the eggs depends on soil moisture and temperature.

The biological relationships describing the growth, development, and survival of lesser cornstalk borers in Alabama peanut fields have been transcribed into equations, and a mathematical model of its population dynamics has been developed. Purpose of the model is to predict population outbreaks before they occur. This is important because, since larvae live in the soil, sampling for the larvae involves the destruction of peanut plants and soil sieving. This is a time consuming and laborious process that may not adequately detect the presence of small larvae which are the easiest to control. The model's behavior in hot and dry conditions agrees well with field observations. Field testing of the model in Alabama, Florida, Georgia, and Texas will begin in the 1985 growing season.

Eggs of lesser cornstalk borer are floated out of soil collected from peanut fields to provide information about the pest.



Species and size of food items required by the blue crab have been determined in studies of marshes surrounding Dauphin Island.



ANIMAL HEALTH

Animal health research continues to address problems of disease prevention and treatment that are important to success of Alabama's livestock industry. Last year's program of research not only sought ways

of managing diseases of cattle and swine, but also investigated the potential of disease-free embryo transfer from infected dams and effects of hormones on livestock development and productivity.



This disease-free calf from a brucellosis-infected cow demonstrates the potential for disease-free embryo transfer.

Disease-Free Embryo Transfer

Successful transfer of embryos from brucellosis-infected dams without the embryo becoming infected was accomplished at Auburn. At present there are three offspring from a *Brucella abortus*-infected cow that were born to three brucellosis-free surrogate dams. The calves and surrogates remained free of the disease. The embryos were collected 6-9 days after ovulation from both naturally and artificially infected beef and dairy cows.

With proper washing and treatment of the embryos after collection from a brucellosis positive dam, the safety factor would be even greater. Also, the transmission of virus through the embryo is being evaluated. An understanding of the interaction between the embryo and virus particles is important for two reasons: (1) it will provide a basis for understanding the epidemiology of vertical transmission of virus diseases; and (2) with the growth in embryo transfer industry on a national and international level, the problem of disease transmission by this route needs to be clarified.

Hormones Affect Animal Functions

A number of studies were done in 1984 to determine the roles of insulin, glucagon, and growth hormone on lactation, growth, development, and the etiology

of metabolic disorders. During lactation, it was found that the actions of glucagon and growth hormone were increased at the liver, to turn on glucose production. This indicates that both hormones play a part in maintaining milk production and that both may be used to increase milk production. As developing bull calves changed from a milk diet to a grain diet, glucagon levels were higher and glucagon actions at the liver greater than when on a milk diet. These data indicate that coincident with rumen development, hormone changes are also taking place. These hormones are believed to convert the liver from one that uses glucose, as in humans, to one of glucose production from propionate. An understanding of how these hormones are regulated as well as how they influence the animal will enable development of means of increasing growth rates, milk production, and treatment of metabolic disorders associated with lactation.

Reproductive Diseases of Cattle

Young calves are susceptible to certain infectious agents which are unable to cause disease in mature animals. The principal difference between the ability of young and adult animals to protect themselves against infectious agents is related to the maturity of the immune system in adults. The immune system of young an-

imals is able to mount certain immune responses, but unable to mount other responses that the adult can. In the Auburn study, the serum of young calves suppressed the ability of lymphocytes to proliferate when stimulated.

Serum from 15 calves was collected at 1-3, 7-10, 21, 60, and 150 days of age. The mitogens phytohemagglutinin (PHA) and concanavalin A (Con A) were used to stimulate proliferation of cultured lymphocytes from three adult and three young animals as measured by uptake of tritium labeled thymidine. There was no difference in the ability of young and adult lymphocytes to respond to mitogens. However, responses to PHA using serum from 1- to 3-day and 7- to 10-day-old calves had 51 percent and 83 percent of the proliferative activity of serum taken when they were older, and responses to Con A were depressed to the same extent (49 percent and 87 percent).

These results suggest that a serum factor, possibly corticosteroids, may be involved in the inability of calves to mount adequate immune responses to certain infectious agents. Furthermore, treatment of young animals to reduce the suppressive activity of serum might be beneficial in treating infections by enhancing immunocompetence.

