Alabama Agricultural Experiment Station
AUBURN UNIVERSITY

1995 Annual Report

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ALABAMA AGRICULTURAL EXPERIMENT STATION

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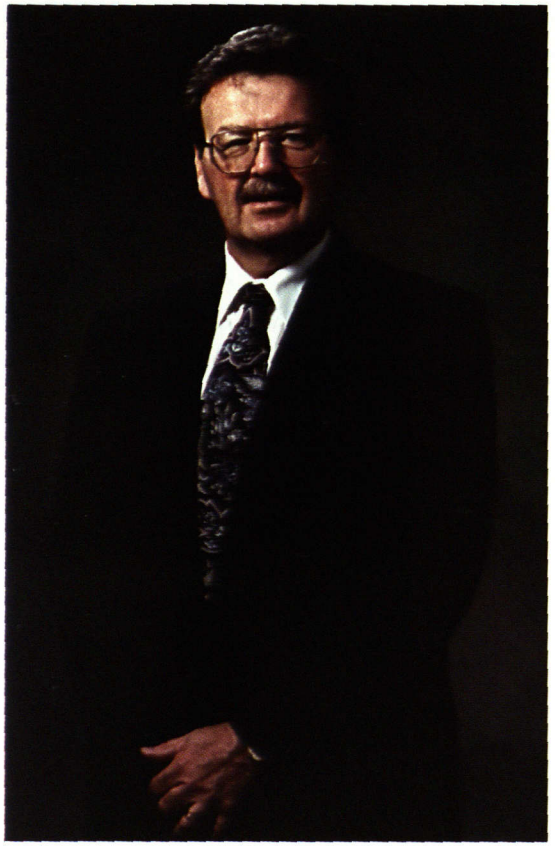


AGRICULTURAL research:
An INVESTMENT in the FUTURE

The Chinese proverb, "Learning is like rowing upstream; not to advance is to drop back," describes the research programs of the Alabama Agricultural Experiment Station (AAES). Our research must address not only today's problems, but it must also look to the future.

Production of food and fiber is no longer an island unto itself, but is influenced or affected by many factors. Governmental programs, world trade policies, environmental concerns and consumer perceptions, to name a few, greatly impact production efficiency. A particular chemical may control a specific weed, insect, or plant or animal disease but its impact on the environment must be ascertained. Hence, our research must verify that existing production practices are still viable, economical and environmentally safe. Integration of the various management practices into a total production system is needed.

Development of a total production system requires use of existing practices as well as the investigation of new ideas. The research described in the 1995 AAES Annual Report represents a small portion of our total research program, but it serves to convey the scope of our efforts to move Alabama into the future.

From basic to applied science, AAES researchers took huge steps forward last year in efforts to improve crop and livestock management, develop new agricultural products, protect the environment, safeguard against foodborne disease and confront economic and social issues vital in ensuring the well-being of Alabama's citizens. For example, Auburn's active biological control research program discovered beneficial microorganisms that control many common agricultural pests, reducing the need for chemical pesticides. Genetic engineers developed tobacco plants that produce a material which can be used to make biodegradable plastic. Animal scientists devised a technique for using ultrasound to produce leaner pigs. Aquaculturists bred a hybrid catfish that could earn millions in new revenues for southeastern fish farmers. Poultry scientists formulated disinfectants that could better control *Salmonella* bacteria attached to chicken carcasses. Entomologists developed a pest control strategy that suppresses cockroaches faster, better and longer than conventional treatments, but uses much less pesticide. Consumer affairs researchers put Alabama's textile and apparel manufacturing plants on the Information Superhighway, giving this industry a much-needed competitive boost. These are but a few examples of the diverse accomplishments made by the AAES in 1995, but they exemplify the goals all our scientists strive to achieve.

Investing in research is like a savings account. If one waits to save until the money is needed, it may be too late. Research conducted today will ensure that the production and utilization of food and fiber will remain an important contributor to the economy of Alabama.

Lowell T. Frobish
AAES Director

food and SPORT Animals

Many AAES projects benefit Alabama's cattle industry, wi

Alabama is blessed with diverse animal agriculture industries, including beef, poultry, fish, swine and dairy production. Also, the state's abundant natural resources give us economically important game animals, such as white-tailed deer and largemouth bass. This diversity of animals requires a diverse research program to ensure proper management and continued growth in related industries. AAES scientists are addressing wide-ranging issues important to these segments of the state's economy: animal health, new or improved animal products and more efficient livestock and wildlife management.

Cattle Parasite Found in State

While most southeastern livestock producers have not yet heard of the parasite *Neospora caninum*, it could be a hidden cause of abortions and calf deaths in the region. AAES animal health identified the parasite in Alabama cows and developed a vaccine to treat the disease. There are no statistics on the parasite's economic damage in the South, but it is known to have an impact of more than $35 million in California.

Researchers tested laboratory strains of the parasite for use as vaccines. Researchers altered the parasites so that they no longer cause the disease, but rather build up treated animals' immunity. Preliminary evidence indicates that the vaccine protects against the organism. AU scientists are working with a pharmaceutical company to test the vaccines and experiment with adjuvant chemicals to boost the effectiveness of the treatments. Infective cysts of the parasite are spread in wild animal wastes, but the precise epidemiology is still under investigation.

In other animal health research, scientists began testing in January 1996 on two compounds which control Cryptosporidium, a parasite that causes diarrhea in humans and livestock. Cryptosporidium can kill animals, but it usually only causes growth loss. This study illustrates the potential impact of animal research on human health. Cryptosporidium can cause life-threatening complications in human AIDS patients. It is likely that the new treatments will soon be used in clinical AIDS studies.

tudies ranging from developing new treatments for parasitic infections to increasing the value of cull cows to overcoming the effects of toxic fescue.

Ultrasound to Produce Lean Pigs

AAES animal scientists used real-time ultrasound in a selective breeding program to develop pigs that produce more lean pork with 34 percent less feed. Their technique can be used easily by swine breeders in the field.

Ultrasound was used to identify low-backfat pigs for use in selective breeding. Using ultrasound data in combination with growth efficiency and growth rate measurements, researchers developed an index that predicts feed efficiency. This index allows breeders to use ultrasound and growth rate data to select more efficient animals, thus removing the need for costly and difficult feed conversion tests.

Researchers have completed three years of research on a purebred Duroc line using this technique. This selected line has 18 percent less backfat, 13 percent larger loin eye area, 31 percent greater daily lean growth and 34 percent better lean feed efficiency.

As with much lean pork, the meat is less firm, has higher water loss and is less flavorful, but these problems are not as severe as they are in most other lean lines. Also, unlike many other lean lines, these Durocs do not have the stress gene, which is related to poor meat quality and sudden animal death.

Animal scientists now plan to use ultrasound in an effort to identify good

Animal health researchers are using pygmy goats to test a new vaccine against a parasite that could be causing abortions and calf deaths in Alabama cattle herds.

muscle quality in live pigs. Researchers also will seek genetic markers for higher-quality muscle. The goal is to use this information in selective breeding to eliminate problems with firmness, flavor and water loss in lean pigs.

Hybrid Catfish Worth Millions

An AAES-developed hybrid catfish has the potential to increase the Southeast's $2 billion catfish industry by at least 20 percent. After more than 20 years of research, the first large-scale attempt to produce these hybrids will occur in spring 1996.

A cross between female channel catfish and male blue catfish, the hybrids grow at least 20 percent faster than channel catfish. They are more resistant to oxygen depletion and to columnaris, enteric septicemia and other diseases. And they are easier to remove from ponds by seining or angling. Overall survival is about 30 percent better in the hybrid fish. These benefits are greater in the higher stocking densities and more stressful growing environments common to commercial catfish production. In addition, the hybrids yield about 1-4 percent more edible flesh.

Blue catfish and channel catfish do not mate naturally, so a major hurdle was developing artificial fertilization techniques to hatch enough hybrid fingerlings for commercial production. Another barrier is achieving cost effectiveness with a highly labor-intensive breeding system. Breeding methods developed at Auburn proved not only to be competitive, but to provide increased profits for the catfish industry.

