



ALABAMA AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY



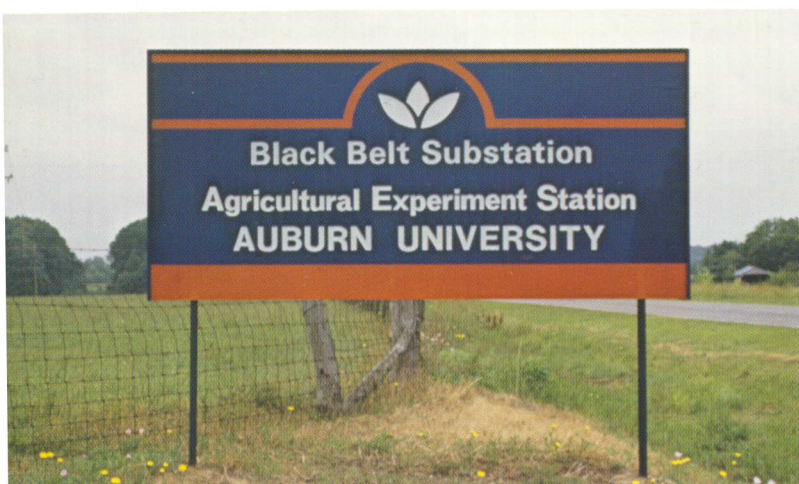
1980 Annual Report



NEW-LOOK IDENTIFICATION SIGNS ADVERTISE THE AGRICULTURAL EXPERIMENT STATION

Colorful new identification signs began showing up at units of the Alabama Agricultural Experiment Station in 1980, as a project aimed at providing greater visibility to outlying units was implemented. When installation is completed in 1981, these new-look signs will extend from near the Tennessee line almost to the Gulf of Mexico, telling residents and transients that Auburn University is nearby.

The orange and blue signs, which feature a unique symbol representing agriculture, also are being installed at Auburn to identify campus facilities that are used for Experiment Station research. Thus, the matching signs are expected to provide an identity for each of the 22 outlying units that will tie it to the overall Agricultural Experiment Station System. Attention being created by the signs already installed indicates that the aims are being realized.



FRONT COVER. This reseeded stand of vetch being turned under at the Plant Breeding Unit, Tallassee, illustrates one valuable use for the four reseeded vetch varieties recently released by the Alabama Agricultural Experiment Station. The new varieties, Cahaba White, Nova II, Vantage, and Vanguard, were ready for release just when rapidly escalating prices for commercial nitrogen created new interest in legume cover crops to supply nitrogen for following row crops. Reseeding ability of the new vetches makes them well adapted for growing in rotations either for turning under or for winter grazing.



Report from the Director

All of the Alabama Agricultural Experiment Station family—scientists, technicians, student workers, resource and clerical support personnel, and administrators—take tremendous pride in this report of our 1980 work. We are proud of research conducted during the last year that made significant contributions to Alabama's total agricultural industry, and we are pleased to tell about major changes in the organizational structure of Auburn's agricultural units that were implemented in 1980.

All agricultural programs at Auburn University were organized during the past year under a Vice President for Agriculture, Home Economics, and Veterinary Medicine. Stanley P. Wilson, former Associate Director of the Agricultural Experiment Station and Assistant Dean for the School of Agriculture, was named to the new vice president position.

The five units involved, the Alabama Agricultural Experiment Station, Cooperative Extension Service, School of Agriculture, Forestry, and Biological Sciences, School of Veterinary Medicine, and School of Home Economics, are each headed by a dean who reports directly to this Vice President. On October 1, 1980, I accepted the challenge of becoming your Dean for Research and Director of the Alabama Agricultural Experiment Station.

Many benefits are being realized as a direct result of the new organizational structure. One of the more significant advantages will be the continued consolidation of personnel and planning procedures in the Alabama Cooperative Extension Service, the Alabama Agricultural Experiment Station, and School of Agriculture, Forestry, and Biological Sciences. Closer association of scientists in all divisions will enable us to do a more effective job of carrying out our mission as a Land-Grant University. The Vice President for Agriculture, Home Economics, and Veterinary Medicine is thrust in a unique role as administrative head to provide overall leadership of all agricultural research, teaching, and extension efforts for agriculture at Auburn University.

Examples highlighted in this report clearly illustrate that the research being conducted by the Alabama Agricultural Experiment Station is highly important and contributes immeasurably to the economy of our State.

It is noteworthy that our research efforts affect every facet of our agricultural and forestry interests in this State. While solutions are being found to many of the problems facing our farmers, foresters, and other user clientele, much research remains to be done. If we are to maintain and, hopefully, increase productivity of our agricultural and forestry enterprises, it is imperative that we receive the financial support necessary for research to support these activities.

Funding at less than increased cost during the past year has necessitated reductions in programs of the Alabama Agricultural Experiment Station. To maintain quality of research, it has been necessary to reduce scope of the program. We now have about 140 science man-year equivalents, compared to about 155 less than a decade ago. As our staff becomes smaller, we are able to address fewer of the problems impacting on the success of Alabama agricultural and forest enterprises.

Several staff members of the Alabama Agricultural Experiment Station were recipients of various awards acknowledging and commending them for their outstanding research during the past year. Recognition has come from scientific societies, trade organizations, academic institutions, and industries. Additionally, several individual scientists were elected to offices, editorial boards, and committees of national scientific societies. These awards, honors, and elections clearly reflect the competency and quality of scientists on our staff.

Agriculture and forestry are expected to contribute substantially to the solution of many of the problems facing America in this decade. We are expected to continue to have readily available an abundance of high quality food at modest prices and an excess of grain for export to aid in our balance of payments, as well as find a solution to our energy problems and maintain and improve the quality of life and our environment. Our agricultural and forest enterprises can meet such challenges, but only if Agricultural Experiment Station receives sufficient support to ensure the research base necessary to continually increase productivity.

— Gale A. Buchanan, Director

SOME NOTEWORTHY FINDINGS IN 1980



Opportunities for improving performance of broilers were increased by research that identified factors correlated with valuable reproductive traits.

POULTRY SCIENCE

Making Egg Shells Stronger

Auburn poultry researchers are searching for ways to stimulate hens to deposit more shell on their eggs. This is a followup to 1980 findings showing that sudden changes in egg size were accompanied by changed shell deposition. Being able to trigger this increase could provide poultrymen a way to attack the problem of inadequate shells that cause loss of saleable eggs.

Experiments were conducted to determine (1) if it is physiologically possible for the hen to deposit extra shell on the eggs, and (2) if so, what the hen's maximum ability is to change shell deposition as egg size is drastically increased or decreased under natural conditions. The first 10 eggs laid by each of 560 pullets and eggs laid during an 18-day

period by hens 14 months in lay were studied. Egg weight, shell weight, and specific gravity were determined on all eggs. Eggs from hens laying an occasional abnormally large (usually double yolked) or abnormally small egg were compared with normal size eggs laid by the same hens on the adjoining day.

When there was a drastic decrease in egg size from both young and old hens, shell weight decreased in about the same proportion. Thus, there was no significant change in shell quality. In the case of a drastic increase in egg size, however, shell deposition increased also. But the increase was not enough to prevent a decline in shell quality.

Timing of Vaccination Important

The day of placement was the best time for vaccinating broiler chicks with infectious

bursal disease vaccine (IBDV). This resulted in best average broiler weight and lowest percent condemnation, plus giving a savings of nearly a half cent (0.42¢) per pound of chick over those not vaccinated.

Disease protection from a commercially prepared, attenuated IBD vaccine was determined under field conditions in the Auburn study. Progeny from flocks over 44 weeks of age that had low levels of maternal antibodies to the disease and from younger flocks with high levels of maternal antibodies were used.

One week's placement from a large broiler producer in Alabama was divided into four vaccination test groups: Group 1—IBD vaccine at 1 day; Group 2—vaccine at 10 days; Group 3—vaccine at 1 and 10 days; and Group 4—no vaccine. Immunity to IBD and Newcastle disease was measured at 2 and 5 weeks of age. Average chick weight, feed efficiency, percent livability, pounds condemned, and grower ranking were recorded to arrive at a cost per pound figure for each vaccination group.

Since the day of chick placement is most convenient for vaccinating, and this timing gave best results, this would appear to be the best time for vaccinating progeny with low levels of IBD maternal antibody.

Why Forced Molting Works

Forced molting of hens has been generally accepted as a method of overcoming the problem of shell-less egg production. But the physiological basis for this effect was not known until 1980 Auburn tests which established that the production of shell-less eggs was accompanied by the accumulation of lipid in the calcium secreting uterine tubular epithelium. Forced molting was found to remove the lipid and correct the egg shell quality problem. A significant increase in uterine pH also was found, indicating a metabolic defect associated with poor shell quality.

Broiler Reproductive Traits Interrelated

Reproductive traits of pullets and force-molted broiler breeder females were found to be correlated, specifically as noted below:

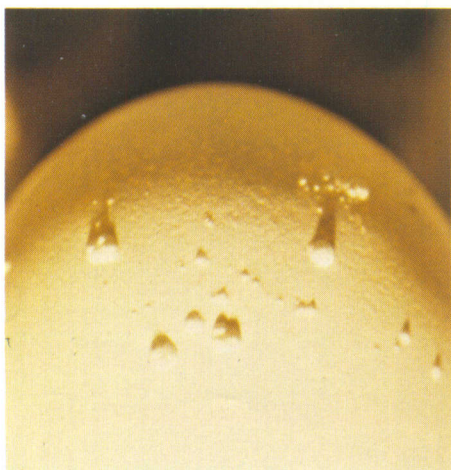
Body weight was negatively correlated with all traits except egg weight.

Egg shell quality exhibited a consistently significant positive correlation with fertility.

Eggs with specific gravity of less than 1.080 had lower fertility and hatch and higher early and late embryonic mortality than eggs with specific gravities greater than 1.080.

Duration of fertility was longer in hens producing eggs with higher specific gravities.

Fertility was positively correlated with hatch and hen-day production in pullets but not with force-molted hens.



Research is continuing in efforts to overcome problems caused by abnormalities of egg shells that cause important egg losses by Alabama poultrymen.

Coccidiosis Wastes Feed

Young chickens infected with coccidiosis do a poor job of digesting feed, which results in poor feed efficiency. This was shown in Auburn tests with 4- to 6-week-old broilers infected with one of two species of *Eimeria* coccidia. The infected chicks passed much more undigested feed than did uninfected chicks.