Animal Response to Virus

One of the ways in which animals respond to infectious agents is by killing virus-infected cells. Because certain viruses, such as herpesviruses, are capable of traveling directly from one cell to another, the host cannot protect itself against such agents by producing antibody. However, by killing virus-infected cells the host can reduce the transmission of virus directly from one cell to another and thereby reduce the severity of an infection. Auburn research found that calves that had been infected and hyperimmunized with infectious bovine rhinotracheitis virus (IBRV), a bovine herpesvirus, were able to produce such a response. However, in order to detect the immune response, it was necessary to cultivate the cells in vitro for several days and stimulate them with the virus.

The type of cytotoxicity that resulted was different from that which was anticipated. The cells mediating the cytotoxicity were not typical cytotoxic lymphocytes. Although the leukocytes were able to preferentially kill cells infected with IBRV, the effector acted in a genetically unrestricted manner. Results thus suggest that a nonspecific increase of cell mediated immunity may help protect cattle against this important pathogen associated with abortion and shipping fever.

H O M E E C O N O M I C S

Nutrition and textiles continue to be the primary foci of home economics research in the Alabama Agricultural Experiment Station. Another trace element, selenium, is being added to the nutrients being studied by nutrition researchers. Too little of this element may lead to increased risk of some tumors and to retinopathy of the eye of premature infants, while too much can be toxic. The study of the effect of farm wives' external employment on family economic stability and functioning is entering the data gathering phase in

which 1,000 Alabama families will receive questionnaires. A new regional housing study on barriers and incentives to affordable housing was begun in 1984. Another new regional project involves ways in which liquids, gases, and solids in solution or suspension migrate through textile fabrics. This relates to the comfort of clothing, since both water vapor and liquid perspiration must be able to escape from the body if the evaporative cooling process is to take place. It also relates to the use of clothing as a protective barrier against

such potentially toxic agents as pesticides. In the Alabama portion of the project, which deals with the diffusion of aerosols and vapor through single layers of fabric and fabric assemblies, various blends of cotton and polyester are being used. Solvent tests with perchloroethylene indicate that initial penetration of the aerosol is slight but, as the solvent evaporates, vapor diffusion increases with time.

Findings from two nutrition studies conducted during 1984 are summarized here.

Manganese Absorption

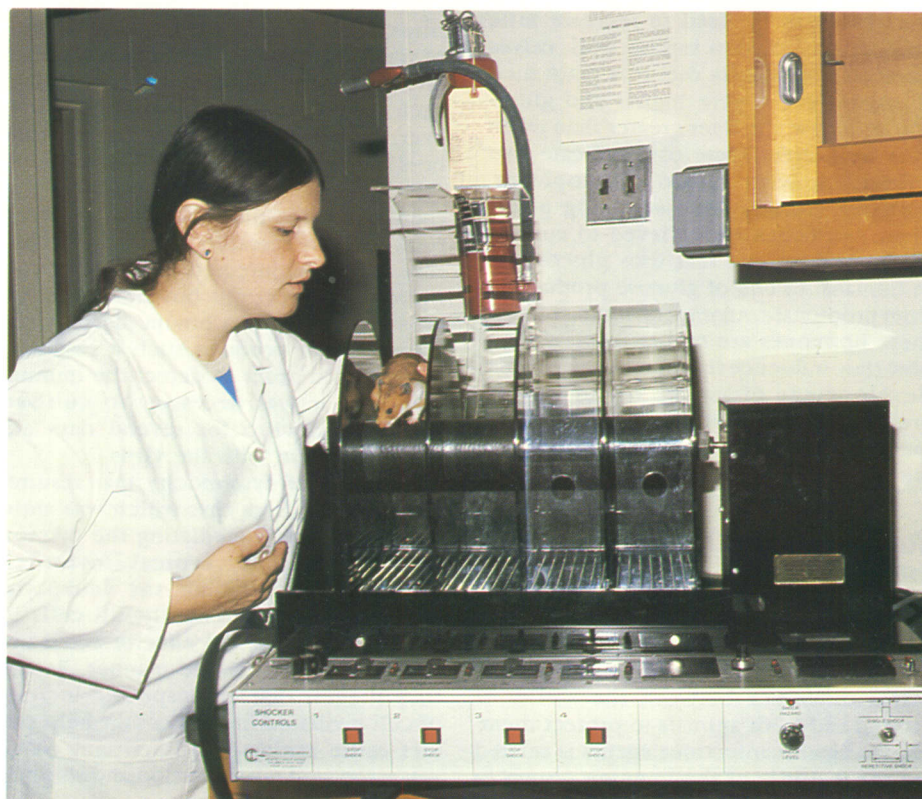
Manganese is an essential element for animal growth and development, but only small amounts are needed. However, the actual amounts needed by humans, the availability for use by the body of manganese found in foods, and the mechanism by which manganese is absorbed from the digestive tract are all unknown at present. Manganese deficiency in animals results in impaired growth, bone abnormalities, retarded skeletal development in embryos, reproductive failure,

and defects in lipid and carbohydrate metabolism.