Researchers found that hybrid fingerlings can be produced at the same price as channel catfish. However, fingerling producers can almost double the price for hybrids, and farmers can still make a 10 percent better profit.

Increasing Value of Cull Cows

Poor-quality or old brood cows retired from a herd are byproducts of cow-calf production; 10-15 percent of Alabama's 920,000 brood cows are culled and sold each year. These cows, which often have poor muscle quality, are now shipped away immediately after culling for use as raw material in ground meat or other low-grade products.

However, AAES animal scientists are developing techniques to enhance the value of cull cows. One goal is to use low-cost extra management to add muscle mass without adding fat to the cows.

Management strategies include feeding the culled cows for 60-100 days while using growth-promoting agents to enhance the animals' muscle quality.

Scientists demonstrated that treating cull cows with the genetically engineered growth hormone bovine somatotropin (bST) can increase muscling and feed conversion by about 40 percent. The synthetic

testosterone trenbolone acetate (TBA) increased muscling by 20 percent and feed conversion by 40 percent. Researchers are now investigating the potential for combination effects with TBA and bST.

Understanding Effects of Toxic Fescue

Basic information uncovered by AAES animal scientists could help producers counter the harmful effects of cattle feeding on endophyte-infected fescue. Endophytes, fungi that grow between plant cell walls, decrease cattle pregnancy rates and calf growth rates.

Animal scientists found that cows grazing infected fescue actually have a normal 21-day estrous cycle and do become pregnant. However, when the animals are examined 42 days into pregnancy, several will no longer be pregnant. Blood samples indicated that this is not a reproductive hormone problem.

To explore this mystery, researchers bred cows not fed fescue, flushed out healthy embryos and implanted them in heifers that were grazing on infected fescue. Whether the animals were bred or implanted, the rate of pregnancy was still reduced at 42 days.

Scientists are now testing the theory that the toxic fungus somehow interrupts the biochemical process that signals to a cow's body that it is pregnant. A fetus must biochemically communicate to the uterus that it is there, and the uterus must recognize this signal so the cow's body can respond appropriately. If these events do not occur, the ovaries begin to produce new eggs and the fetus dies. In a spring 1996 grazing trial, researchers will use molecular techniques to examine embryo and uterus tissue samples. The goal is to measure whether the proper biochemical events actually take place.

Pond-Raised Shrimp Harvested

AAES aquaculture researchers in October 1995 harvested the first crop of pond-raised shrimp in a project to develop culture technology for this commercially important shellfish in Alabama. Goals included evaluating the growth and culture of the native Gulf white shrimp in South Alabama and assessing the economics of its production as a bait or food fish.

Preliminary results indicated that it is highly profitable to grow these native shrimp as bait. Gulf white shrimp produced 4,000 pounds of bait per acre. High stocking density proved to be most profitable in bait production. Researchers will stock at even higher rates in May 1996 and focus on studies of aeration, management efficiency and water quality. In the proposed long-term project, decades of Auburn catfish research will be adapted to the production of shrimp in brackish ponds.

Since annual shrimp harvests are subject to drastic seasonal variability, many producers in Mobile and Baldwin counties

A new AAES-produced hybrid catfish could increase the South's catfish industry by 20 percent.

are interested in pond production of the shellfish. However, many basic questions must be answered before wide-scale production is advisable.

Bait production appears to be much more profitable than food fish production. Bait shrimp — which are about one-third as big as medium food shrimp at market size — sell for almost three times as much as food shrimp. The native Gulf white shrimp is superior for bait production.

This research is conducted at the Alabama Department of Marine Resources facility in Gulf Shores. In a companion study, the Gulf Coast Research Laboratory in Ocean Springs, Miss., is working on shrimp hatchery technology.

Improving Poultry Products from Feet to Breast

Poultry scientists are focusing on multiple aspects of production, transportation and processing that affect final poultry product quality. From the feet to the breast, these studies have yielded information that increases profits for the poultry industry and provides higher quality products for consumers.

In one study, researchers found that long transportation distances, especially during high temperatures, can significantly reduce the yield of sellable product. Chickens tend to shrink about .25 percent per hour under optimum transportation conditions; double that in hot weather. However, scientists determined that providing electrolytes and Vitamin C in water before slaughter can reduce this shrinkage.

Responding to an export demand for chicken feet, researchers are examining environmental and dietary conditions that reduce the quality of a chicken part once sold to rendering plants for about 2 cents per pound. In Asian markets, chicken paws can be sold for about 50 cents per pound. High ammonia concentration in chicken house litter can cause dermatitis in the feet, creating sores that make them unsalable. Researchers found that increasing the concentration of dietary zinc enhances healing. Poultry scientists also are evaluating sand as an alternative bedding material to reduce chicken foot lesions.

Other studies focus on skin quality in whole birds. In one project, researchers tested a feed additive to control the protozoan disease coccidiosis. They found that

AAES aquaculture researchers, in cooperation with t
develop culture technology for this important shellfi

abama Department of Marine Resources, harvested the first crop of pond-raised shrimp in a project to

the additive hampers collagen metabolism, a problem that reduces skin quality and strength. Tests demonstrated that the additive should not be used at all during the first three weeks of production or used continuously in subsequent weeks.

Improving Sportfish Management

Conventional wisdom among anglers maintains that dense aquatic vegetation means great fishing in Alabama reservoirs, but AAES fisheries research has shown that this is not the dominant factor in the reproductive success of largemouth bass. Instead, researchers found that retention time of a lake's water in the spring and early summer is more important. Retention time, the rate at which water is flushed from a lake, ranges from two to 435 days in Alabama reservoirs. Too rapid water movement causes algae and microscopic animals to get flooded out of a reservoir, ultimately reducing the amount of prey for bass and other species.

Scientists determined that a retention time of 30 days or more is critical

AAES fisheries researchers found that the rate at which water flows through Alabama's reservoirs can have a huge impact on bass and crappie populations.

for enough algae and plankton development to support a strong food base.

At Lake Guntersville, for example, water volume turns over every 12 days on average. Under rainy conditions, when the lake flushes faster, bass reproduction is reduced. During dry periods water retention is 20-25 days, and there is better reproduction. In Weiss Lake, resource managers keep the water level as high as possible between April and June, providing a greater young bass population. Plants were found to help increase bass populations in fast-flushing lakes.

Plants capture nutrients and provide a food source for young bass. Unfortunately, growth is slow in young fish that rely on dense vegetation, and many do not reach a large enough size to survive the winter. Researchers found that plant coverage of more than 15 percent of a lake's surface causes a reduction in adult fish growth. Anglers are more likely to catch a greater number of small bass in more heavily planted lakes.

Meeting Deer Dietary Requirements

AAES wildlife research has underscored the importance of crude protein in the diets of white-tailed deer in Alabama. Deer need at least 17 percent dietary protein year-round to maximize growth potential, but native vegetation often provides only 7-11 percent.

Using AU's captive deer herd, wildlife scientists fed one group of fawns a diet with 22 percent crude protein and another group only 11 percent. Dramatic differences were seen in all measured characteristics of the animals. For example, yearling males fed the higher-protein diet were 14 percent heavier and had antlers 52 percent heavier.

To help land managers economically provide year-round, high-protein forages for wild deer, researchers also determined the most cost-effective mixture of 39 cool-season and nine warm-season grains, legumes and grasses.

Researchers found wheat, oats and rye to be the most cost effective and most productive cool-season forages from September-March, costing less than $100 per ton of forage. If they are planted on good soils that support reseeding and perennial growth, Crimson clover and ryegrass are cost effective from winter through early spring, costing less than $200 per ton of forage. Combining these grasses and small grains supplies abundant, high-quality forage during a stressful period for deer, and it also attracts game to forage plots during hunting season. Red clover and ladino clover, which cost less than $50 per ton of feed, are very cost effective from April to September. Red clover — and ladino, if it is planted on high-quality sites — continues to produce well in the summer, when native vegetation is scarce and low quality. Soybeans, velvetbean and peas also are cost-effective warm-season forages, costing less than $60 per ton of forage.

Plant PRODUCTION

Auburn's Turfgrass Research Unit plays a major role in AAES plant production research with studies designed to improve lawn care and golf course management in the South.