Calculations are that 1 percentage point in feed efficiency was worth \$16 million to the nation's broiler industry in 1980. Since low grade coccidiosis, without mortality, can cause 1 to 50 points poorer feed conversion, this disease can make a big difference to the poultry industry.

Full feeding of uninfected birds also was found to cause more undigested feed in feces than from chicks getting restricted feeding. Full feeding can result in 9 to 18 points less in feed efficiency.

ZOOLOGY-ENTOMOLOGY

Ear Tags Control Horn Flies

A new approach to horn fly control on cattle—use of ear tags containing insecticide—gave encouraging results in trials at the Black Belt Substation.

Two synthetic pyrethroid insecticides, Ectrin® and Atroban®, were evaluated. Each was formulated into PVC ear tags to allow slow release of the pesticide over a long period.

When all cows in a herd were tagged, both products provided excellent control for 5 to 6 months. Tagging half or one-third of the individual animals reduced fly populations in relatively isolated herds. When animals were near untreated herds, however, horn fly control was possible only by tagging each animal.



Tagging beef cows with insecticide-containing ear tags controlled horn flies for 5 to 6 months when all animals in a herd were tagged. Two brands of tags were effective.

Controlling Cotton Insects

Early season application of pesticides for control of tarnished plant bugs in cotton has often been followed by population explosions of bollworms (*Heliothis* spp.). Such irruptions probably occurred because the pesticides killed predators and parasites that attack bollworms.

Ambush® or Pounce® (permethrin), Orthene® (acephate), Bolstar® (sulprofos), Lannate® (methomyl), Dylox® (trichlorfon), and Lorsban® (chlorpyrifos) killed plant bug nymphs for 2 weeks. Only Ambush or Pounce was effective for as long as 3 weeks.

Among the beneficial insects, lady beetles were highly susceptible to all chemicals tried. Big-eyed bugs and Nabids varied in their reactions to the chemicals, but all populations suffered damage. Green lacewing larvae were tolerant to Cygon® (dimethoate), but all other chemicals reduced their populations for 2 weeks or longer. Population recovery of most beneficials seemed to come from in-field increase rather than from immigration from surrounding areas.

Problems with Citrus Whitefly Parasite

Release of a biological control agent for citrus whitefly on gardenia gave promising results at Auburn, but failed in Huntsville and Birmingham. The exotic wasp, which parasitizes the whitefly, had disappeared from the Huntsville and Birmingham areas by mid-summer of the second year after release. Winter damage to gardenia plants apparently caused a reduction in the whitefly

population, thus causing a collapse in the parasite population. The wasp successfully established populations in Auburn, resulting in significantly reduced whitefly population.

Woodborers Abundant in Alabama

Seventeen woodboring beetles (Cerambycidae) were added to the Alabama list by 1980 collections, bringing the total to 55 species recorded. The red-headed ash borer has three generations per year in Alabama, with peak adult activity in April, July, and September. Mating occurred on the host trees, and eggs were laid in cracks in bark. Incubation of the eggs took 6 days, and larvae then bored into the sapwood. Development from egg to adult took 60-142 days.

Microbes or Insecticides for Tomato Insects

Although microbial materials were effective against tomato insects, they were less effective than insecticides. Three formulations of *Bacillus thuringiensis*—Dipel®, Elcar®, and Thuricide®—were used separately and in combination with Pounce® and Lannate® insecticides on staked tomatoes.

Lannate at 0.45 pound per acre and Pounce at 0.1 pound per acre gave the most protection against the fruitworm. Elcar was the least effective, but all materials reduced the

number of *Heliothis* insects attacking tomatoes. None of the materials was effective against the tomato pinworm.

Fire Ant Control Difficult

Since the fire ant bait, Mirex®, was removed from the market, no effective materials have been available for control over a large area. While there is still a critical need for a good fire ant control agent, one new bait—named Amdro®—gave fair results in 1980 Auburn tests. Its control was rated as acceptable, although only 50-80 percent of colonies were controlled.

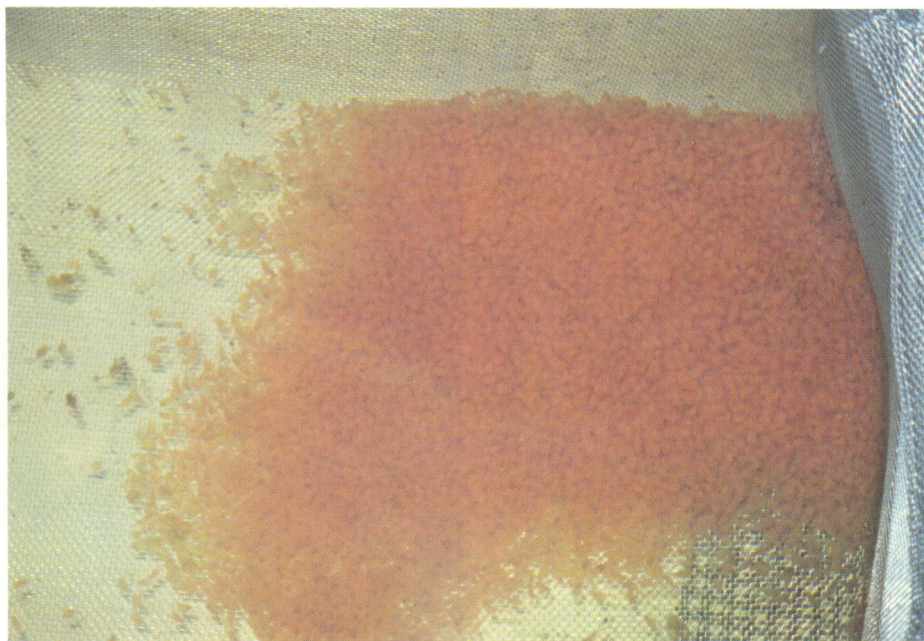
Two other baits, SN-72129 and EL 468, were included in the tests that evaluated various rates on Black Belt, Piedmont, and Coastal Plains soils.

Pitfall trapping of five non-target arthropods in the treated areas indicated that the baits did not affect these arthropods.

Dove Habits Learned

Mourning dove fledglings fitted with radios were tracked after they left the nest. These young birds were fed by a parent for 10-12 days after leaving the nest. They stayed within ¼ mile of the nest site for 15-20 days, and then joined juvenile flocks and roamed over the countryside. Nesting dates in central Alabama are from the last week of February through September.

Dove fledglings fitted with radios were tracked to learn about how the young birds lived during their first few weeks out of the nest.



Mass selection proved to be a valuable tool for increasing growth rate of catfish. One generation of selection boosted growth rate 17 percent.

FISHERIES AND ALLIED AQUACULTURES

Economical Pond Fertilization

The standard program for pond fertilization, 8-12 applications per year of 40 pounds 20-20-5 per acre, may not be the best choice. Four other fertilization programs, each using the same number of applications per year, were equally effective in increasing sunfish production, and at lower costs.

The four programs used these amounts per acre for each of 8-12 applications:

- 18 pounds of triple superphosphate (0-46-0)
- 9 pounds of triple superphosphate (0-46-0)
- 9 pounds of diammonium phosphate (18-46-0)
- 7 pounds of liquid fertilizer (13-25-0)

Fertilizer costs for the four fertilization programs were one-fifth to one-half of that for the standard program.

Vitamin C Protects Catfish Against Pathogens

Dietary vitamin C deficiency is known to increase the susceptibility of channel catfish to bacterial diseases. Last year Auburn researchers found that increasing the dietary level of this vitamin to four times the requirements for normal growth and health provided increased resistance to infection for fish injected with a virulent strain of the *Edwardsiella tarda* bacteria. Thus, increasing the level of vitamin C in catfish feeds during periods when they are most sensitive to bacterial infection, such as in early spring or when fish are being handled, may reduce disease losses.

Selecting for Performance

The growth rate of channel catfish can be improved through mass selection. One generation of selection in a wild strain resulted in a 17 percent increase in growth, a direct result of marked improvement in fingerling growth rate. Survival of the select progeny was higher than that of random progeny. Fingerling growth of two domestic strains also indicated a positive response to selection. Brood stock of the wild strain and one domestic strain selected for growth rate also had increased fecundity.

The reproductive advantage that 3-year-old crossbred channel catfish exhibited over pure-line channel catfish was not exhibited by 4-year-olds. Apparently the crossbred brood matures earlier than pure-line brood. Although intraspecific mating abilities did not vary, only crossbred individuals hybridized with blue catfish.

Rearing Large Catfish Fingerlings

Stocking densities can be used to regulate size that channel catfish fingerlings will reach in their first growing season. Catfish fry stocked at a rate of 60,000 per acre in primary rearing ponds reached a size of 3+ inches in about 45 days. When restocked into secondary rearing ponds at four densities (10,000 to 50,000 per acre), a 100-day feeding period enabled fingerling sizes of 6, 7, and 8 inches to be produced.

A stocking density of 10,000 3-inch fingerlings per acre yielded 8-inch fingerlings after 100 days, whereas the highest density



(50,000 per acre reduced to 25,000 after 45 days) produced 6.5-inch fingerlings. With intermediate stocking, 15,000 and 25,000 per acre, fingerlings reached 7 inches.

Stocking rates and daily gains were: 50,000 per acre, reduced to 25,000 after 45 days—20.7 pounds gain; 25,000—18.7 pounds; 15,000—11.5 pounds; and 10,000 per acre—10.6 pounds.

Food Determines Bass Recruitment

Whether young largemouth bass survive and grow into the catchable size range in the Southeastern United States is largely determined by food availability—in both small and large impoundments. Sampling young-of-the-year largemouth throughout the growing season in large reservoirs indicated that their growth and subsequent recruitment into the catchable size group are significantly less than what is normal for a fertilized bass-bluegill farm pond. Reduced prey availability in the form of young-of-the-year bluegill may be the limiting factor affecting bass recruitment (i.e. slow bass growth resulting from limited food increases the expectation of death due to natural causes). In this respect, a comparison of bluegill recruitment in reservoirs with and without shad present strongly implies that competition for food by shad affects bluegill physical condition and subsequently the number of young bluegill produced.

Contamination in Small Streams

Preliminary results show that small streams in east-central Alabama contain relatively small amounts of heavy metal contamination (mercury, lead, and copper) and chlorinated hydrocarbons (DDT, PCB, and Toxaphene).

Opintlocca Creek receives agricultural drainage from an area historically known to produce cotton in Macon County. Saugahatchee Creek receives municipal and industrial discharges from Opelika and Auburn.