A recent study found that one-third of all children with convulsive disorders of unknown cause had whole-blood manganese concentrations significantly below normal. In Auburn studies of manganese absorption in the small intestine, fasting rats were given either a saline solution or the saline solution containing 5 milligrams of manganese. The surface cells of the intestine were analyzed for the presence of a protein associated with the manganese.

A manganese binding protein was found and it was determined that this protein was of lower molecular weight than those that bind zinc and iron during absorption from the intestine. The amount of manganese associated with the binding protein was 3-4 times greater in the rats given the manganese supplement than in those given only the saline solution. Manganese seemed to dissociate from and recombine with the binding protein. Studies of the manganese-protein and calcium-protein complexes are presently being done for chickens which lay eggs with a shell and for those which lay eggs without a shell.

Research with hamsters indicated health benefits from Vitamin E diet supplementation along with exercise.



Vitamin E, Exercise, and Health

Vitamin E and exercise appeared to offer health benefits in the continuing study of the interrelationships among vitamin E consumption, cholesterol production, and prostaglandin formation. Test hamsters were fed a diet containing 0.5 percent cholesterol and two levels of vitamin E. Animals were assigned to four groups: (1) control vitamin E diet and no exercise; (2) supplemental vitamin E and no exercise; (3) control vitamin E diet plus exercise; and (4) supplemental vitamin E plus exercise.

The vitamin E supplemented groups gained less weight and had lower serum cholesterol values than did the control group despite similar food intakes. No differences in high density lipoprotein cholesterol were found among the four groups, but exercise did reduce the levels of low density lipoprotein cholesterol. No differences in production of prostaglandin were found among the four groups. Percent mortality among groups was 18.8 for the control diet, no exercise; 13.3 for the control diet plus exercise; 12.5 for the vitamin E supplemented diet, no exercise; and 0 for the vitamin E supplemented diet plus exercise group.

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

Research in agricultural economics and rural sociology zeroes in on the bottom line profit aspect of agriculture and the "people approach" to current events in rural areas. Projects active in 1984 dealt with costs and

prices in relation to production and marketing of row crops, livestock, and catfish, as well as providing an economic analysis of such programs as bovine brucellosis eradication and a study of the farm finance situation.

Sociological studies delved into such things as how well young people succeed in career goals as they move into the adult world and farmers' opinions on government agricultural programs.

Grain Sorghum Marketing

Research on grain sorghum marketing indicated that availability of markets is a major factor related to expansion of grain sorghum acreage in the State. Limited volume of sorghum has provided little incentive for grain and feed firms to allocate facilities for storage or to change feed rations to utilize grain sorghum. Sixty-eight firms, or 59 percent of those responding to a questionnaire, indicated they had bought sorghum in the past and 75 firms (66 percent) planned to buy grain sorghum in 1984. These firms were located in 38 counties distributed throughout most of the major producing areas of the State.

Lack of markets, which has been perceived by some to be an obstacle to increased sorghum production in Alabama, does not appear to be a problem in major grain producing areas. Research disclosed a lack of reliable price data for sorghum in Alabama because of low production and limited cash sales. An analysis of average prices for the period 1974-83 indicated that Alabama sorghum prices ranged from \$1.90 per bushel in 1977 to \$3.22 per bushel in 1983. The 10-year average price for sorghum was \$2.54 per bushel compared to \$2.85 for corn, or 89 percent of the corn value. Alabama sorghum prices have averaged 21¢ per bushel above the U.S. price, but only 89 percent of the corn price compared to 91 percent for the United States.

Opinions on Government Programs

A sample of almost 1,500 Alabama farmers surveyed in early 1984 found that farmers supported voluntary agricultural programs, with few supporting mandatory programs. Farmers with larger operations and those more dependent on farm income favored target prices and deficiency payments. Crop farmers favored maintaining equal or higher target prices and deficiency payments, while livestock farmers wanted low grain support prices. Continuation of a farmer-owned grain reserve, with a limit placed on payments, was desired. Loan rates set



Availability of markets was found to be a major factor related to expansion of grain sorghum production in Alabama.

in relation to market prices were desired. Strong support was found for requiring farmers to follow recommended soil conservation practices to qualify for price and income support programs.