AAES plant systems research is as varied as the plant species that play such vital roles in the state's economy. Innovative techniques to improve the value of row crops and to develop hardier grasses for golf greens, disease-resistant ornamental plants for landscape use and productive new forages for livestock production are but a few of the goals Auburn researchers are striving to attain.

Best Bermudagrass for Southern Golf Courses

Southern golf courses could enjoy considerable savings in management expenses because of AAES turfgrass research. Agronomists are evaluating Bermudagrass cultivars and ecotypes that developed naturally on greens throughout the region and may be better adapted to hot, humid summers and cold, rainy winters.

Researchers have planted four experimental lines and eight selected Tifgreen and Tifdwarf variants collected from various sources, including selected golf course greens. The turfgrasses are being evaluated on a U.S. Golf Association-type putting green and on native sandy loam soil. In 1996, agronomists will subject the test courses to various mowing heights and topdress frequencies, while simulating the stress of traffic at a level similar to golf course play.

Preliminary research showed that grow-in of grass cover was slower on the USGA green, indicating that variants selected from local putting greens may be

more adapted to native soil. Also, spring seedhead production, which severely impairs turf quality, was more of a problem on the USGA green. However, the grasses were usually darker on the USGA green, and spring greenup ratings were higher on that green. A Tifdwarf variant from a Mobile golf course was greener than most other grasses, but it was the only grass to produce fall seedheads. A variant from Lakewood produced more spring seedheads than most of the other grasses, while the Mobile variant did not produce spring seedheads.

Making Plastic from Tobacco

AAES microbiologists have genetically engineered tobacco plants that produce polyester, a protein-based polymer that can be used to make biodegradable plastic. This breakthrough was the first time scientists have demonstrated the expression of a synthetic gene in plants.

Production of petroleum-based plastics requires hazardous chemicals, and disposal of these products presents major solid waste problems. Protein-based polymers are environmentally safe, can be made from renewable resources and break down naturally after disposal. In addition to use in plastic packaging, the polymers can be used in medical supplies, controlled-release agrochemical products and other industrial applications. However, for protein-based polymers to compete with petroleum-based plastics, they must be produced abundantly and inexpensively. One of the most productive and economical ways to produce the polymer is to harvest it from plants.

Genetically engineered tobacco could provide an environmentally safe source of plastic.

Scientists first experimented with isolating a natural polymer-related gene from bacteria that produce small amounts of polyester, but this gene proved too complex to manipulate. Researchers at Auburn and the University of Alabama at Birmingham then created a synthetic gene with similar properties but with a simpler genetic structure. AU microbiologists used a gene gun to insert this gene into tobacco chloroplasts. In this process, tungsten particles were coated with the synthetic DNA and accelerated into plant tissue by a gunpowder charge. These tissue samples were cultured and grown into mature tobacco plants, which were shown to express the synthetic gene. Researchers are now trying to determine whether these parent plants transfer the gene to subsequent generations.

Finding Disease-Resistant Ornamental Plants

AAES horticulturists have a broad program of investigating the best ornamental plants for Alabama. Researchers continued to evaluate red maples, shade trees, crape myrtles and flowering dogwoods, and in 1996, a rhododendron study will begin.

In a comparison of red maple cultivars at the Piedmont Substation, Autumn Flame, Autumn Blaze, Fairview Flame and October Glory were found to be the best for the Southeast, based on growth and fall color. In a test of crapemyrtle cultivars, foliage of several selections was free of powdery mildew: Acoma, Caddo, Cherokee, Choctaw, Comanche, Nathez, Osage and Sarah's Favorite. However, several mildew-free or resistant cultivars — Acoma,

Comanche, Near East and Yuma — exhibited extensive *Cercospora* leaf spot and some premature leaf shed. Orbin's Adkins, Carolina Beauty, Wonderful White and Raspberry Sundae were susceptible to both diseases. Only light foliar spotting was seen on Fantasy, Tuscarora and Tuskegee, all of which also had excellent mildew resistance.

In flowering dogwoods trials, little or no powdery mildew damage was seen in the Giant Dogwood; the Korean dogwoods Milky Way, Milky Way Select and Satomi; or the *Cornus kousa* x *Florida* hybrids Stardust, Ruth Ellen, Galaxy, Constellation, Stellar Pink and Aurora. Among the traditional flowering dogwoods, only Cherokee Brave was free of mildew. Heaviest mildew damage was seen the common dogwoods Autumn Gold, Pink Beauty, Pink Flame, and Wonderberry, and First Lady. Most selections, with the exception of the cultivar Rainbow, showed few signs of anthracnose.

Managing Native Forages

Alabama's Black Belt needs alternative warm-season forage grasses; commonly used species such as Bermuda and Bahia are not well suited to this region. However, native perennial grasses are naturally adapted to the state's growing conditions and could meet the needs of Alabama farmers. AAES agronomists are developing strategies to manage these grasses for forage production.

Researchers planted several native bunch grasses — big bluestem, Indian grass, switchgrass, little bluestem and Eastern gamagrass — in Black Belt pastures in spring 1995. Goals include determining factors critical to successful establishment of the grasses: temperature, moisture, fertility, date and method of planting and other factors. Agronomists also hope to determine how much grazing the grasses can tolerate, how often and how short they can be cut for hay and how they influence sediment and nutrient loss from pastures. In addition, the project will seek to identify advantages and disadvantages of integrating native forage-livestock production into major Alabama cropping systems.

Unlike the sod-type grasses commonly used as forages, soil compaction is not a problem for many native grasses. Compaction, caused by vehicle and cattle traffic, depletes soil oxygen and can prevent plants from reaching water and nutrients. Switchgrass and Eastern gamagrass, for example, can penetrate compacted soil by rooting through the restrictive layer in order to reach deeper moisture and nutrients. Even in drought, the deeply rooted switchgrass can thrive. Native grasses can also enhance wildlife habitat.

Crape myrtles and other ornamental plants are the focus of AAES horticulture studies.

Several AAES integrated pest management projects benefit King Cotton, one of Alabama's top cash crop.

INTEGRATED pest management

Agricultural production on the level required to meet society's needs is not possible without the use of advanced technology and tactics. Unfortunately, as the demands on agriculture increase, the traditional arsenal against crop diseases, weeds and insects is becoming more and more limited. Environmental concerns have put tight constraints on using the chemical pesticides that made modern agriculture possible. Researchers in the AAES are developing or evaluating an array of environmentally safe new weapons that could ensure continued growth in agriculture.

Genetically Engineered Cotton Studies

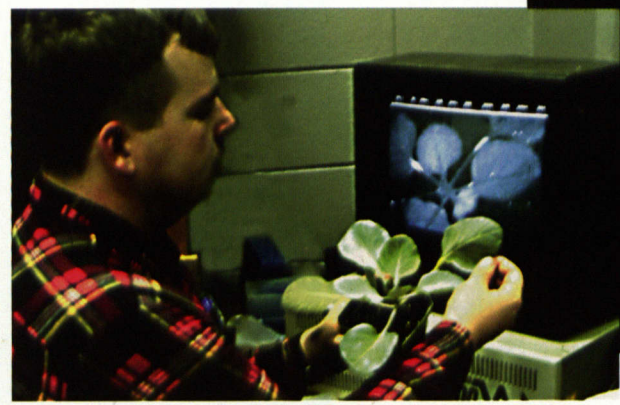
Genetically engineered crops are an increasingly important weapon in the arsenal against agricultural pests. However, these weapons must undergo careful testing before they can be used on a large scale. AAES researchers are testing three new genetically engineered cotton varieties to maximize the economic benefit of these crops and determine how they can best be integrated into management strategies.