Small streams flush out contaminants faster than larger streams, which may explain the low level of residues found in ecosystems of small streams in east-central Alabama.

The third creek being studied, Sandy Creek in Chambers County, receives drainage from mainly forested watersheds and some pasture land.

Residue samples were taken from stream sediment, various invertebrates, and fish. As expected, some bioaccumulation of residue is exhibited in the food chain. Small streams are more likely to flush material out of the system because of frequent floodings, which may explain the low level of residues in the ecosystems of small streams.

Overfeeding Catfish Lowers Water Quality

Twenty-five ponds in west-central Alabama that were used for commercial culture of channel catfish had maximum daily feeding rates ranging from 17 to 120 pounds per acre. Plankton algae were more abundant and concentrations of nitrate, ammonia, and chemical oxygen demand were greater in ponds with maximum feeding rates above 50 pounds per acre per day than with lower feeding rates. Of 11 ponds fed more than 50 pounds per day maximum, 4 had fish kills resulting from nitrate toxicity. Ammonia concentrations reached potentially lethal values in ponds with high feeding rates, but no fish mortality was attributed to ammonia toxicity.

Although some fish ponds that were fed at lower rates (less than 50 pounds maximum) had discernible off-flavor, the degree of off-flavor in the fish went higher as feeding rate increased. Algae of the genera *Lyngbya* and *Scenedesmus* were often present in ponds where fish were appreciably off-flavor.

These findings suggest that drastic increases in feeding rates during the past 5 years may be largely responsible for the off-flavor problems encountered during that time.

ANIMAL AND DAIRY SCIENCES

Lameness Disease of Dairy Cattle

A significant percentage of the cows placed in confinement at the E. V. Smith Research Center dairy unit experienced lameness (sore feet, swollen hocks, infected feet) within 1-4 weeks. Severity of lameness following confinement dictated that the cows be allowed relief from total confinement on concrete. Anatomical comparisons of feet and legs of normal and lame cows indicate that anatomical, structural differences among feet and legs of cows influence their susceptibility to lameness diseases when they are totally confined on concrete.

Finishing Cattle on Pasture

Results from a 14-year project show that slaughter beef can be profitably produced on pasture. With cattle slaughtered directly from pasture, 41 percent graded USDA Choice, 52 percent Good, and the remainder graded Standard. Net economic returns to land, labor, and operator's management averaged \$62.47 per steer. The difference between purchase price and sale price was \$1 per hundredweight, so the net return was from the enterprise and not from increases in market price.

Genetic Selection for Rapid Growth

Purebred Angus and Charolais cows representing two growth curves have been established at the E. V. Smith Research Center. Fast and slow maturing cattle are represented in each breed, but there was little difference in weaning weight between the genetic types within breed. Height of hip exhibited significance at weaning, and this measure continued to show significant differences up to 18 months. At 18 months there were major differences in weight between the fast- and slow-maturing cattle in both breeds. After the genetic lines are established as needed, detailed reproductive physiology and body composition studies will be conducted with this herd.

Safety of Ensiled Animal Waste

Animal waste is a nutrient resource that has potential as an animal feed. Potentially pathogenic microorganisms in the waste can be eliminated by ensiling waste formulated rations. Auburn test results show that acid developed during the ensiling process is critical in eliminating potential bacterial pathogens, such as fecal coliforms, salmonellae, and mycobacteria. When acid development reaches pH 4.3 or lower, bacterial pathogens are eliminated from bovine waste and corn silages. Due to the higher buffer capacity of chicken litter, a pH of 4.3 is more difficult to attain.

Genetic Improvement of Swine Efficiency

Performance differences among breeds offer opportunities for improving efficiency of swine production. Such differences showed up in Auburn tests comparing crossbred gilts representing $\frac{3}{4}$ Duroc and $\frac{1}{4}$ Landrace, $\frac{3}{4}$ Hampshire and $\frac{1}{4}$ Landrace, and $\frac{3}{4}$ Spot and $\frac{1}{4}$ Landrace, all bred to Yorkshire boars.

Conception rates and litter sizes at birth did not differ significantly among the breed groups. At 21 and 42 days of age, however, the Hampshire crossbred sows had the largest litters and the Spot crossbred sows the smallest. Pigs from Hampshire crossbred sows were the lightest at birth and at 42 days, while those from Duroc crossbred females were the heaviest.

Bull Test Records Improve

A total of 94 bulls completed the 1980-81 performance test with average daily gain of 3.31 pounds. The bulls required 7.7 pounds of feed per pound of gain, considerably better than the 8.2-pound average reported for the previous year. Weight per day of age at the end of the test was 2.94 pounds, which was higher than in any of the previous tests. This is the oldest established bull test in the United States, with the 1980-81 test being the 31st consecutive test year.

Beef Production Systems Compared

Beef production differences were found between pasture systems, finishing programs, and breed combinations in 1980 research.

Angus x Hereford cows were maintained on pastures overseeded with either clover or rye. The average adjusted weaning weight was 415 pounds and 427 pounds for the legume and non-legume overseeding, respectively. Body weight loss during winter averaged 12 percent of fall weight for the group on legume overseeded pasture and 17 percent for those on the non-legume pasture.

Post-weaning performance of steers and heifers was measured using a drylot and pasture finishing program. Carcasses of cattle finished in drylot graded low Choice and those from the pasture program averaged high Good.

Angus-sired cattle averaged almost two-thirds of a grade higher than Charolais-sired cattle due to greater deposition of marbling. Adjusted backfat was higher for the Angus-sired cattle (0.5 vs. 0.3 inch).

TOP: Records of the latest bull test show average weight per day of age of 2.94 pounds, the highest during the test's 31-year history. BOTTOM: Performance differences among sow breeds showed up in Auburn tests, offering opportunities for improving efficiency of production by swine producers.



HORTICULTURE

Heat Tolerant Tomato

Progress is being made toward development of a tomato variety that can produce tomatoes despite hot Alabama weather. A promising heat tolerant line was selected from a summer heat stress test at the E. V. Smith Research Center in 1980. The plants were field set on July 11 and set a good crop of firm, crack resistant fruit that had good shoulder color development. Fruit size was classified as medium plus.

The new line is derived from heat tolerant selections made at the Wiregrass Substation in 1978 and 1979. It is indeterminate in growth habit and has the jointless fruit stem. This line is fixed for resistance to rootknot nematode and Fusarium wilt (race 1), and probably to Verticillium wilt, and is segregating for tobacco mosaic virus resistance.

Shaping Alabama Apples

Hot weather in spring and summer causes poor shape and color of Red Delicious apples produced in the Southeast. High temperature following bloom results in the apples being flatter and lacking calyx points that are typical of fruit grown in the Northwest. Hot nights in August, when fruit is ripening, inhibit red color development.

Foliar spraying with two growth regulating chemicals, Promalin® (a mixture of gibberellic acid 4, 7 and bezyl adenine) and Ethrel® or Cepha® (ethephon) was found to improve both shape and color of apples in Auburn research.

Promalin was found to promote development of the calyx points and increase fruit length, length-diameter ratio, and weight. Delicious apples grown in Alabama normally have a length-diameter (L/D) ratio of .88, whereas .93 is necessary for an apple to conform to the desired shape. Promalin treated fruit had an L/D ratio of .98 in the tests.

Ethephon had already been found to enhance red color development, so a combination of Promalin and Ethrel or Cepha was tried. The result was fruit with an L/D ratio of .98 and satisfactory red color. This fruit was equal to that grown in the Northwest in both shape and color and could easily compete in the market.

Improved Steam Peeling

A steam peeling system developed at Auburn should help avoid excessive peeling and trimming losses, high labor costs, and oxidative discoloration in processing fruits and vegetables. Ideally, peeling should remove only a thin outer layer and leave no peeling or defect to be trimmed by hand.

The Auburn method uses rapid heating by high pressure steam diffused uniformly

throughout the peeling chamber, followed by instantaneous release of pressure and cooling with cold water. The result is higher product recovery, better product quality, and reduced hand trimming, and it requires no expensive caustic solutions. This method results in a 20 percent yield improvement with sweet potatoes, 15 percent yield improvement with apples, and a 10 percent yield advantage with beets over peeling methods now in commercial use.

Built-in Insect Resistance

Breeding horticultural crops for disease and insect resistance is receiving a great deal of attention because of the potential for reducing dependence on costly chemical based pesticides. Research with cucumbers is providing basic information that may lead to insect resistant varieties and development of other non-chemical methods of preventing insect damage.

The research has confirmed the presence of the compounds which act as feeding stimulants for the major insect pest of cucumbers, the cucumber beetle. Since these chemicals impart bitter taste to human taste buds, they

have been called "bitter principles." Cucumber seedlings not having these bitter principles are not attacked by the cucumber beetle. Although the bitter taste is seldom found in the cucumber fruit, all commercially desirable cucumber types have bitter seedlings which are subject to insect attack.

The techniques of chromatography and mass spectrometry were used to isolate and identify the specific bitter principles found in two cucumber varieties with bitter seedlings and one whose seedlings were not bitter. Strangely enough, a compound isolated from the non-bitter variety was almost chemically identical to the bitter principles of the two "bitter" varieties. This compound did not impart a bitter taste to the seedlings and did not stimulate the beetle to feed on the seedlings.

Results of this research may now be used as the foundation for applied research projects such as (1) selective breeding to eliminate bitter principles from the seedlings of commercially desirable cucumber types, (2) extraction of bitter principles from cucurbits to be used in insect traps, and (3) the synthesis of bitter principles to be used in mass trapping of cucumber beetles to reduce insect populations.



Spraying apple foliage with Promalin was found to overcome the problem of poor shape of apples produced under Alabama's hot conditions. The sprays resulted in development of desired calyx points and increased fruit length, length-diameter ratio, and fruit weight (apple at right).

Acceptable Southernpea Flour

An Auburn-developed process that effectively removes the objectionable flavor and odor of southernpea flour makes it possible to use this high lysine product to enrich wheat flour. Previous efforts to use low cost lysine from legumes, primarily from soy flour, to improve protein utilization of wheat flours by humans were unsuccessful because of the persistent bean flavor. Since southernpeas are relatively abundant in lysine, the new process may lead to its use.

The Auburn process consists of rapidly heating a flour in water slurry to near boiling, then flashing the slurry into a reduced atmosphere chamber where volatile flavors are removed. Yeast breads formulated from wheat flours fortified with flavor-stripped southernpea flour had flavor as acceptable as breads from non-fortified wheat flour.