Seventy-four percent of Alabama's farmers indicated that the federal deficit should be reduced in order to lower interest rates to borrowers. More than half the farmers stated that the federal budget should be balanced even if it meant a substantial cut in all government programs, including farm price and income supports.

Farm Finance Situation Studied

A survey of Alabama farmers carried out in November 1984 provided useful insights into the critical financial condition

of the agricultural sector. The data revealed that 16 percent of farmers were delinquent in real estate debt payments, 17 percent on machinery and equipment, and 18 percent on operating loans. The debt-to-asset ratio averaged 29 percent, compared to the national average of 22 percent. Delinquency rates on real estate debt were highest in Piedmont, Black Belt, and Sand Mountain areas of Alabama. Considering the overall debt situation, Limestone Valley area farmers appeared to be least affected by debt problems. The highest debt-to-asset ratio for farmers was in the Black Belt, where the average was 42 percent. Major causes for financial difficulties reported by farmers were low product prices, high interest rates, increased costs for inputs, and unfavorable



A tripling of the size of the catfish industry in 16 years will be required to meet growing market demand.



The accelerated eradication program for brucellosis was found to yield a benefit of \$4.17 per dollar of cost.

weather. Less than 1 percent cited high land prices as a primary cause of financial difficulty.

Over 38 percent of the farmers responding said they planned to leave farming in the next 5 years. The primary reason given was retirement, although financial and health problems were also reported as major reasons.

Economics of Catfish Industry

Per capita consumption of commercially processed catfish has increased tenfold since 1970. Since most of these fish are raised on farms in Mississippi, Alabama, and Arkansas, the growth in catfish consumption is a significant development for Southern agriculture. Some economic effects of the growth were apparent in 1984 economic research data.

An obvious effect of the catfish industry growth is increased land use for this enterprise. Establishment of additional processing plants and feed mills can be expected as a result of the growth in catfish demand. A major finding of the study was that consumers appear to be quite sensitive to changes in the price of catfish (price elastic demand). With a commodity that has a price elastic demand, small changes in price induce relatively large changes in the quantity demanded. This means that consumers substitute other fish, or even poultry, beef, and pork, for catfish when price increases. The elasticity coefficient for catfish was found to be -1.54 , which means that if the farm price of catfish increased 1 percent and other factors affecting catfish demand remained unchanged, the quantity of catfish demanded would decrease 1.54 percent.

This relationship between price changes and quantity demanded has implications

for the catfish industry. An industry facing an elastic demand curve for its product finds that its revenues vary inversely with price. When prices fall, revenues increase and when prices rise, revenue falls. Thus, the market can absorb relatively large increases in supply without declines in producer revenues.

The demand for catfish is projected to eventually represent 6 percent of all fish consumed by Americans. The present market share is 2.4 percent. Most of the growth will occur by the year 2000, requiring a tripling of the size of the industry in just 16 years. However, the industry must remain efficient and price competitive while achieving this growth.

Attainment in Nursing Careers

In a study of youth from high school to young adulthood, it was found that many who planned to be nurses when seniors in high school had not reached their goal when they became young adults. Results of the study suggest that many did not have the aptitude necessary to pursue a career in nursing as their occupational goal. Persons of low socioeconomic status were less likely to become nurses than were those of high socioeconomic status, but that effect was linked with race and ability.

Of the youth who planned to become nurses, 66 percent did not attain their goal within 7 years after graduating from high school. The largest percentage of these were found to be employed in sales and clerical occupations. However, about 18 percent of the persons who planned to enter nursing retained their original interest by diverting to other occupations within the health field, such as becoming a nurse's aide.

Data indicated that recruitment into nursing is changing. An early decision to

enter nursing was related to greater commitment to a career in the nursing profession. Marital status had little relationship to whether a nurse was actively employed in the profession.