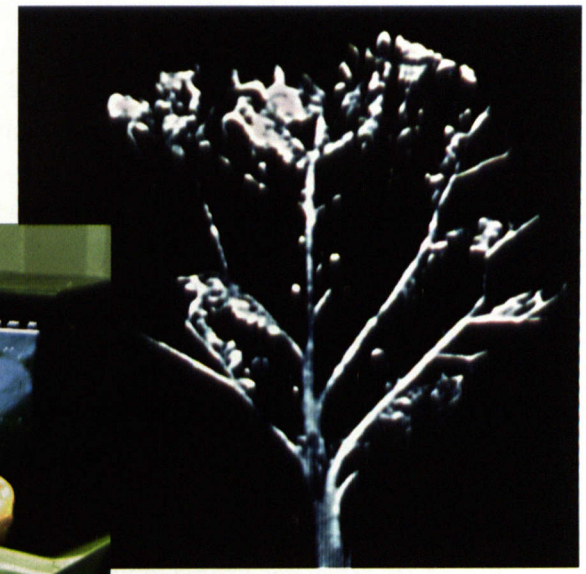
Two of the new products are genetically engineered Deltapine cotton varieties from Monsanto — Bollgard and Roundup-Ready Cotton. Bollgard contains *Bacillus thuringiensis* (Bt) genes that enable the plant to produce proteins toxic to the insecticide-resistant budworms that have devastated much of Alabama's cotton. Roundup-Ready is tolerant to the broad-spectrum herbicide Roundup.

In studies at the Prattville Experiment Field, researchers found that Bollgard is 99 percent effective against the budworm. Bollgard seed should be available in 1996, and Alabama farmers are expected to plant more than 60 percent of their cotton fields in the genetically engineered crop.

It is difficult to apply herbicides to normal young cotton plants without damaging the crop. Researchers found that multiple applications of Roundup can be harmlessly applied over the top of young Roundup-Ready cotton to control a wide spectrum of broadleaf weeds. Under low-rainfall conditions, which hindered activation of pre-emergence herbicides, Roundup provided effective weed control. However, research showed that applications must be restricted to early in the season. Roundup-Ready Cotton was registered for use in 1995.

Auburn researchers have also studied





Special computer-assisted camera equipment (left) was used to study how genetically engineered, bioluminescent pathogens grow inside cabbage plants. The photo above shows a diseased cabbage leaf, while the photo below pinpoints disease-causing bacteria in the same leaf, even in areas where there are no outward symptoms.

the use of BXN Cotton, a Stoneville variety from Calgene that is immune to the herbicide Buctril. Researchers found that Buctril can be safely sprayed over young BXN cotton to provide effective control of broadleaf weeds.

Farmers cannot use soil-incorporated herbicides in conservation tillage systems, in which the ground is left untilled to reduce erosion. Researchers showed that the ability to spray Roundup or Buctril over the respective genetically engineered cotton varieties is a major advantage in conservation tillage. The soil-applied herbicides commonly used now are applied before plants emerge. With the bioengineered cotton, farmers can wait and see when and where weeds develop, thus avoiding unnecessary pesticide use. Also, Roundup and Buctril have no residual activity in the soil, making them environmentally safe.

Glowing Microbe Aids Disease Study

AAES plant pathologists have used genetically engineered, glow-in-the-dark bacteria and space-age camera equipment to reveal how disease-resistant plants confront pathogens. Understanding the mechanisms of disease resistance is necessary before these defenses can be bioengineered into susceptible plants.

Scientists transformed pathogenic bacteria to express a gene isolated from glowing microbes, which are associated with marine fish. The luminescent pathogens were used to infect normal cabbage plants. Using a Charge Coupled Device — a high-tech camera used by astronomers — researchers produced real-time pictures of the glowing path of the disease as it progressed throughout infected leaves. This non-destructive procedure allowed scientists to spot diseased tissue, even when symptoms could not be detected by other means. Researchers charted the disease from very early to very late stages of infection and took small leaf samples to analyze the biochemical warfare being waged at each stage.

Using these tools, Auburn researchers showed that resistant plants produce a constant antibacterial environment and are prepared before pathogens invade. Resistant plants benefit from steady, low-level production of several defensive biochemicals. This production shifts into high gear when pathogens enter, allowing resistant plants to react quickly.

In response to pathogen invasion, resistant plants produce certain peroxidases, which are enzymes involved in toughening cell walls to defend against pathogens. Non-resistant plants may also produce these enzymes but too late to stop the spread of disease. Researchers also found that resistant plants steadily produce another enzyme known as CHL2, which is thought to degrade pathogen cell walls.

AAES entomologists found that the tarnished plant bug, which is an increasing problem in cotton production, is not affected by traditional pest management strategies. However, their research indicates alternative approaches to control the pest.

Current efforts are aimed at cloning the genes responsible for these defensive mechanisms.

Tactics to Manage Cotton Pests

Insecticides sprayed to control the boll weevil in cotton most likely also controlled the tarnished plant bug. But now that the need for boll weevil management is reduced, tarnished plant bugs have become a greater problem in Alabama. AAES entomologists have defined this insect's ecosystem and are now examining ways to alter the pest's habitat to control damage to cotton crops.

Researchers found that tarnished plant bugs build up huge populations in weedy areas and are extremely mobile. When the weedy areas are disturbed or become mature, vast numbers of plant bugs start migrating. One finding that might surprise producers is that cotton is not a preferred host plant for these insects. However, they will cross cotton fields in huge numbers, eating as they go.

Unfortunately, this mass movement often occurs when flower buds are developing. Another unusual finding is that, unlike most other insects, female bugs can hold onto their eggs and deposit them at will. Females will lay a few eggs on many plants before finding the ideal host on which to dump the majority of the eggs. The ideal host is not cotton, but significant numbers of eggs are laid on cotton as bugs migrate.

Since the tarnished plant bugs are just passing through on their way to more preferred plants, insecticides and biological control treatments often are not effective. Researchers plan to seek alternative methods for managing the pests. One option includes the use of trap plants to avoid damage from the bugs. For example, alfalfa is a preferred host for tarnished plant bugs; once they enter an alfalfa field, they generally do not leave. Planting alfalfa around a cotton field or in strips throughout the field might trap the bugs.

Bacteria Control of Wheat Disease

Take-all root rot of wheat has the potential to devastate Alabama's wheat crop. Unfortunately, there are no resistant wheat varieties and no fungicide treatments provide complete control. AAES plant pathologists discovered natural bacteria that control this root disease in Alabama.

Researchers surveyed wheat fields in major wheat production areas of the state to isolate root-associated bacteria to screen as potential biological control agents for suppression of root rot. A total of 189 *Pseudomonas* and *Bacillus* species were screened in greenhouse studies. Preliminary studies showed that two of these bacteria were at least equal to Baytan in root rot control. Baytan is a fungicide that suppresses take-all in the early season but dissipates after about six to eight weeks. Biocontrol agents colonize the roots and continue to suppress disease throughout the season.

AAES plant pathologists have discovered beneficial bacteria that could control a devastating wheat root disease.

In addition to suppressing the disease, one strain showed signs of increased plant growth, while a second had significantly higher populations on wheat roots. Researchers are now screening the two microbes on wheat planted in November at the E.V. Smith Plant Breeding Unit.

Sesame: Cash Crop and Nematode Killer

Nematodes can devastate cotton, soybeans and peanuts, but most of the effective pesticides to control these microscopic worms have been or soon will be banned. In a broad program to develop alternative strategies for managing soilborne diseases,

AAES plant pathologists have identified many plants that can be used in rotation with cash crops to control nematodes. However, there are no markets for most of these plants.

Research in 1995 showed that sesame is a natural nematicide that has the potential to become a major cash crop. Sesame is sold for 25 cents per pound in the U.S., which means that the break-even point for producing this crop in Alabama is 400 pounds per acre. Researchers found that even sesame fields leveled by Hurricane Opal produced that amount of seed. In the best situations, such as were seen in Belle Mina, sesame production allowed a projected $100 per acre profit. These yields were 30-50 percent below average since the crop was harvested with inadequate equipment. Sesame requires intense management and specialized harvesting equipment. Researchers are now trying to determine the best ways to grow this crop in Alabama.

Six sesame cultivars suppressed common nematodes. Two cultivars cut populations of root-knot nematodes to zero at the Plant Breeding Unit near Tallassee; one cultivar yielded more than 500 pounds per acre. At the Tennessee Valley Substation, one cultivar cut populations of spiral nematodes to four per 6.1 cubic inches of soil, while yielding 851 pounds per acre. Another cultivar reduced these nematodes to 30 per 6.1 cubic inches and yielded 1,135 pounds per acre. In this test, cotton had 85 spiral nematodes and yielded 1,178 pounds per acre.