Pine Bark Nursery Growing Media

Pine bark may replace the more expensive and scarce sphagnum peat moss as media for container grown nursery plants. The bark is readily available in the South where container plants are widely grown, it is econom-

ical to use, and it can be milled to serve the purpose.

In 1977-80 tests at Auburn, fresh pine bark milled to pass a ¼-inch screen and amended with dolomitic lime, phosphorus, and minor elements made an excellent medium for producing Japanese holly and azaleas. The mix is well drained and disease resistant.

For azaleas, the medium was adjusted to about pH 5.0 by adding 4 pounds of dolomitic lime per cubic yard. Eight pounds of the lime were needed for the holly medium, to adjust it to pH 5.5 to 6.5. Two sources of liquid nitrogen at 200 to 300 p.p.m. were adequate. Potassium was included with nitrogen applications weekly at 200 p.p.m., using potassium chloride. Ammonium nitrate yielded better azalea growth than calcium nitrate in the all pine bark medium, at equal nitrogen levels. The source of nitrogen did not seem as important on holly growth.

Various deciduous shrubs, broadleaf evergreen shrubs, and narrowleaf evergreens also were successfully grown in the pine bark medium, using slow release fertilizers and both complete liquid and dry sources.

Light weight of the pine bark media is another point in its favor. The average semi-trailer load of 6-inch container grown plants

(6,200 to 6,500 pots) would weigh 23,000 to 25,000 pounds, well below the 40,000-pound load limit. Even when pine bark is mixed 25 percent by volume with builder's sand, a full truck would weigh only 37,000 to 38,000 pounds. Using heavier media would make it necessary to ship fewer plants per load, resulting in higher transportation costs per plant.

Subsoil Acidity Reduces Sweet Potato Yields

Subsoil acidity had a marked effect on yield of marketable sweet potatoes in joint research by the Department of Horticulture, USDA-SEA, and Department of Agronomy and Soils at the E. V. Smith Research Center. A pH range of 4.3 to 6.0 was established in the subsoil (6- to 12-inch depth), and the surface soil (0 to 6-inch depth) was uniformly limed to pH 6.0.

Maximum marketable yields occurred at the highest subsoil pH (5.8 to 6.0) in 1979. In 1980, production ranged from 332 bushels marketable at pH 4.3 to 444 bushels at pH 5.2 and above. The yield of cull roots increased as the subsoil became more acid (lower pH values).

An Auburn-developed method that removes the objectionable flavor and odor of southernpea flour makes possible use of this high lysine product to enrich wheat flour. Yeast breads containing the low cost flour from southernpeas combine good flavor with high nutritive value.



BOTANY, PLANT PATHOLOGY, AND MICROBIOLOGY

Bayleton Labelled for Fusiform Rust Control

Cooperative research efforts by the Alabama Agricultural Experiment Station, the USDA Forest Service's Southern and Southeastern stations, and the Weyerhaeuser Company led to labelling of Bayleton® for fusiform rust control on pine seedlings in forest nurseries. This cooperative work demonstrated Bayleton's effectiveness and resulted in sufficient data to support its registration. During 1980, 24(c) state labels were obtained in Arkansas, Alabama, Louisiana, Mississippi, Georgia, Florida, North Carolina, and South Carolina, permitting use of this effective material in Southern forest nurseries.

Four applications of Bayleton during the spore-flight period (April-June) at rates ranging from 0.25 to 0.50 pound active ingredient per acre per application proved sufficient to control this disease in forest nurseries. Further tests underway are evaluating its effectiveness against fusiform rust on young seedlings in plantations.

Unusual Plant Pathogens Studied

A rickettsia-like organism (RLO) associated with phony disease of peach was found to be present in higher concentrations in plum roots than in peach roots. Followup studies revealed that leafscald was prominent on plum trees yielding high RLO counts and low to nonexistent on trees with low concentrations of RLO. Since little was known about varietal reactions to leafscald, 26 plum cultivars or hybrids involving the several species were evaluated for RLO incidence. Some cultivars consistently yielded low RLO counts, indicating some resistance to the bacteria.

Other pathogenic bacteria studied were the spiroplasmas, wall-less and often helical shaped microorganisms that cause disease in some plants. The Auburn research showed that the amino acid, arginine, has a growth-promoting effect on the corn stunt spiroplasma as well as some other plant-infesting spiroplasmas. Investigations are continuing into the nature of this effect and a possible role of arginine in the pathogenicity of spiroplasma.

The Auburn Herbarium

The reference collection of plant specimens in the Auburn University Herbarium has grown substantially in the past several years, and was recently acknowledged as a National Resource Collection. Its present total of



Fusiform rust galls on diseased seedlings at right, in comparison with healthy ones at left, illustrate the value of using Bayleton for controlling this disease in forest tree nurseries. Auburn research in cooperation with other research agencies and industry resulted in labelling of Bayleton for use in the nurseries.

40,000 specimens primarily represents the flora of the Alabama Piedmont and Coastal Plains regions, but statewide ranges of poisonous plants and endangered plant species also are documented. Service functions of this herbarium include plant identification for the public and loans of specimens for botanical research by scientists and students at other institutions.

Anhydrous Ammonia Extends Nematicide

Planting time applications of both anhydrous ammonia and the fumigant nematicide, ethylene dibromide (Soilbrom 90®), gave better control of the soybean cyst nematode than did fumigation alone. Other studies have demonstrated that anhydrous ammonia is an efficient killer of many parasitic nematode species.

The relatively low cost of ammonia, when compared to cost of standard nematicides, makes these findings potentially important to Alabama farmers. It may be possible to reduce the amount of nematicide needed per

acre by using the material along with anhydrous ammonia. Added ammonia also may serve to stimulate populations of microorganisms antagonistic to certain nematodes.

Nematode-destroying Fungi

An investigation of nematode-destroying fungi in Alabama agricultural soils found both predatory and parasitic fungi. Predaceous forms produce extensive growth, and they capture nematodes by such methods as constricting and non-constricting rings and adhesive branches, nets, and knobs. Rings are formed in response to one or more compounds produced by the nematodes. Certain amino acids and specific peptides are the active ingredients in such ring-inducing substances.

One group of endoparasites forms adhesive spores which become attached to the nematode or, if ingested, they germinate in the gut. Another group possesses highly specialized hypodermic needle-like cells which effectively penetrate the nematode body.

FORESTRY

Price Increases for Forestry Equipment Vary

Prices for forest management equipment have been increasing faster than prices for timber harvesting equipment. In fact, forest management equipment prices have risen faster than the rate of inflation since 1974, while prices for timber harvesting equipment have not kept pace with inflation. The producer price index for machinery and equipment did not increase as fast as the producer price index for industrial commodities, but it increased faster than prices for timber harvesting equipment.

The Southwide average price paid for pulpwood delivered to a mill also increased more than timber harvesting equipment prices. However, this larger increase was due mainly to the 1973-74 paper shortage that pushed pulpwood prices up considerably more than their normal increase. From 1974 to 1978, prices for timber harvesting equipment increased at a slightly faster rate than the prices for pulpwood, but the total increase from 1968 to 1978 was still below the total increase in prices paid for pulpwood.

These findings came from a study in which prices as of January 1 for each year from 1968 through 1978 were collected for 10 pieces each of forest management equipment and timber harvesting equipment. The prices were converted to indices using 1968 as the base year, from which an average index was calculated for both types of equipment. These indices were compared with the producer price index for industrial commodities, the producer price index for machinery and equipment, and the index representing the price of pulpwood delivered to the mill during 1968-78. Such measures gave a realistic look at forestry equipment prices in relation to inflation.

Forestry Leads Alabama's Industries

The best single measure of an industry's economic contribution to a region is "value added," which is the value that an industry adds, through its own operations, to the value of its purchased raw materials. It also represents an industry's contribution to the gross national product. This measure confirms that the forest industries collectively have been one of Alabama's growth leaders since 1960. With recent and planned expansions in the pulp and paper industry, forestry and forest products are sure to maintain economic leadership in the years ahead.

Research recently completed at Auburn reveals that, in 1977, the combined value added of the forest industries was \$1.38 billion, exceeding both heavy metals (\$1.04 billion)



Use of anhydrous ammonia, in addition to the fumigant nematicide Soilbrom 90, at time of planting soybeans resulted in better control of the soybean cyst nematode than from fumigation alone. Because the ammonia is considerably cheaper than the fumigant, use of both materials could lower the amount of fumigant needed and provide a cost savings.



Although inflation has been increasing the cost of equipment used in forestry and other agricultural production, certain types of machinery have increased in price much more than others. For example, an Auburn study found that forest management equipment has gone up faster than the inflation rate, whereas timber harvesting equipment prices have not kept pace with inflation.

and textiles (\$0.67 billion), two of the State's traditional leaders. Even when compared with all of agriculture, forestry appears to be the leader. Since value added of agriculture is not routinely estimated by the U.S. government, it can only be approximated from existing data published by USDA. If the cost of raw materials (feed, livestock, seed, fertilizer and lime, and miscellaneous) is subtracted from gross receipts from farm marketings, the result, which is an approximation of value added by primary agricultural production, is \$0.72 billion. Adding the value added by the food processing industry (\$0.55 billion) gives a total estimated value added of \$1.28 billion, about \$100 million less than forestry.

Since wood is one of the most important raw materials of the forest industries, the industry is dependent on the thousands of forest landowners in Alabama. Contrary to popular belief, the forest industry owns only about 20 percent of the State's 21.3 million acres of commercial forest land (and commercial forest land represents about two-thirds of the State's total land area of 32.2 million acres). Thus, even if industry lands are managed intensively, private landowners will still supply the majority of the industry's raw material. With improved forest management techniques and greater economic incentives, Alabama's land and timber base is

capable of supplying even more timber than it does today.

Virtually all public and private forecasts agree that there is great potential for expanding domestic and international forest products markets. And it is almost a certainty that the South will become the "wood basket" of the nation in the years ahead. Alabama's industry and landowners are well situated to take advantage of these developments.

Feller-buncher Dependability Determined

Feller-bunchers are becoming more and more common on timber harvesting operations, primarily because they allow small trees to be harvested economically. This machine cuts smaller trees and puts them into bunches, thus reducing the single stem effect of the smaller trees. Feller-bunchers are highly productive when operating, but seem to experience a high number of failures.

A study of 32 feller-bunchers documented failure frequency rate and pattern, availability for use, average repair time, and most common causes of failure. It was found that average time between failures ranged from a low of 6.7 hours to a high of 56.8 hours, depending on the type of feller-buncher and age of the machine. The failure rate pattern

did not follow the classic "bath-tub" shaped curve, but rather exhibited an increasing failure rate during the first year. The remainder of the curve did follow the typical pattern, a period with a relatively constant failure rate preceding the increasing failure rate as the machine wears out.