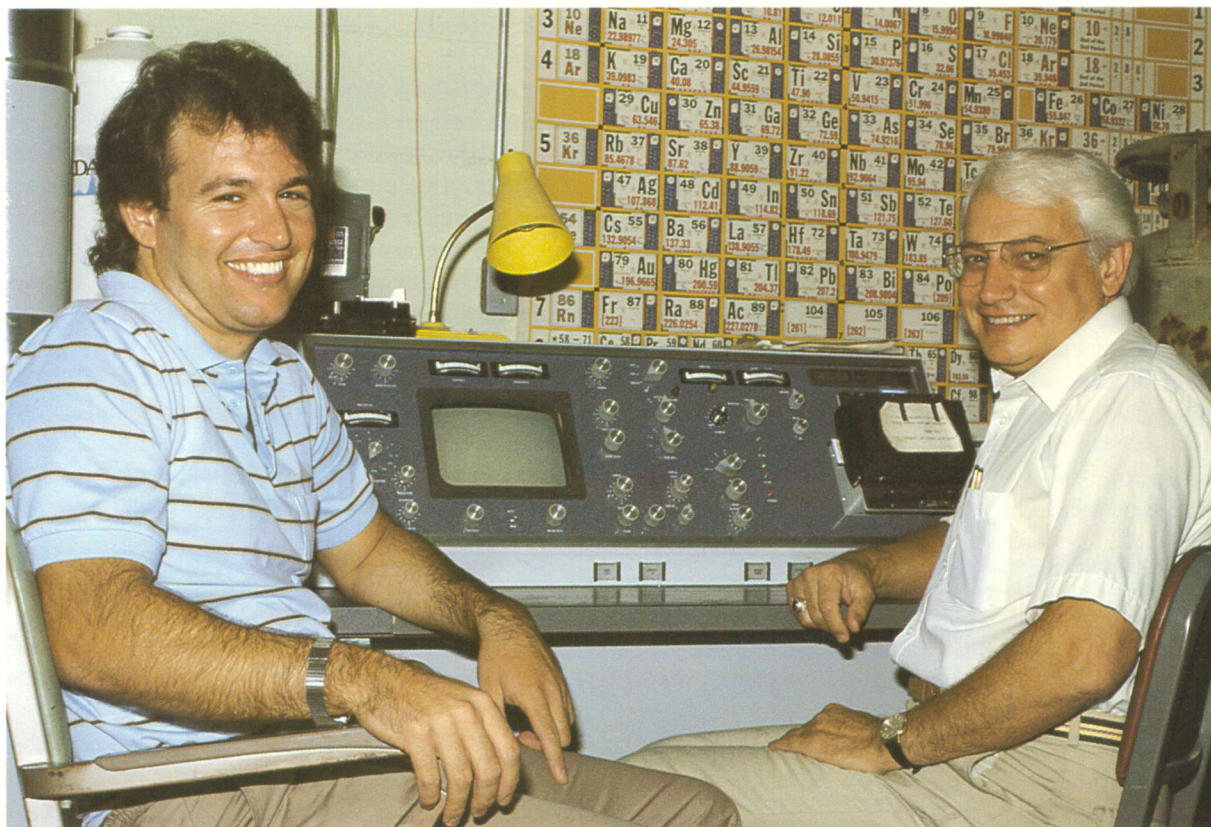
Economics of Brucellosis Eradication

It is estimated that brucellosis infected herds can lose up to 40 percent of the calf crop and about 20 percent in milk production. Because of the seriousness of the disease, Alabama is involved in a nationwide accelerated eradication program. Results of a benefit-cost analysis conducted by economists of the Alabama Agricultural Experiment Station indicate that the eradication program is valuable to the State.

A simulation model was used to project losses for both the beef and dairy industry under the present eradication program. Annual beef losses under the program by the year 2000 were projected to be only 3 percent of the 1983 value. In contrast, losses would increase if there were no program. With no program, dairy losses were projected to increase at a rapid rate because of the potential for spreading the disease. The accelerated eradication program yielded a net present value of \$141.2 million by the year 2000. Without the program, it was estimated that losses would be \$331.8 million. The accelerated program yielded a benefit of \$4.17 per dollar of cost.

Management is a key to control and eradication of the disease. The brucellosis program has the capability of increasing a producer's average return to the livestock operation. Adherence to the eradication program can lead to lower production and health maintenance costs, thereby helping maintain the farmer's competitive edge.

DIRECTOR'S RESEARCH AWARD



Winners of the Director's Research Award, an annual recognition of particularly noteworthy performance in research, for 1984 were Dr. Dale Huffman, Department of Animal and Dairy Sciences, and Dr. Joseph J. Giambrone, Department of Poultry Science. Huffman was selected for the Senior Award, which goes to a scientist with the rank of Professor, and Giambrone received the Junior Award, which is restricted to researchers of Assistant or Associate Professor rank.