Microbe Controls Disease and Vector

AAES scientists have documented for the first time that a beneficial root-associated microorganism not only can make a plant more resistant to a disease pathogen, but also can reduce feeding by the insect that transmits the pathogen. Researchers identified bacteria that are better than weekly pesticide applications at controlling bacterial wilt disease and the cucumber beetle, which spreads the disease. Normally, such biological control agents are very specific, either affecting the disease or the vector, but not both.

Bacterial wilt is particularly destructive to cucumbers and muskmelons, but it also affects squash, zucchini, pumpkins, watermelons and cantaloupes. Insecticides targeted against the cucumber beetle comprise the primary control method for bacterial wilt. However, insecticides are not very effective because beetles are highly mobile and not many beetles are needed to transmit the disease.

During observations of field experiments to confirm the effectiveness of bacteria against anthracnose on cucumbers, researchers found that the microbes were also protecting against bacterial wilt. Subsequent greenhouse and field tests identified the broad-spectrum effect of these bacteria against bacterial wilt and cucumber beetles. When applied as a seed treatment, the bacteria populate a plant's roots but provide protection throughout the whole plant.

The bacteria boost a plant's immune system, much like a vaccination in animals. In addition, the microbes reduce the plants concentration of cucurbitacin, a compound that greatly stimulates beetle feeding. Absence of this compound reduces feeding and transmission of bacterial wilt between plants. Biochemically, the precursors for cucurbitacin are the same as the precursors for plant defense mechanisms. It is possible that instead of producing the feeding stimulant, the bacteria change the plant's metabolic pathway to produce defensive compounds.

Two bacterial strains were shown to be more effective than insecticides. Compared with the insecticide treatment, plants treated with the most effective strain were infested with 36 percent fewer cucumber beetles, exhibited a four-fold decrease in bacterial wilt symptoms and produced 35 percent more cucumbers.

New Weapon Against Aflatoxin

AAES scientists have identified bacteria that greatly reduce peanut infestation with *Aspergillus flavus* fungi, which produce the carcinogen aflatoxin. This finding, combined with other information generated at Auburn, could significantly reduce the aflatoxin problem in Alabama.

Irrigation is the only effective way to consistently reduce aflatoxin but is not always affordable. AAES research linked lesser cornstalk borer feeding to the spread of *A. flavus*, but insecticides to control lessers do not completely control aflatoxin. Other studies showed that elevated soil calcium reduces aflatoxin. Combining insect control and soil fertility with a bacterial treatment could greatly reduce the occurence of this contaminant.

SPOD-X LC, a new biological insecticide under evaluation by AAES researchers, was shown to be effective at controlling beet armyworms.

Researchers collected and screened more than 150 bacterial strains for activity against *A. flavus*. Five of the most promising strains were tested in 1995 at the USDA National Peanut Laboratory. Controlled-environment plots were used to duplicate the extreme heat and drought that promote growth of lesser cornstalk borers and *A. flavus*.

Two of the bacteria reduced aflatoxin contamination by more than 90 percent. On average, the bacteria reduced aflatoxin concentrations to approximately 20 parts per billion (ppb), which is within the acceptable limit. Untreated peanuts had 200 ppb of aflatoxin. Treated plants also produced a greater yield.

New Beet Armyworm Insecticide

Thanks to research by AAES entomologists, cotton farmers will soon have a new non-chemical weapon against the beet armyworm, which devastated the cotton crop in 1995. SPOD-X LC, a biological insecticide in the final stages of field testing by Auburn researchers, could become the best way to control beet armyworms.

SPOD-X LC was originally marketed for use on ornamental plants. However, AU scientists recognized the product's potential and instigated studies of its use on cotton in 1993.

Beet armyworms are major cotton pests under the right conditions, and there is currently nothing on the market to provide adequate control of these insects during heavy infestations. SPOD-X LC contains a naturally occurring virus that kills armyworms without harming other insects or humans. Once eaten by larvae, viral infection literally dissolves the insects from the inside out. The product provides excellent armyworm control, even against insects resistant to chemical insecticides.

SPOD-X LC's pattern of action is ideally suited to the development and impact of the armyworm. In cotton, it is usually not the first generation of beet armyworms that causes major damage. A new generation of armyworms is produced each three to four weeks throughout the season, and there are greater numbers in each generation. Ultimately, a huge population of worms late in the season eats the cotton foliage, blooms and bolls. SPOD-X LC is applied early in the season when insect numbers are low, thus preventing the overwhelming population growth. When insects die they become residual applicators, with each dead worm spreading more virus to later generations.

FOOD safety, QUALITY & nutrition

Recent years have seen several major outbreaks of foodborne disease, creating more interest than ever before in controlling *Salmonella*, *E. coli* and other pathogens that continue to pose a threat to U.S. consumers. Equally vital are efforts to improve the quality and nutritive value of our food supply. Scientists in the AAES made major strides in 1995 toward accomplishing these goals.

Nutrition and food science research to improve infant formulas is one example of the AAES food technology program.

Improving Infant Formula

AAES nutritionists and food scientists have come a step closer to making infant formulas that provide all the benefits of breast milk. Researchers tested a promising source for an essential omega-3 fatty acid that formula lacks. Other sources of this fatty acid have negative effects on growth, but a fatty acid produced by microbes appears to provide the needed benefits without any drawbacks.

Breast milk contains physiologically significant amounts of the omega-3 fatty acid docosahexaenoic acid (DHA), but traditional formula has none of this essential lipid. DHA is found in the retina and brain and is believed to be involved in visual acuity and neural development. In premature infants, eyesight is affected by the lack of DHA. DHA may also play a role in intelligence. Adults synthesize DHA from another fatty acid called linolenic acid. However, babies must get DHA from breast milk or formula. Fish oil is a good source of DHA, but previous research showed that it inhibits the status of a biochemical related to growth.

Controlling the spread of foodborne disease pathogens such as *E. coli* or *Salmonella* in poultry products is a major goal of the AAES.

Using piglets as models, researchers found that formula supplemented with microbially produced DHA did not decrease growth of the animals. Pigs receiving the supplemented formula had increased concentrations of DHA in the brain, retinas and other tissue. Researchers are now designing experimental techniques to test the functional consequences of the lack of DHA, with the goal of defining the exact role this fatty acid plays in physiological processes.

Controlling Foodborne Disease

Free-floating *Salmonella* bacteria are easily killed in poultry processing, but pathogens attached to a chicken's skin are difficult to reach by traditional methods. However, AAES poultry scientists have developed techniques to remove most of the firmly attached *Salmonella*.

The topography of chicken skin protects bacteria from the acids used to clean poultry. Adequate kills of skin-attached bacteria require 2-6 percent acid concentrations, which are expensive and discolor the skin. However, acid solutions of .5-1 percent killed up to 99 percent of Salmonella when combined with the emulsifier Span-20. Only 20-30 percent were killed when reduced-acid washes were used alone. Emulsifiers, which hold together oil and water, likely force bacteria into contact with the acid bath. Citric and lactic acids worked best in these treatments, and effectiveness was enhanced when the treatments were applied in scald baths. Researchers will use the Span-20 treatments in a processing plant pilot program in 1996.

In other foodborne disease research, researchers found both inherent and environmental factors that affect the heat resistance of *E. coli* 0157:H7. Some *E. coli* isolates are naturally harder to kill by cooking. Scientists also found that *E. coli* heat resistance is improved when fat, salt and certain spices are added to chicken, turkey, beef and pork products. However, additives used in fat reduction formulations decreased heat resistance. *E. coli* was most heat resistant in turkey franks, turkey ham and turkey sausage. However, USDA heating guidelines still seem to be adequate to control *E. coli*.

Detecting Adulterated Meat

Federal law requires that raw and cooked meats be labeled accurately as to the species they contain. Prevention of substitution and adulteration of meats with undeclared species is important for economic, religious and health reasons. AAES food scientists have developed an inexpensive, accurate and rapid test for meat inspection.