Mechanical availability of the 32 feller-bunchers ranged from a low of 47 percent to a high of 97 percent, again depending on type and age of machine. Average repair times also showed considerable variation, ranging from 1.1 to 7.4 hours.

The hydraulic system was by far the most common cause of equipment failure, accounting for over 41 percent of all failures. Hoses, pipes, and fittings were responsible for 23.5 percent. The next most common failure was the shear assembly. Although feller-bunchers do fail frequently, most of the failures are relatively minor and only require replacing a hydraulic hose or fitting or welding. Twelve percent of all repairs involved welding.

Service time provided an interesting contrast in that service time tends to dampen the effect of failures. The more a machine operates, the more it must be shut down for service, and this service time reduces availability. When a machine fails, however, it is serviced during down-time, thereby eliminating a separate shut-down for service.

Equations providing information on volume, green weight, and dry weight of the entire tree have been developed at Auburn. These equations should prove helpful in new, weight-basis systems of buying timber.

Total Tree Weight Equations Developed

A recently completed study, in cooperation with the U.S. Forest Service, developed equations for estimating green weight, dry weight, and cubic foot volume for above-ground components of longleaf pine and tupelo in Alabama. Such equations are needed because of the recent shift to timber buying on the basis of weight rather than volume, a shift made because of ease, objectivity, and accuracy of obtaining weights. There also is considerable interest in determining the biomass available in the traditionally unmerchantable upper portion of the stem and in limbs for potential use in wood products and for energy.

Trees of each species studied were selected from their natural range, primarily the Coastal Plains, to obtain a representative sample of trees from 1 to 20 inches in diameter. Each sample tree selected was felled and divided into merchantable bole, upper bole, and limbs. Green weight of each portion of the bole and limbs was observed in the field and samples of each were returned to the lab for dry weight and volume determinations. Information from these samples was used to estimate dry weight and volume of each component weighed in the field.

Regression equations were estimated for green weight, dry weight, cubic foot volume for bole wood and bole bark to various points up the bole, limb wood and bark, foliage, and for combinations. Predictor variables included diameter breast high, total height, merchantable height, crown length, diameter at live crown base, and transformations of the above.

Three other Southern universities that cooperated in the study developed similar equations for loblolly, slash, and shortleaf pines, water-willow oak, sweetgum, and a group of red oaks. Primary user of the equations will be the U.S. Forest Service in the Renewable Resource Evaluation (forest survey). This evaluation provides periodic information on growth, cut, and supply of forest resources by county within each state, and is used by many forestry organizations for short- and long-term planning.

The equations developed provide information on volume, green weight, and dry weight of the entire tree, not just merchantable volume as has been reported in the past. Forestry organizations can use the equations to evaluate growth and yield, timber inventory, harvesting, and product scaling for the total tree and its components in terms of volume and weight.



AGRONOMY AND SOILS

Starter Fertilizer for Early Sorghum

Data from 1980 research at the Wiregrass Substation suggest that starter fertilizer can improve production of grain sorghum planted in late winter or early spring. Starter fertilizer (10-34-0) applied to no-till grain sorghum planted April 26 increased average grain yield 16 bushels per acre (from 76 to 92 bushels). With conventional tillage, starter fertilizer increased average yield 7 bushels per acre (from 81 to 88 bushels).

In other studies, use of 18-46-0 starter fertilizer advanced maturity by as much as 2 weeks. Such earlier maturity may be critical for ratoon cropping systems (growing first crop from planted seed and a second crop from tillers off the first crop's stubble).

Chemical Enhances Cotton Yield?

Galecron® originally was manufactured as a cotton bollworm ovicide. Now it is being investigated as an agent to enhance yield of cotton.

In 1980, beginning at pinhead square, multiple applications of Galecron were applied to measure its effect on yield. Plots receiving Galecron at various rates and number of applications had yield increases ranging from 5 percent at lower rates and fewer applications to 18 percent at higher rates and more applications.

Soybean Root Growth

Under Water Stress

Observations of soybean root growth through glass windows of the Auburn Rhizotron revealed how the crop's roots react to different moisture conditions.

Non-irrigated plants produced several times more root biomass than plants under irrigation. Irrigation at 4-hour intervals resulted in an even smaller root system than on plants given the same quantity of water in larger applications at 24-hour intervals. However, the higher irrigation frequency resulted in more vegetative growth and more soybean seed at the end of the season.

Seed yield and shoot biomass of all irrigated plants were nearly double that measured on non-irrigated controls, although root biomass was much higher without irrigation.

Cocklebur Tough on Cotton

Previous cocklebur research established that cotton yield losses can run as high as 90 percent from this tough weed. In more recent studies designed to establish the threshold of damage, yield losses of 17 percent resulted from two common cocklebur plants per 50 feet of row. This increased to a 70 percent loss at densities of 32 cocklebur plants per 50 feet. Line equations revealed yield losses of about 70 pounds of seed cotton per acre for each common cocklebur per 50 feet of row that is left to compete with cotton for the entire growing season.



Effectiveness of new post-emergence grass herbicides under test is illustrated by the kill of seedling johnsongrass in soybeans (left). Infestation of johnsongrass in the beans is illustrated by the untreated stand at right. One of the materials, trade name Poast, will be available under an experimental use permit in 1981.

Granular vs. Seed-applied Inoculant

A new technique of inoculating legume seeds, such as soybeans and peanuts, is in-furrow application of granular inoculant of *Rhizobium* bacteria. Using 5 to 10 pounds of the granular inoculant is supposed to provide more rhizobia than the traditional seed-applied culture. But higher material and equipment costs may limit use of the granules.

Results at the Wiregrass Substation indicate that type of inoculant to use depends on whether fungicide-treated seed are planted. Where fungicide-treated seed are used, granular inoculant is preferred because it can be separated from the seed to prevent the bacteria in the inoculant being killed by the fungicide. Without fungicides, however, seed-applied inoculant is preferred. It results in better inoculation—25 to 33 percent more nodules on roots at equal rates of inoculants—and has the added advantages of lower cost and easier application than granules.

The toxicity of the fungicide Captan® to the inoculant was evident in field and laboratory tests. Nodule numbers per plant were reduced more than 90 percent by using seed-applied inoculant with fungicide-treated seed, in comparison with granular inoculant. Separating the rhizobia from the Cap-

tan-treated seed by as little as 3/8 inch preserved the inoculant's effectiveness.

The research was done in soils containing practically no soybean rhizobia, so nodulation effects can be attributed to the treatments. Inoculation is unnecessary on soils where soybeans have been grown in recent years.

Combinations for Peanut Weed Control

Although effective herbicides are available for weed control in peanuts, a combination of herbicides and cultivations proved best in Wiregrass Substation tests. This combination gave the highest profit per acre of peanuts, and also provided the most return per dollar spent on weed control. Use of two cultivations with single herbicide applications of Balan® (benefin), Vernam® (vernolate), Lasso® (alachlor), or Premerge 3® (dinoseb) resulted in profit per acre ranging from \$282 to \$334 and dollars returned per dollar spent on weed control ranging from \$12 to \$15.

Without herbicides, as many as five mechanical cultivations per season did not consistently provide acceptable control in the test area, which was heavily infested with large crabgrass, Texas panicum, morning-glories, Florida pusley, Florida beggarweed,

sicklepod, and pigweeds. Hand hoeing was tried as a supplementary procedure, but it did not give a favorable return.

New Grass Herbicides Tested

Several experimental herbicides (KK-80, BAS-90520H, RO 13-8895, CGA-82725) gave good post-emergence grass control in soybeans, cotton, and peanuts in 1979-80 evaluations. A single application provided good control of such tough pests as seedling johnsongrass, crowfootgrass, and broadleaf signalgrass. Rhizome johnsongrass required an additional application for acceptable control. Common bermudagrass in cotton was controlled with higher rates and two applications.

One of these herbicides, BAS 90520H, will be available in limited supply during 1981 under an experimental use permit. The trade name will be Poast®.

Too Much Fertilizer Can be Bad

Too much fertilizer can be as costly as too little. In 1980 soybean field experiments, for example, very high soil-phosphorus levels on properly limed soils caused severe yield reductions.

The field plots were established earlier by adding fertilizer phosphorus and lime at several rates to provide a wide range of soil-phosphorus levels and soil pH. Soybeans were subsequently grown for 3 years without additional fertilizer or lime.

Zinc deficiency symptoms appeared early in the growth stage on the high-phosphorus soils when soil pH was above 6.0.

Pigweeds Not Tolerant to Herbicides

In certain areas of the United States and Canada, weeds have developed resistance to AAtrex® (atrazine) and related triazine herbicides in fields where AAtrex was applied annually for 6 to 10 years. But this has not occurred in Alabama, according to a recent Auburn study with redroot pigweed, one of the weeds reported to develop such resistance.

Common pigweed species were collected at 19 sites in Alabama, including areas not treated with herbicide and areas that had received various herbicide treatments. Biotypes were selected and seed collected for study. Five selections showing the highest tolerance to the herbicides were further evaluated. Results show that Alabama's pigweeds are still susceptible to AAtrex, Cotoran® (fluometuron), and Treflan® (trifluralin). However, the continued use of the same herbicide each year increases the possibility of resistance developing.

Alcohol Fuels from Sugar Crops

Sugar-producing crops, sweet sorghum and sugar beets, showed good potential as feed stocks for fuel grade alcohol production



Good condition of this steer illustrates the potential performance of cattle grazing fungus-free fescue grass that is not infested with the fungus that causes "fescue toxicity." Steers grazing fungus-infested fescue make slow growth and show poor condition and health caused by the fungus.

in 1980 tests at nine locations. Yields at the Gulf Coast Substation were 35 tons per acre (35 percent dry matter) of sweet sorghum and 17 tons of sugar beets.

Sweet sorghum was emphasized because it appears to have the greatest potential for alcohol production from the standpoint of yield and adaptability. Research with it included variety trials at nine locations, five fertility tests, three date-of-planting tests, one herbicide test, and one evaluation of growth regulators to enhance sugar content. Sugar beet testing included trials with 25 varieties at three locations.

Overcoming Fescue Toxicity

Current efforts to overcome the toxicity problems of cattle grazing tall fescue containing a fungus (possibly a new species of *Acremonium*) could have far-reaching effects. In fact, growers could expect cattle gain on non-infested fescue to be equal to that on winter annual pastures—and at lower cost.