Huffman was selected in recognition of his outstanding accomplishments in the field of meat science since joining the Auburn faculty in 1963. His work in the development of restructured steak and chops with a bite more typical of muscle meat than either ground or flaked products has brought international recognition to Auburn, both to himself and to the research programs of the Alabama Agricultural

Experiment Station. He also pioneered work in the use of gas atmospheres to extend the shelf life of fresh meat, work that led to the more economical use of gas atmosphere storage instead of vacuum packing for shipment of meat products.

Giambrone's honor recognizes his state, national, and international standing in the science of immunology and disease control of poultry. He is considered the foremost authority in the world on infectious bursal disease, commonly called Gumboro. He has worked extensively with coccidiosis, newcastle disease, malabsorption syndrome, and fowl cholera. Three serologic tests for detecting antibodies to several important poultry diseases were developed by Giambrone and are now routinely used by poultry disease researchers throughout the world. He has been on the Auburn faculty since 1977.

Dr. Joseph J. Giambrone (left) and Dr. Dale Huffman (right) were winners of the 1984 Director's Research Award.

RESEARCH ON DISPLAY

The Southeast No-Tillage Systems Conference, held July 10 at the Wiregrass Substation, Headland, was the most ambitious event of the 1984 field day season that displayed research to thousands who visited field units of the Alabama Agricultural Experiment Station.

The No-Tillage Conference alone drew more than 3,000 people from Alabama and neighboring states who came to learn about no-tillage and limited-tillage farming methods. Guided tours of the Substation allowed visitors a first-hand look at plots and field-size tests involving innovative cropping systems. In addition, researchers from other Southeastern States contributed reports of no-till experiments, which were distributed to guests in a printed proceedings produced at Auburn. Newest equipment for limited-tillage farming was exhibited and demonstrated.

Two months later at the other end of the State, a "State Soybean Management Field Day" drew an interested crowd that toured research areas of the Tennessee Valley Substation, Belle Mina, and heard researchers from four departments of the Experiment Station ex-

plain research on varieties, row spacing and plant populations, no-till production, fertilization and cropping systems, soil erosion, and control of soybean diseases and insects.

Another gathering of statewide scope, at the E. V. Smith Research Center, Shorter, the Plant Breeding Unit, Tallassee, the Lower Coastal Plain Substation, Camden, and the Chilton Area Horticulture Substation, Clanton, featured research tours that were a part of the 1984 Commodity Conference. Field crops were the emphasis of tours and discussions at Shorter and Tallassee, while swine research was featured at Camden and fruit and vegetable research was displayed at Clanton.

Field days or other meetings held at each substation in the Experiment Station System during the year highlighted specialized research underway to serve particular needs of farmers in each major farming region of Alabama. These programs covered major farm commodities produced in the State, including grain crops, soybeans, cotton, peanuts, fruits, vegetables, beef cattle, swine, ornamentals, dairying, forestry, and pecans.



Field days dealing with ornamental horticulture research (above) have been popular with Alabama nurserymen. Growing interest in grain production brought farmers to research tours to view work with grain sorghum (below).





The Southeast No-Tillage Systems Conference (above) drew more than 3,000 from the region to view research on different conservation tillage practices. Research on vegetable production (below) is of interest to both commercial producers and home gardeners.



Members of the Alabama Pecan Growers Association had the opportunity to study pecan research during tour of test plantings held in conjunction with the organization's annual meeting (below).