Tests now used by meat inspectors are expensive, variable in quality, have a poor detection limit, require overnight incubation and cannot detect species in cooked meat. The new Auburn test overcomes these problems.

This new technique uses monoclonal antibodies (MAbs), which react with certain proteins in cooked poultry meat. Food scientists developed six MAbs that can be used in a series of tests to quickly identify the specific species of poultry meat used to adulterate products. The tests can be used to inspect raw products if they are cooked briefly. In addition to merely detecting the presence of adulteration, these tests can quantify the extent of contamination. They also can be used to measure the maximum internal temperature that the meat reached when it was cooked. Researchers are now developing MAbs to detect mammalian muscle proteins.

The tests are suitable to be made into commercial kits that can be used easily in the field. To use the test, cooked meat samples are ground and extracted in a saline solution for 10 minutes. MAbs are coated onto a small dipstick and dipped into a vial containing the meat solution. Results are immediately obvious as the clear solution turns green if the target meat is detected; the more adulteration, the darker the color.

Decontaminating Beef Trim with Intense Flame

AAES meat scientists have developed a method for using direct flame to decontaminate beef trim used in ground products. Searing the surface of beef trim with a high-intensity flame was found to significantly reduce bacterial populations without harming product quality.

Direct flame for six seconds decreased populations of bacteria that cause beef spoilage. Ground beef subjected to this treatment, packaged and stored in a retail display case had a shelf life about two days longer than untreated meat. Researchers are now examining the use of direct-flame treatments to control *E. coli*, *Salmonella* and *Listeria*.

Traditional methods to control bacteria in beef processing occur at the whole-carcass level. But there are many steps between carcass inspection and meat grinding, leaving plenty of opportunities for recontamination. The new Auburn-developed technique can be applied immediately before grinding. In ground product preparation, beef trim is transported via a conveyer belt to a grinder. AAES scientists added a new piece of equipment to this process: a chamber that projects flame on the top and bottom of meat. This chamber is assembled around the conveyer just before it feeds into the grinder. The system can be added to existing processing plants without large capital outlay.

AAES researchers have developed an innovative new technique to detect adulterated meat products.

environmental QUALITY

As our population grows, and livestock, crop and timber production become more intense, Alabama's water systems, forests and other natural resources are increasingly threatened. Sustained agricultural and forestry productivity, as well as the health and well-being of our citizens, depend upon protecting these resources. Safe disposal of animal wastes, low-impact timber harvesting, prevention of pesticide runoff and other vital environmental protection goals have long been the focus of AAES researchers.

Sustainable use of Alabama's vast timber resources is a goal that many AAES forestry and agricultural enginee

searchers strive to attain.

Reducing Environmental Impact of Timber Harvesting

Abundant forest land is among the Southeast's most valuable natural resources. Sustained use of this resource without damaging the environment is a goal addressed in several AAES forestry projects. Developing improved management practices, new technology, and a basic understanding of how forest systems function will allow sustainable use of this region's forests while minimizing environmental impacts.

One recently completed study showed that timber harvesting causes few problems for the environmental health of wetlands as long as proper management practices are used. There is great potential for harming forested flood plains, but there are simple, commonly known ways to avoid this damage. If these best management practices are followed, wetlands are not affected — even if trees are clear-cut.

Forestry researchers are now examining how silvicultural practices affect long-term productivity of a forest. In this fundamental research, scientists hope to learn more about how the forest ecology functions, such as how flooding affects nutrient availability. Such information is important because logging road installation or highway construction across a flood plain could affect flooding patterns, which, in turn, could affect nutrient availability. Inadvertent shifts in nutrient availability can harm floodplain productivity. On the Ogeechee River, researchers built controlled areas to study the effects of flooding on nutrient availability. They partially buried sections of large pipe in which river water is pooled for various periods. With these artificial microcosms, researchers are studying mass, carbon, nitrogen and phosphorus dynamics in decomposing foliar litter exposed to different flooding regimes during a three-year period.

Other forestry scientists are evaluating impacts of road construction, tree harvesting and site preparation on commercial timber land in South Alabama. In one phase of the study, researchers found that soil erosion is lessened by the use of grass roads, which are produced by spraying grass seed and fertilizer on dirt roads that lead to timber harvesting sites. Gravel roads were not as effective but did offer better erosion control than dirt roads over a 15-month period. After clear cutting the area, researchers will evaluate various site preparation techniques to ready the land for replanting. Preliminary results illustrated the effectiveness of "streamside management zones," strips of undisturbed land along stream banks, in preventing significant amounts of sediment from reaching the water.

Reusable Portable Bridges Reduce Stream Damage

Construction and use of stream crossings are major causes of sedimentation and erosion in timber harvesting operations. Sediments can transport other pollutants into waterways, aid in the destruction of aquatic habitats and fill in reservoirs and channels. Preliminary research has demonstrated that AAES-developed portable timber bridge systems have little or no impact on streams if roads are correctly constructed.

Upstream and downstream water quality tests showed that AAES-produced portable bridges have little impact on stream health.

Researchers compared installation, use and removal of portable bridges to other common stream crossing methods in commercial timber operations. After measuring sedimentation upstream and downstream, researchers found that the glued-laminated-timber-beam bridges did not modify stream channels and introduced almost no sediments to the stream.

Culverts are placed in a stream and soil is piled on top, a process that can introduce large amounts of sediment into the water. Also, culverts can become clogged and cause even more soil to wash downstream. Vehicles driving across fords churn up the stream bed and can introduce sediments. However, the only site disturbance required with a portable bridge is leveling the stream bank for placement of a mud sill, on which the bridge is placed. This disturbance did not affect the stream banks or the channel. Unlike permanent bridges, the portable structures are easy to install and can be reused many times. If a portable bridge is installed at least 10 times, the total cost for each installation can be as little as $2,550, which is competitive with the cost of installing permanent culverts on most streams.

Researchers also developed a specialized portable bridge that reduces the environmental impact of skidder traffic. Skidders, large tractors used to drag trees from a harvest site, are not allowed to drive through streams. And since they are used in a given area only for a few days, construction of a permanent crossing is not feasible. Now, a skidder must travel around streams, greatly increasing the machine's route. As the length of travel increases, so does fuel consumption, forest damage and soil compaction or erosion. The AAES portable bridge consists of glued-laminated timber deck panels equipped with steel protective plates, which allow the skidder to pick up the panels and install them.

Reducing Broiler Litter Pollution

The potential for water quality damage by improperly managed broiler litter is well documented, but many people are unaware that this poultry industry byproduct can cause air pollution as well. When spread over pastures, litter releases gasses that contribute to acid rain, global warming or ozone depletion. AAES scientists have long studied the water quality effects of litter use and are now developing a method to determine its air pollution potential.

Broiler litter — feed, wastes, and other materials that collect on chicken house floors — presents a major disposal problem for Alabama's $7 billion poultry industry. One traditional use of litter is spreading it over pastures as a fertilizer. As the litter lies on the ground, ammonia, methane and nitrous oxide can dissolve into the atmosphere and contribute to various pollution problems. As a first step toward developing management schemes to reduce these emissions, AAES agronomists are refining a new device to monitor ammonia release in the field. This device consists of a 10-foot rotating mast that turns in the wind. Extended from the mast are rods that hold glass vials containing a chemical that traps ammonia gas. The device can measure the gas flow at different heights. To test the monitor, researchers coat an area with urea, allow the device to collect samples for three days, then compare its findings to a traditional reference technique for measuring gas emissions.

Other AAES research has demonstrated valuable uses for broiler litter, but it must be used wisely to avoid overloading ground and surface waters with nitrates and other nutrients. For example, researchers demonstrated that applying eight tons of litter per acre on conventionally tilled corn/winter rye fields in the Tennessee Valley was enough to cause water quality problems. However, four tons caused less contamination than the soil test recommendation for commercial fertilizer. This lower rate provided corn yields equal to fields treated with commercial fertilizer.

On the other hand, leaching studies under seedling loblolly pines in the Appalachian Plateau showed that applying broiler litter to these young trees is unwise. Research showed that pine seedlings lack root systems extensive enough to capture the bulk of nitrogen released from litter. It is possible, however, that litter could be safely used at the mid-rotation thinning, about 16 years into the timber production cycle.