During the 1979-80 grazing season at the Black Belt Substation, steers grazing fungus-infested tall fescue gained at the rate of only 0.8 pound per day and per acre gain was only 190 pounds for the season. In contrast, steers on non-infested fescue had average daily gains of 1.8 pounds and made 379 pounds per acre. Animals on the "clean" pastures looked good and behaved normally, while those on fungus-infested fescue had rough hair coats, nervousness, intolerance to heat, and elevated body temperatures.

Since the fungus is seed-transmitted, effective seed treatments are being sought. Other approaches are to breed fungus-resistant plants and to develop a safe, systemic fungicide for use on established pastures.

Better Sericea on the Way

Sericea varieties even better than the new AU Lotan are in the development stage at Auburn. Results with large numbers of low-tannin lines indicate that further progress can be made in increasing digestibility of dry matter and crude protein, percentage crude protein, and total soluble sugars, and in decreasing tannin content. These traits are being incorporated with disease and rootknot nematode resistance, and with higher forage and seed yields. Several superior lines are being increased for additional testing and possible release.

AGRICULTURAL ENGINEERING

Grain Inspection System Devised

An extensive review of grain quality indicators and measurement methods indicated that use of remote sensing technology to develop a continuous monitoring system for use during grain transfer operations might be impractical with today's technology. Many indicators of grain quality were identified, with many having meaning or being of value to only a small segment of users.

Most detection methods were found to be too slow or too expensive to be incorporated into the normal inspection procedure of a grain elevator on a continuous basis. However, two indicators were identified which showed potential for automation—moisture content and broken corn and foreign material. Both are of economic value and will

make an automated system valuable to a grain handler.

A microprocessor based system which utilizes a commercially available electronic moisture meter was developed and tested. The system will control sampling and measuring of moisture content at time intervals determined by the user. The system also can calculate running averages, send messages when upper and lower limits are exceeded, and perform other control functions. It performed all functions expected of it in the tests. A method for automating measurements of broken corn and foreign matter also was described, which can be readily incorporated into the microprocessor based system.

Pecan Roots Respond to Irrigation

When Hurricane Frederic devastated the pecan irrigation experiment at the Gulf Coast Substation, this appeared to wipe out the value of the project. But valuable information was obtained from these trees by digging up the roots to study effects of irrigation on root growth patterns. The visual results were:

1. Sprinkler irrigation resulted in the greatest root density and the most uniform root distribution.
2. Least root development occurred where there was no irrigation.
3. An abundance of small roots occurred beneath the drip irrigation emitter, even into the subsoil.
4. Upward root growth (negative geotropism) was encountered and its development appeared, in some cases, to be enhanced when under an emitter.
5. In general, it appeared that overall root development was increased with increasing amounts of water delivered through the irrigation system.

Reliability of Farm Machinery Investigated

Preliminary results from a farm machinery reliability study indicate that farm tractors in Alabama average being broken down 4 percent of total working time. As might be expected, tractors 1 year old or newer account for only 2 percent of total tractor breakdown hours. Surprisingly, however, these same tractors accounted for 14 percent of the total number of tractor breakdowns. Thus, new tractors have fairly frequent breakdowns of short duration. In addition



Water collected at various points under irrigation provide data used by the computer to design application patterns to give more uniform application of water by hose-towed traveler and towable pivot irrigators.

to determining frequency and duration of farm machinery breakdowns, the study also will seek to learn what causes the breakdowns. The data will be correlated according to total hours of use or acres covered, soil type, farm size, crops grown, and machine age.

Computers Improve Irrigation Efficiency

Computers are being successfully used in efforts to increase efficient use of water and energy, both valuable resources used in irrigation. Hose-towed travelers and towable pivots are being studied.

One improvement has been the incorporation of an initial delay with a hose-towed traveler to more adequately irrigate field boundaries. The delay allows the irrigator to

remain stationary for a set period so that additional water will be applied at the start-up position. Normally, insufficient amounts are applied near the boundary. The result was more adequate irrigation of the ends of the field, but there also was over-irrigation of certain locations.

Energy Savings Possible

Research at Auburn's solar heated poultry unit has identified some areas where energy savings may be achieved with cost-benefit ratios competitive with fuel prices. Since ventilation air requirements constitute a major source of heat loss from poultry buildings, it seemed logical to look at preheating ventilating air as a primary means of conserving heat. A low cost preheater was designed that is capable of replacing

Pre-formed beds allowed earlier planting in sticky soils and reduced emergence problems over conventional planting in Black Belt Substation research. A special bed-forming implement was used to make the beds, and its design is being changed to improve bed uniformity.



approximately 15 percent of brooding energy requirements.

In efforts to reduce need for traditional fuels, whose prices are continually escalating, research is being expanded to include use of wood burning stoves to provide supplemental heat required for both a liquid storage and rock storage solar heated brooding system.

Modifying Soils for Better Production

Problems in water use, tillage, and traction in Coastal Plains and Black Belt soils are being studied in cooperative research with the USDA's Soil and Water Research Unit and National Tillage Machinery Laboratory. One phase of the study involves the use of narrow row beds for soybeans.

Narrow beds were formed on a sticky clay soil at the Black Belt Substation, using a specially designed bed-forming implement. The beds had a drainage slope of approximately 0.9 to 1.0 percent. Two rows of soybeans were planted on each bed and compared with conventional cultural practices. The beds made possible early planting (3 to 4 weeks earlier), and there were fewer emergence problems than with conventional planting.

Some design changes were made on the bed-forming implement to improve bed cross-section uniformity, and the planter is being changed to improve its performance on the beds. New beds were formed in December 1980 on a slope of 0.5 to 0.6 percent to reduce the scouring and sediment transport observed with the slope of 0.9 to 1.0 percent.

Total Utilization of Swine Waste

Information is already being gained from a multi-phased project dealing with integration of waste treatment components into a utilization system that either recycles or reuses all on-site generated waste. The components include a flushing system for waste transport, a liquid-solids separator unit, a continuously expanding anaerobic digester, refeeding of the separated solids and digester residue, single-cell protein production using the liquid fraction from the separator, and supernatant recycling for flushing purposes.

The project also includes a study of anaerobic digestion using the continuously expanding volume (CEV) concept, which will investigate the effects of cycle time, temperature, and loading rates on the performance of CEV digestors. Results thus far using a heavy loading rate and extremely short cycle time suggest that continuously expanding digestors have limits of operation.

In laboratory studies concerning enhancement of gas production and quality using a

hydrolysis pretreatment, it was shown that the soluble carbon, carbohydrate, and total oxygen demand can be significantly increased. Since these components comprise about 41 percent of the potential methane production, digestion of pretreated swine waste should be improved considerably.

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

Economics of Turf Production

Data from 26 turfgrass operations showed total marketings of 4.4 million square yards of turf from approximately 1,100 acres. Gross sales at the wholesale level were \$4.2 million, excluding delivery and installation charges. Bermudagrass accounted for 70 percent of the acres grown and 60 percent of the gross income.

Average investment for land, equipment, and buildings was \$1,670 per acre, with small operations having the highest capital investment per acre. Fixed, variable, and total costs per acre averaged \$260, \$665, and \$925, respectively. Net return to overhead and risk from the sale of turfgrass averaged \$391 per acre for all farms.

Most turfgrass growers were located in counties within or bordering major population centers.

Alabama Youth Study Followup

Studies concerning the aspirations, goals, and attained status of a sample of Alabama youth begun in 1966 were continued to learn about the subjects' adult status. The original sample consisted of 280 persons in the 10th grade in selected north Alabama high schools.

Eleven years after completion of high school, 60 percent of the young adults resided in the same county. Only 12 percent lived outside Alabama. Only four males gave farming as their principal occupation, while one-fourth had occupations associated with a variety of professions. Although place of residence of the group was primarily urban, one-third lived in open country and 12 percent on farms.

Implications of Game and Fish Laws

Alabama farmers' unique position regarding outdoor recreation land and the state's wildlife resources, in light of increasing demands on outdoor recreational resources, was the reason for an Auburn study of game and fish law implications. Alabama law recognizes that farmer-landowners have the exclusive right to catch and kill the fish and



LEFT: Turfgrass production offers opportunities for good returns on a per acre basis, but large investment is necessary for this specialized farming venture. RIGHT: Getting the greatest return from Alabama's large acreage of soybeans calls for extra attention to marketing. One marketing alternative getting major attention is use of the futures market as a hedge against price changes.

wild animals found on their land. However, they must abide by the rules and regulations of the State Department of Conservation and Natural Resources. Farmer-landowners also have certain responsibilities for the safety of hunters and fishermen other than trespassers. An additional right is to propagate wild animals for restocking their land.

Basis Patterns Important In Soybean Marketing

With increased production of soybeans and rather wide fluctuations in market prices, there is a need for farmers to consider marketing alternatives. One such alternative is the use of the futures market as a hedge against price changes. Carrying out sound hedging transactions requires information on "basis," which is the difference in local market prices and the futures price.

Daily cash prices at 21 marketing locations in Alabama were compared to futures price quotations for 7 soybean contract months during the 4-year Auburn study. The Gulf area had a significant price difference from other market areas. Although basis fluctuated among corresponding months of different years, this variability was less than that associated with price level. Analysis of variance tests revealed a significant difference in basis patterns in one or more market areas for each contract month.

Objective Credit Scoring

A quantitative and objective system of credit scoring was developed to discriminate between acceptable agricultural loans and those that are weak and need close supervision. Data used in the study were obtained

from loan applications of borrowers at eight Production Credit Associations.

Variables found to be significant in distinguishing between acceptable and problem loans were (1) total liabilities divided by total assets, and (2) annual loan repayment anticipated divided by total assets. The scoring system developed was found to correctly classify 88 percent of the loan applications.

Grain Flow Patterns Established

Research on flow patterns of grain produced and handled in Alabama, as well as grain imported and exported, revealed that storage capacity of grain marketing firms increased from 1970 to 1977. About 63 percent of the grain received by Alabama marketing firms was from out-of-state sources. Corn accounted for more than 50 percent of the total. Illinois was the most important source of imported grain and Indiana was second. Rail transportation brought in about 41 percent of the grain, trucks more than 34 percent, and the remaining 25 percent came by water. Net grain imports into Alabama were almost 80 million bushels in 1977.

Black-operated Agriculture Different

Black-operated farms tended to be concentrated in the central part of the State, generally in the Black Belt region. A relatively high rate of tenancy existed among these farmers, according to Auburn findings, but there also was wide variability across counties.