1 9 8 4 F I N A N C I A L R E P O R T

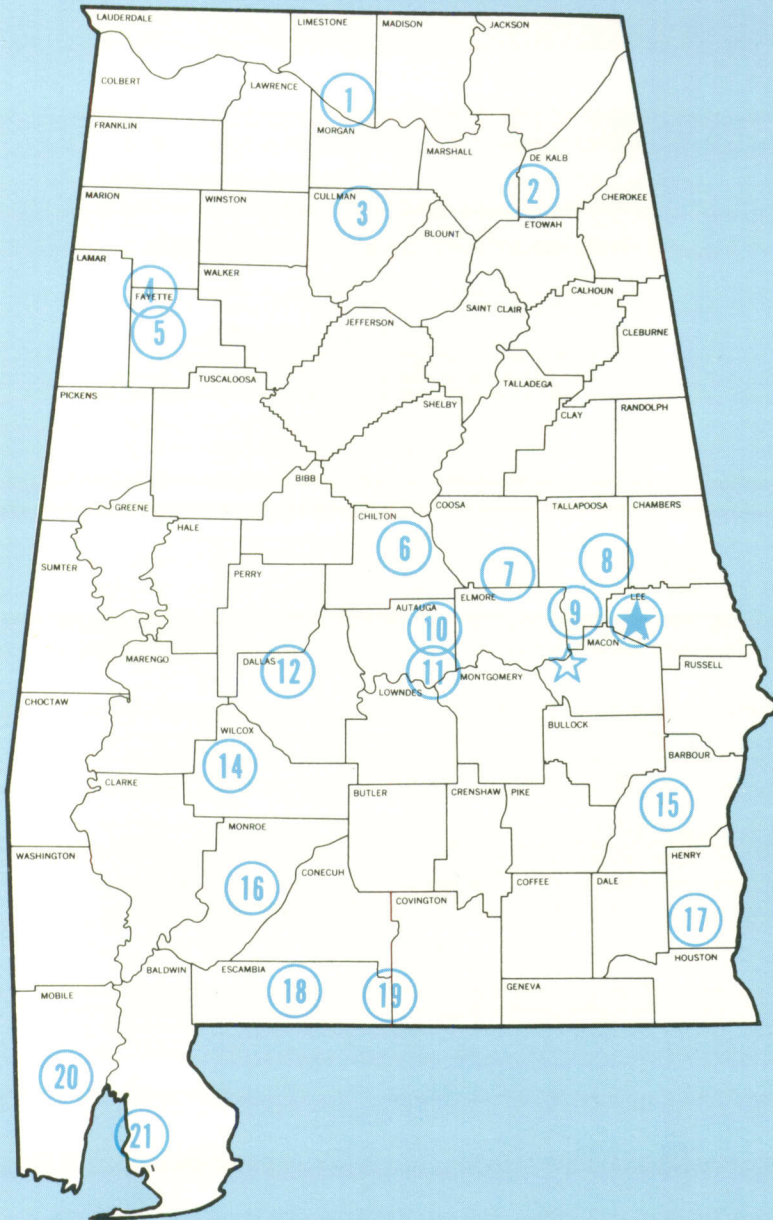
FUNDS AVAILABLE

Appropriated	
State _____	\$ 8,701,497
Federal _____	\$ 3,817,823
Total Appropriation _____	\$12,519,320
Grants _____	\$ 3,833,127
Sales _____	\$ 4,524,674
TOTAL FUNDS _____	\$20,877,121

EXPENDITURE BY COMMODITY

	Appropriated Funds	All Funds
Beef Cattle _____	11.5%	16.8%
Cotton _____	2.7%	2.5%
Dairy Cattle _____	2.4%	4.4%
Feed Grains _____	3.7%	3.1%
Fish and Wildlife _____	5.0%	9.4%
Forestry _____	9.4%	7.9%
Fruits, Nuts, and Vegetables _____	9.9%	6.9%
Human and Resource Development _____	6.5%	4.3%
Ornamentals and Turf _____	5.4%	4.1%
Pasture and Forage _____	4.0%	3.8%
Peanuts _____	3.7%	3.9%
Poultry _____	8.4%	6.8%
Soil, Land, and Water _____	5.3%	4.7%
Soybeans _____	7.4%	7.0%
Swine _____	9.6%	9.9%
Other _____	4.9%	4.5%
	100%	100%

ALABAMA'S AGRICULTURAL EXPERIMENT STATION SYSTEM



★ Main Agricultural Experiment Station, Auburn.

☆ E. V. Smith Research Center, Shorter.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Chilton Area Horticulture Substation, Clanton.
7. Forestry Unit, Coosa County.
8. Piedmont Substation, Camp Hill.
9. Plant Breeding Unit, Tallassee.
10. Forestry Unit, Autauga County.
11. Prattville Experiment Field, Prattville.
12. Black Belt Substation, Marion Junction.
13. The Turnipseed-Ikenberry Place, Union Springs.
14. Lower Coastal Plain Substation, Camden.
15. Forestry Unit, Barbour County.
16. Monroeville Experiment Field, Monroeville.
17. Wiregrass Substation, Headland.
18. Brewton Experiment Field, Brewton.
19. Solon Dixon Forestry Education Center, Covington and Escambia counties.
20. Ornamental Horticulture Substation, Spring Hill.
21. Gulf Coast Substation, Fairhope.