Research continued in 1995 on the use of artificial wetlands to treat effluent from livestock production facilities.

Disposing of Livestock Wastes

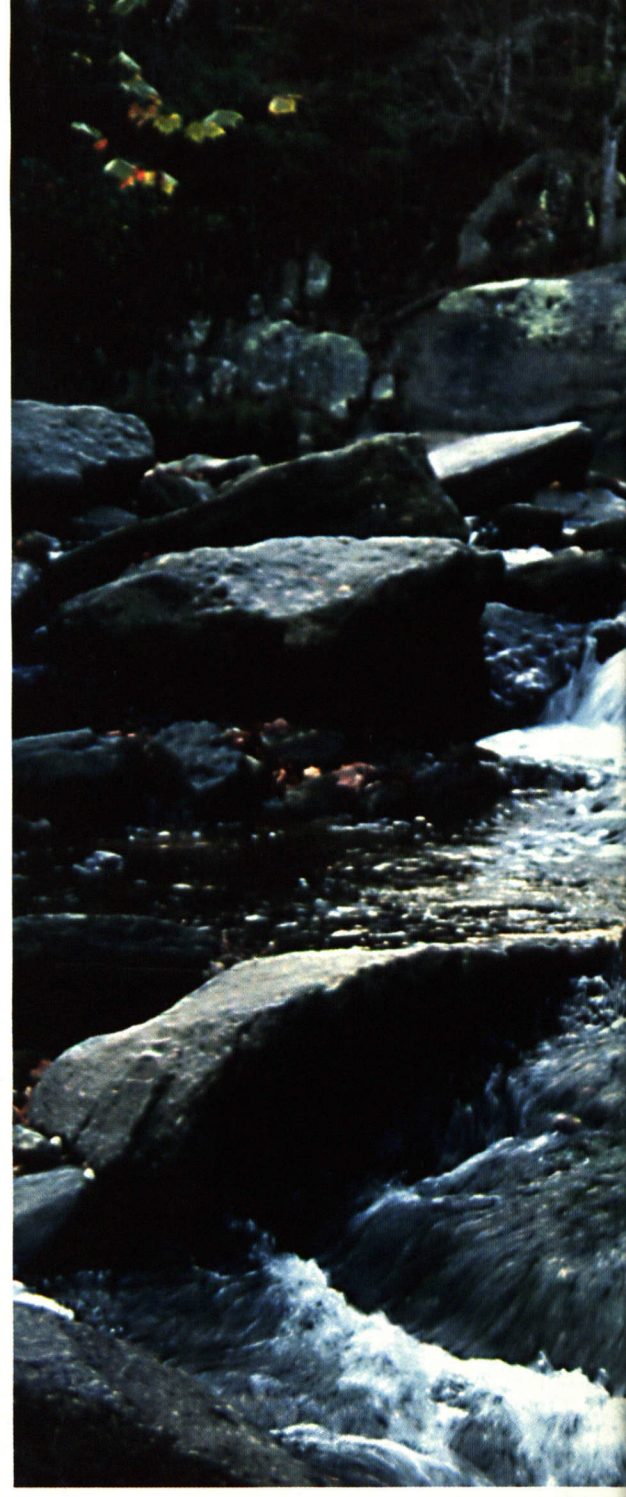
Finding environmentally friendly ways to dispose of animals wastes is a major challenge in the beef, dairy, poultry and swine industries. Agricultural engineers continued studies to improve the effectiveness of constructed wetlands in treating liquid waste before it is applied over land.

Researchers found that at temperatures above 50 degrees, live plants in the treatment ponds are best at capturing excess nutrients. However, after the first frost, plants actually add nutrients to the water. From mid-December to mid-February wooden rods driven into the pond bottom provide better treatment; rods provide a growth media for bacteria that break down waste products.

Engineers also determined which plants produce the greatest biomass in constructed wetlands. Nutrient harvesting and removal is directly proportional to the biomass produced. Also, the harvested plants can be used as a feed for livestock. *Phragmites australis* (common reed) proved to be the preferred species, producing almost twice as much biomass as the next closest plant.

As an alternative to using wetlands in liquid waste management, researchers previously designed a novel process with potential for abating pollution and providing a new on-farm energy source. Engineers developed a "suspended particle-attached growth" anaerobic fermenter, which can turn liquefied animal wastes into usable methane gas within four days. This device can be used with the hydraulic flushing systems commonly used to transport wastes out of animal production buildings.

Based on eight years of research, engineers developed design criteria for organic loading rates, hydraulic detention times and temperatures for beef, dairy, layer and swine wastes. Studies also addressed process design variables such as reactor media fill ratio, media porosity and media type. Tanks can be made of epoxy plastic or fibre glass and are packed with a synthetic fibre similar to air conditioner filter media. Waste flows into the bottom of the tank and remains for various times based on the waste type. Methane is piped out of the tank's top and can be pumped into a storage tank or used directly in space heaters, internal combustion engines and other farm equipment. Other methods of methane production from agricultural wastes take 20 days, whereas the new system processes waste in three or four days.



Monitoring and preventing pollution in Alabama's streams and lakes is one of AAES' top priorities.

Pollution in Alabama Lakes

AAES fisheries researchers have completed water quality studies on four major Alabama lakes — West Point, Eufaula, Weiss and Neeley Henry — and will complete a study of Lewis Smith Lake in 1996. Conducted under the U.S. Environmental Protection Agency's Clean Lakes Program, these studies indicate problems with toxic contamination in some lakes and high lev-

els of nutrient enrichment throughout the state.

Toxic contaminants were found in the two Chattahoochee River reservoirs — West Point and Eufaula — and in the two Coosa River reservoirs — Weiss and Henry. Chlordane, an insecticide that was once used to control termites, was the most significant problem in the Chattahoochee reservoirs, while industrial PCBs were found in excessive concentrations in the Coosa reservoirs. By examining fish in some lakes and sediments in all, researchers determined the distribution of toxic contaminants. For example, chlordane contamination was limited to the very uppermost portion of Lake Eufaula. Public health officials have issued advisories to prohibit consumption of fish from areas of these reservoirs. Interestingly, the health advisory for West Point Lake is based on high concentrations of contaminants in catfish and largemouth bass, but Auburn studies found no significant contamination in black crappie and hybrid striped bass. In a related study of the Huntsville Spring Branch/Indian Creek tributary to the Wheeler Reservoir, researchers found that DDT discharged from a manufacturing plant almost 25 years ago still persists.

Chattahoochee and Coosa river reservoirs also have significant problems with nutrient enrichment, or elevated amounts of nitrogen and phosphorous. Nutrient enrichment causes excessive growth of plankton algae, which can cause water quality problems and fish kills. Sewer overflow, discharge of treated wastewater and runoff from agricultural and urban areas are major causes of this nutrient overload.

West Point Lake, in particular, suffers from the impact of nutrients flowing from the Atlanta area. Studies showed that a Georgia ban on high-phosphate detergents and limits placed on phosphorous in treated wastewater have decreased phosphorous loading in West Point and Lake Eufaula. However, further reductions could be needed to offset the effects of planned increases in treated wastewater discharges and anticipated reduced tributary flows caused by increased water consumption upstream.

Smith Lake has some tributaries that are impacted by contaminants from poultry, cattle and other agricultural operations. AAES researchers are working to determine the effects of nutrient enrichment on receiving waters; 1996 data will be compared to results from a similar study conducted in 1986 to determine water quality changes. Estimates of nutrient and sediment loading will be made using satellite imaging and remotely sensed data.

Tools to Stop Herbicide Runoff

AAES scientists found that under the best of circumstances in nursery production, 25 percent of the herbicide applied to plants misses target pots and is washed away. However, researchers have developed two techniques to greatly reduce this potential source of water contamination.

Based on an earlier study that showed herbicides are tightly bound in the upper layer of potting media, researchers developed a method for using media to filter pesticides out of runoff water. In lab models, media was placed in plastic pipes, enclosed on each end with wire mesh. Thirty percent of herbicide residue was filtered from water that flowed through the media filter. Longer exposure times removed up to 70 percent. Using media, a product available in large quantities at nurseries, is much simpler and cheaper than the activated charcoal that some nurseries use.