Size of black-operated farms was about half the State average, and with disproportionately less harvested acreage. Fewer black operators reported off-farm work than was true as an average for all farmers. This was partly because of advanced age of black operators, two-thirds of whom were 45 and older. Only 21 percent of black-operated farms had sales of \$2,500 or more. Black farmers incurred less debt than other Alabama farmers.

Farm Loans Profitable to Banks

Commercial banks, although traditional suppliers of agricultural credit, must justify farm loans in light of other investment opportunities. Such justification is evident in results of an Auburn case study of five Alabama banks. Farm loans were found to compare favorably with other types.

Installment loans were found to be the most costly, while mortgage loans were least costly. Loans for agricultural purposes were found to cost one-third as much as those in the installment category. It was found that a farm loan made at 8.0 percent interest would compare favorably in terms of profitability with a 7.67 percent mortgage loan, an 8.19 percent commercial loan, and a 9.01 percent installment loan.

HOME ECONOMICS RESEARCH

Getting All the Nutrition from Food

The body is not able to utilize all the food value present in the foods eaten. The degree of utilization may be affected by the nutritional status of the individual, the amount of food eaten, and the combination of food and drugs consumed at the same time.

A high priority nutritional problem is determining the digestibility and absorption (termed bioavailability) of foods. Learning how to accurately measure bioavailability is the subject of current research. One way to do this with animals is to "label" specific foods with radioactive tracers. One such Auburn study used rats to measure bioavailability of radioactive zinc (^{65}Zn) in proteins. Results indicated that cooking chicken meat and eggs increased the bioavailability.

Method of radioactive "labeling" affected results. Zinc incorporated in the eggs by feeding hens the radioactive isotope (called intrinsic labeling) was more available to the rats than when the ^{65}Zn was simply mixed with the eggs (extrinsic labeling). Thus, simple mixing of radioactive tracers with foods may not give accurate bioavailability data. When intrinsically labeled proteins were fed with a zinc-containing cereal, there was a decrease in bioavailability of zinc in the proteins.



Graduate student collects milk from rat for an Auburn study that is providing information about how type of fat in the diet affects the formation of prostaglandins in human milk. Prostaglandins are naturally occurring compounds that act like hormones in every system in the body, and their production requires certain fatty acids in the diet of nursing mothers.

Finish Affects Cotton Fabric Pyrolysis Products

Cotton fabrics, to which various types of finishes had been applied, were burned under controlled conditions. Analysis of gases given off during pyrolysis substantiated the theory that halogen containing flame retardant finishes act in the gas phase to retard combustion of the fabric. Wrinkle resistant finished fabrics gave some products that contained nitrogen, indicating that nitrogen present in the resin finish was carried into the gas phase and did not remain in the residual fabric char.

Vitamin C and Cigarette Smoking

How Vitamin C may offset effects of cigarette smoking on blood pressure was shown in an Auburn study of acute physiological responses to smoking. Human subjects given 400 milligrams of vitamin C (ascorbic acid) prior to smoking showed less rise in blood pressure than when given a placebo. Heart rates were not significantly different, however.

When dosage of vitamin C was increased to 1,200 milligrams, subjects exhibited greater rises in blood pressure and higher heart rates than did the placebo group.

Maternal Diet Affects Human Milk

Certain fatty acids in the diet are essential for the body to produce prostaglandins, naturally occurring compounds that act like hormones in every organ system in the body. Hydrogenating vegetable oils to produce margarine and solid vegetable cooking fats causes some of the fatty acids to be transformed into *trans*-fatty acids. These *trans*-fatty acids cannot be used by the body in forming prostaglandins.

To determine the effect of type of fatty acid eaten on prostaglandin content of human milk of nursing mothers, a method for separating the prostaglandins into subclasses was developed. This Auburn research identified two prostaglandins in both human and rat milk. Feeding diets high in *trans*-fatty acids to rats increased the *trans*-fatty acid content of milk but did not appear to affect the milk's prostaglandin content.

Substations and Experiment Fields



No Alabamian is more than a short drive away from the Alabama Agricultural Experiment Station. A network of substations, experiment fields, and other units—blanketing the State from the Tennessee line to the Gulf of Mexico—allows research on every major soil type and in every specialized farming region. Project leaders from the Main Station, at Auburn, are able to match their research to needs of particular areas of the State where specific agricultural problems exist, providing truly individualized solutions.

The 1980 list of cooperative projects between project leaders and substations and experiment fields emphasizes the extensive program of research at outlying units. A total of 533 individual projects is listed, covering all phases of row crop, livestock, fruit and vegetable, and ornamental production problems. Many of the projects are repeated at several substations and fields throughout the State, providing an overall picture of conditions with that enterprise. Others relate to specific problems at a single location.

A major value of the outlying units is their function in disseminating research results to farmers. Numerous fields day programs offer area farmers, agribusinessmen, and other professional agriculturists a first-hand look at research results. Visits on an individual basis also help farmers keep up with latest agricultural technology.

Location of substations and experiment fields throughout Alabama allows research with crops and livestock on each major soil type in the State. Comparisons of sunflower varieties at the Black Belt Substation (top) provide information about a potential crop for area farmers, and forestry research at the Lower Coastal Plain Substation (center) allows detailed study of this important agricultural enterprise. Systems for producing beef cattle are being studied at the Wiregrass Substation (bottom), as well as at several other State locations.

Support Departments

Research Data Analysis

Nearly 300 data sets were created and analyzed during 1980, many of which contributed to the improvement of publications by staff of the Agricultural Experiment Station. Many consultations with staff and graduate students about statistical design, analysis, and interpretations also were held.

Close support was provided to all project leaders involved with variety testing, and the handling of these data received high priority. Systems for expediting summary and analysis of variety test data were developed by personnel of Research Data Analysis and are being improved on a continuing basis.

Notable examples of support to research personnel are in the areas of forage and weed science. In these instances, computerized planting plans were provided to project leaders and time saving data systems were developed for quick and accurate editing and processing of the data.

Programming support to the Soil Testing Laboratory helped speed the flow of results back to users. Monthly and final summaries of data from the bull testing program were provided on a priority basis during the test period.

Records from all outlying units were received and processed for permanent storage in the Agricultural Experiment Station permanent record books. In addition to the permanent records, all data received for analysis by the department are stored on a permanent magnetic file.

Department of Research Operations

Although construction has been curtailed by restriction of funds, the highlight of 1980 was the April 2 dedication of a major facility, the Solon Dixon Forestry Education Center, near Andalusia. Some 300 Auburn friends were on hand to help dedicate this center that provides much needed facilities for forestry teaching, research, and extension.

Service work to existing research facilities and equipment required an increasing portion of the department's efforts in 1980.

Plans were developed and construction done by contract of 70 cattle isolation units, to be used by Department of Animal Health Research in studying how and when brucellosis organisms are transmitted from dam to offspring.

Modifications at the dairy unit included construction of a new shed adjoining the dairy, moving of working facilities, and add-

ing 24 individual calf stalls. All calf pens were enclosed to reduce draft and exposure, heat lamps were installed, and perforated rubber mats added over the metal floors. These changes significantly improved calf performance and reduced death losses.

A new lagoon was built to handle waste at the swine breeding unit, and buildings were modified to provide winter protection.

Production and storage of feed and maintenance of pasture for beef and dairy cattle were major services provided in 1980. The extended drought reduced yields of all feed crops at the E. V. Smith Research Center and this necessitated transporting stored feed from other sites. An irrigation system capable of handling 100 acres prevented total failure of corn for silage at the Center.

A herd of grade beef cattle was donated to the Agricultural Experiment Station by Dr. and Mrs. Solon Dixon. This herd, located at the Dixon Farms, Andalusia, will be handled to provide economic data for commercial cattle enterprises. Pastures are being developed and fences and working facilities constructed.



Data from crop variety tests, like the one being planted (below), get speedy handling and analysis from the Department of Research Data Analysis. Such expediting is necessary for prompt reporting to farmers. Seventy cattle isolation units (above) were constructed for use in a study of how and when brucellosis organisms are transmitted from dam to offspring.





Research results are useless unless delivered to those who can use them, so major efforts of the Agricultural Experiment Station go into disseminating findings. Field days and tours (above), which offer a first-hand look at research underway, continue to be popular among farmers, agribusiness representatives, and other professional agriculturists. Down-to-earth reports given at the field days provide good opportunities for reporting in the mass media, which is an important vehicle used in delivering research results to potential users.

TELLING OUR STORY

The philosophy that research is not completed until the results are reported to those who need them is an accepted principle of the Alabama Agricultural Experiment Station. Therefore, much attention is given to telling Auburn's research story to its many publics. All faculty and staff have a responsibility in reporting research, but the Department of Research Information has major responsibility in this critical task.

Agricultural Experiment Station publications continue to be used in telling the complete story of research projects to a select audience of farmers and professional agricultural workers, while practical and human interest aspects of research are reported in the mass media. Researchers regularly use

scientific journals to keep other scientists informed of their work. Exhibits are used to interest urban dwellers in work of the Agricultural Experiment Station.

Experiment Station Publications

Station publications produced during 1980 totaled 30, with 100,000 copies printed. These were distributed to farmers, government leaders, and selected groups in other states and foreign countries. In addition, four brochures were printed to inform the public about certain aspects of the Auburn research program. Faculty members prepared 279 technical articles for professional journals during the year.

The Mass Media

A summary of work with the mass media shows that 744 news releases and picture stories were provided newspapers, magazines, radio and television stations, and specialty publications during 1980. Feature articles and research columns in farm magazines took practical research from laboratory to farm.

Exhibits

Educational exhibits portraying agricultural research were displayed at seven strategic locations throughout Alabama. These consumer-oriented exhibits were viewed by thousands at fairs, commodity conferences, shopping centers, and other special events.

Faculty Honors and Recognitions

Numerous honors came to faculty and staff during 1980 in recognition of outstanding accomplishments and service to agriculture in general and to specific scientific disciplines. Those listed are the more significant state, national, and international recognitions, including honors and awards, election to offices in scientific and professional organizations, and invitations to present papers before professional groups.

Honors and Awards

Carl S. Hoveland—named 1980 Man of the Year in Service to Alabama agriculture by the *Progressive Farmer*; was Goddard Lecturer at University of Tennessee; elected vice president, American Forage and Grassland Council.

Gale A. Buchanan—recipient of the 1980 Southern Weed Science Society's Distinguished Service Award.