Researchers conducted a series of laboratory studies and are now conducting the first field studies with the media filter. With the goal of refining the system for maximum filtration, scientists are analyzing a variety of factors, including media particle size and the use of different media commonly found in a nursery.

Herbicides are traditionally broadcast applied, meaning that they sprayed over the top of a group of target pots. After determining that herbicides which actually hit the pots do not leach from media, AAES researchers developed a more precise method for applying the chemicals. Combining the herbicide with the fertilizer, which is applied directly into the pot, remedies the problem of herbicide loss and does not require extra labor. In the most effective formula, liquid herbicide is mixed with water and sprayed on fertilizer in an industrial blender. The optimum coated formulation is eight pounds of Ronstar 50WP herbicide coated onto 25 pounds of Nursery Special 12-6-6 fertilizer. Herbicide-coated fertilizer provided weed control similar to broadcast applications, while reducing the amount of herbicide runoff to practically zero.

AAES scientists developed a prototype system for filtering excess herbicides in drainage water from nursery plant production.

ECONOMIC, SOCIAL AND health ISSUES

Improving the quality of life for state citizens is one of the founding principles of the AAES. Issues related to economic development, physical health and emotional well-being are the focus of many Experiment Station investigations.

Alabama Textiles on the Internet

With support from the AAES and National Textile Center, consumer affairs researchers have developed an Internet database that gives textile and apparel manufacturers greater marketing opportunities throughout the nation. Through the electronic directory, major retailers and large manufacturers can contact even the smallest, most rural Alabama plant to order products or offer subcontracts. Computer-assisted sourcing of apparel production has thus far generated at least $50 million in Alabama sales.

AAES consumer affairs researchers helped put Alabama's textile industry on the Information Superhighway.

This National Sourcing Database meets the need for a single, centralized source of information on the nation's currently available textile and apparel production capacity. It contains in-depth information on each plant's capabilities, including such factors as minimum production limit, types of equipment, next available production time and ability to do embroidering or other special tasks. Buyers search the database by product category to find factories that meet their specifications.

Information on Alabama manufacturers was first compiled into a prototype database in 1994. Factories in Georgia and the Carolinas were subsequently added to the system.

AAES resource economists are developing plans to better market and preserve Alabama's national forests.

Eventually, the database will include all the nation's textile and apparel plants. Researchers also developed a simple, inexpensive modem package that allows small plant managers to access the database and update the information on their respective firms. The database is now completely operational and is being introduced to product developers in major retail companies, such as Wal-Mart and J.C. Penney's.

Marketing Alabama's National Forests

Lack of planning for multiple uses and lack of knowledge about users of Alabama's national forests can cause resource degradation. AAES economists are developing marketing plans for these resources and are analyzing the recreation areas to identify ways to better preserve them.

Researchers profiled community leaders, special interest groups and users of Talladega National Forest (TNF) to design more effective marketing strategies. Surveys showed that the user segment with the greatest potential economic impact on area communities is the smallest group of visitors. This group, designated as urban users, travels the farthest to reach TNF and spends more time and money per trip. Urban users are attracted to TNF for hiking, backpacking, camping, fall color viewing and related activities. More urban users could be attracted by improving or expanding areas dedicated to these activities.

Local and regional users of TNF preferred hunting and fishing, which have placed pressures on the park s wildlife population. These groups expressed strong preferences for expanded facility development, which may be costly to provide. However, they were more willing to pay additional user fees to cover such costs.

Researchers identified a need to zone TNF to avoid conflicting uses. For example, hiking trails now run through areas designated for hunting. A non-hunting corridor in a portion of the forest would ensure safety while reducing pressure on wildlife.

TNF's Cheaha Wilderness and Bankhead National Forest's Sipsey Wilderness and Sipsey Fork Wild and Scenic River were found to be suffering from symptoms of site overuse that threaten to render some sites unacceptable. To prevent resource abuse or area closures, researchers formulated multiple-use management plans with suggestions for renovations or new facilities.

How Families Face Stress

AAES family and child development researchers are working to identify the major stressful events faced by Alabama's rural and urban families and the role of social support networks in maintaining family well-being.

Data were collected from 318 parents of college-aged children on life events that had impacted families during the previous year. In general, the sample was white, educated, middle-aged, and about evenly divided across rural, suburban and urban areas. Results suggest that even families many

would view as cushioned from adversity must be able to adapt to and cope with a high frequency of stressful events.

During the past year, the average family reported experiencing four life events that affected its well-being. The most frequently reported stressful events were associated with financial and employment issues. The most difficult issues for families included death, life cycle transitions and health problems. In coping with problems, these families first turned to social network members. Extended family members were mentioned most often, followed by friends and nuclear family members. Spiritual resources were also cited frequently as a source of solace and support.

This study highlights the need for family life education programs to stress skill development in providing emotional support to others and in creating and nurturing social support networks. Further, agencies that provide support to families should seek to enhance and work cooperatively with families natural support systems.

New Strategy to Control Roaches

AAES entomologists have developed a formula that takes into account a wide range of home and landscape characteristics to predict the size of cockroach populations and how best to control the insects. This new pest management strategy eliminates cockroaches faster, better and longer, while using a fraction of the pesticides required in standard treatments.

House age, unscreened windows, wall cracks, loose-fitting doors, wood piles, amount of mulch and shrubbery, numbers of outbuildings, hardwood trees and pets, and many other variables are factored into the formula. By identifying problematic areas, researchers were able to control cockroaches with small, strategic applications of bait, gel and spray. In addition to limited insecticide use, the integrated pest management (IPM) strategy also consists of sanitation and landscape management, such as pruning, removing ivy or using alternative mulches. This strategy is designed for smokybrown cockroaches, which are large, dark-brown insects.

Entomologists are devising similar strategies for other household pests.

Traditional perimeter insecticide treatments applied according to label directions are effective for about 30 days, while the IPM system lasted 60 days. Cockroach abundance was unaffected outside the spray zone in the perimeter treatment, and cockroaches quickly reinvaded from peripheral habitats. IPM treatments significantly reduced cockroach populations and suppressed the insects for a longer period. Plus, IPM treatments require 80 percent less pesticide use.

Controlling cockroaches and other household pests is a major goal of the AAES urban entomology program.

1995 Director's Research Awards

Winners of the 1995 AAES Director's Research Awards were Claude Boyd, a professor in the Department of Fisheries and Allied Aquacultures; and Greg Mullins, an associate professor in the Department of Agronomy and Soils. These awards are presented annually to recognize outstanding career accomplishments in the Experiment Station.

Boyd, a native of Mississippi who joined the AU faculty in 1971, has made significant contributions toward reducing the environmental risk posed by effluents from catfish ponds, including pioneering research in the use of aquatic plants to filter wastewater. He also demonstrated the relationship between feed input and water quality variables in ponds, which has helped fish and shrimp producers avoid many problems. In other studies, Boyd designed a water circulator for catfish ponds, developed techniques to measure pond lime requirements, analyzed the use of fluid fertilizers in ponds, devised a system to more accurately estimate pond water budgets and evaluated products used in commercial and sportfishing ponds. Currently, Boyd is evaluating products to improve pond water quality and developing reliable management procedures to remove phosphate from pond water.

Mullins, a Virginia native who came to Auburn in 1985, has addressed many issues related to soil fertility and chemistry. For example, he evaluated the dry matter production and nutrient uptake of cotton varieties, generating information crucial in answering cotton fertility questions. Mullins also showed that late-season surface applications of potassium to cotton is as effective as deep placement, thus saving farmers unnecessary expenses. Another of Mullins' studies is opening new markets to U.S.-produced fertilizers. Previously, the European Economic Community penalized U.S. fertilizers for being low in water-soluble phosphorous, but he proved that U.S. fertilizers are as effective as European products. Mullins also studies alternative crops such as lupin and the use of industrial and agricultural wastes as soil amendments.

Left, Senior Research Award winner Dr. Claude Boyd.
Right, Junior Research Award winner Dr. Greg Mullins.

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