Ben F. Hajek—coached Auburn University soil judging team to its third consecutive national championship; named chairman-elect of Division 81, Soil Science Society of America.

George Hawkins—received 1980 Honor Award from the American Dairy Science Association.

Richard T. Lovell—received 1980 Distinguished Service Award from Catfish Farmers of America; served as chairman of Research Committee, Catfish Farmers of America, and regional project on "Freshwater Food Animals."

Paul K. Turnquist—had biographical sketches in 1980 edition of Men of Achievement and 1980 Who's Who in South and Southwest; elected vice chairman, Power and Machinery Section, American Society of Agricultural Engineers.

Harry G. Ponder—received special plaque and medal for dedicated service from Atlanta Nurserymen's Association.

Lowell E. Wilson—honored by resolution from Associated Milk Producers, Inc., for work in assembling data on the proposed market for the Federal Order Hearing.

Harold Walker—coached Auburn's first weed science judging team to regional championship.

V.L. Brown—named Man of the Year by Alabama Crop Improvement Association.

G. J. Cottier—elected a Fellow by the Poultry Science Association.

E. S. Renoll—listed in Who's Who in *Technology Today*.

Elections, Invited Papers, Other

David Topel—member of a three-man "trouble shooting" team sent to Japan to investigate problems leading to banning of U.S. pork imports by Japan.

Donald E. Davis—elected president-elect of the Weed Science Society of America.

R. D. Schultz—served as Distinguished Visiting Professor at the Ontario Veterinary College, University of Guelph, Canada; was first president of the American Association of Veterinary Immunology.

Clyde E. Evans—assisted University of Mexico, at its request, to develop a national program in soil testing.

Gary Mullen—spent 10 days studying ectoparasite problems of livestock and poultry in Ecuador and conferring about health problems of the nation, at the invitation of University of Guayaquil.

W. D. Davies—elected Southeast Representative, Educators Section, American Fisheries Society; appointed associate editor, American Fisheries Society.

W. A. Rogers—appointed to Board of Professional Certification of Fish Health Section and Professional Certification Committee, American Fisheries Society; elected to nominating committee of American Fisheries Society; recognized for contribution as editor, Proceedings of Southeastern Association of Fish and Wildlife Agencies.

David A. Roland—presented invitational papers on egg shell quality to convention of the South Pacific Poultry Science Association, in Auckland, New Zealand, and in five Southeast Asian nations.

Paul A. Lemke—served as national president of the Society for Industrial Microbiology; appointed to governing board of American Institute of Biological Sciences.

Claude Moore—elected president of Poultry Science Association.

Dale L. Huffman—elected president-elect of American Meat Science Association.

J. E. Dunkelberger—served as president of Alabama-Mississippi Sociological Society.

C. D. Busch—elected chairman of regional project concerned with trickle irrigation.

Ray Dickens—gave invited paper on roadside weed control research to Landscape and Environmental Division, U. S. Department of Transportation Research Board.

Kenneth Ottis—served as vice president, Alabama Academy of Science.

Bessie Fick—served as president of Southeastern Hospital Conference for Dietitians and Alabama Nutrition Council; on advi-

sory council, Department of Nutritional Sciences, University of Alabama (Birmingham) Medical Center.

Mike Lisano—served on Southern Association Accrediting Board for University of Georgia.

J. L. Adrian—elected chairman of Southern Regional Research Committee on Fruit and Vegetable Production-marketing Subsector.

B. Lewis Slaten—served as chairman of Fabric Test Methods Sub-committee of Committee D-13 (Textiles), American Society for Testing and Materials.

Urban L. Diener and Norman D. Davis—received special recognition at Montgomery conference dealing with problems of aflatoxin in milled corn.

C. E. Johnson—served as chairman of technical coordinating committee of Power and Machinery Division, American Society of Agricultural Engineers.

Julian Dusi—was president of Chattahoochee Valley Natural History Club.

J. L. Stallings—appointed director of Washington, D. C., office of South-East Consortium for International Development as member of Southern Africa Program Development Committee.

Bryan Truelove—invited by USDA to serve as panelist on comprehensive review team for federally-sponsored research in plant physiology and weed science at Clemson University.

Mike Williams, Gary Mullen, and James Harper—visiting professors at University of Guayaquil, in Ecuador.

Ralph Mirarchi—named chairman of Endangered Species and Non-game Committee, Alabama Chapter of the Wildlife Society.

C. R. Rossi—named to editorial board, American Journal of Veterinary Research.

Robert T. Gudauskas—appointed senior editor of Plant Disease, new international journal of applied plant pathology.

Neil R. Martin—served as second vice president, Southern Agricultural Economics Association.

W. T. Dumas—elected chairman of Regional Research Project S-134, "Engineering Systems and Energy Needs for Cotton Production."

Kenneth C. Sanderson—named chairman of the Growth Regulation Section of the Southern Nurserymen's Association Research Workers Conference; appointed associate editor of Journal of the American Society for Horticultural Science and HortScience.

C. A. Flood—named to board of directors of Council for Agricultural Science and Technology, representing American Society of Agricultural Engineers; elected chairman of Monographs Committee of ASAE.

S. D. Beckett—elected president of Animal Disease Research Workers in the Southern States.

Ruth Galbraith—served as chairman of Research Section, American Home Economics Association; chairman of Policy Board for *Home Economics Research Journal*; member of the Executive Board and Executive Committee of AHEA; awarded honorary membership in committee for D-13 (Textiles) of the American Society for Testing and Materials.

John Pritchett—named executive secretary of Alabama Academy of Science.

W. E. Hardy—served as vice president for membership of Southeast American Institute of Decision Science.

J. S. Ramsey—appointed representative for Southern Division to the Exotic Fishes Section, American Fisheries Society, and member of Technical Advisory Committee, Southeastern Fisheries Council.

Donald Y. Perkins—chosen president-elect of Southeast Region, American Society for Horticultural Science.

Jacob Dane—elected vice chairman of Southern Regional Project and Work Group on Soil Water Research.

G. W. Benz—continuing as a member of editorial board of Veterinary Parasitology, of Amsterdam, The Netherlands.

J. J. Giambone—elected first officer, Southeast Avian Research Workers Association.

Ian Hardin—served as chairman of textile research symposium at regional meeting of American Chemical Society.

Mike Williams—elected chairman of teaching section, Entomological Society of America.

E. W. Rochester—served as secretary for state section of American Society of Agricultural Engineers and American Society of Professional Engineers.

Willard T. Blevins—served as regional president of American Society for Microbiology and hosted Auburn meeting of the Society.

Wallace Griffey—elected secretary-treasurer of Experiment Station Superintendents Section, Southern Association of Agricultural Scientists.

Projects Underway in 1980

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

Crops, Livestock, Poultry, and Farm Management

Alternative Business Organizations Used by Alabama Farmers

Development of Models for Evaluation of Credit Worthiness of Agricultural Borrowers

Economic Aspects of Commercial Turfgrass-sod Production in Alabama

Freshwater Food Animals

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

Marketing and Prices

Alternative Structures for Increasing Efficiency of Inter- and Intra-regional Grain Marketing Systems

An Economic Analysis of Alternative Marketing Strategies for Cotton Producers

Culture Systems for Year-round Marketing of Fish from Freshwater Ponds

Development, Production, and Marketing of Christmas Trees

Marketing Performance of Selected Milk Pricing Systems for the Southern Region

Organization and Efficiency of the Fruit and Vegetable Production-marketing Subsector in the South

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

Resource Use and Planning

An Economical Analysis of Variations in Rural Land Value

Changing Structure of Agriculture: Causes, Consequences, and Policy Implications

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

Efficient Vehicle Routing and Scheduling for Agribusiness Firms and Public Services

Financial Management and Farm Growth

Law for the Alabama Farmer

Rural Development

Defining and Achieving Life Goals: A Process of Human Resource Development

Public Services and Economic Development in Rural Communities

AGRICULTURAL ENGINEERING

Crop Production - Farm Machinery

Determining Farm Machinery Reliability for Southeast Field Conditions

Engineering Systems and Energy Needs for Cotton Production

Soil Surface and Profile Modification for Improving Soil-water Relationships

Fish Production

Freshwater Food Animals

Irrigation

Application Efficiency and Energy Usage of Irrigators on Irregularly Shaped Fields

Trickle Irrigation in Humid Regions

Nut Culture

Factors Influencing Vegetative and Reproductive Development of Young Pecan Trees

Poultry Production

Optimize Efficiency of Energy Utilization in Agricultural Housing Systems

Reproduction Performance of Artificially Inseminated Broiler Breeders Maintained in Cages

Utilization of Solar Energy in Poultry Production

Environmental Influences on Poultry

Waste Control

Animal Waste Utilization and Treatment Systems

Process for Making Animal Feed from Waste from Cattle in Production Units

Development of An Integrated System for Total Utilization of Swine Waste

AGRONOMY AND SOILS

Beef Production

Beef Production on Selected Forage Systems

Developing Pasture, Hay, and Silage Management Systems for Cattle

Cotton Production

Controlling Weeds in No-till Cotton

Evaluation of Cotton Varieties and Strains

Fertility Requirements of Cotton

Petiole Nitrates in Cotton

Rotation of Cotton with Alfalfa and Corn

Dairy Production

Energy and Protein Levels in Silage Concentrate Blended Rations for Dairy Cows

Evaluation of Phalaris and Phalaris-ladino Clover Pastures for Dairy Cattle

Forage Crops

Chemical Profile and Nutritive Value of Forage Genotypes and New Forage Varieties

Establishment, Management, and Utilization of Improved Forage Species and Cultivars

Forage Legume Viruses

Plant Germplasm—Its Introduction, Maintenance, and Evaluation

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

Toxicity of Tall Fescue

Grain Crops

Grain Crops Cultivars and Experimental Strains Testing

Grain Sorghum Production

No-till Corn Production

Plant Breeding

Breeding and Evaluation of Low-tannin Sericea and of Interspecific Vetch Germplasm

Breeding Phalaris and Tall Fescue for Improved Winter Forage Production

Breeding White Clover for Persistence and Yield

Selecting Advanced Lines of Soybean

Soil Chemistry, Microbiology, and Fertility

Availability of Residual and Fertilizer Phosphorus

Diagnosis and Correction of Manganese and Molybdenum Problems in Legumes

Distribution and Significance of Mineral Components in Alabama Soils

Effects of Soil Acidity and Calcium on Soil Solutions and Yield of Crops

Fertilizer Budgets in No-till Crop Production

Fertilizer Requirements of Peanuts

Nitrogen Requirements of Agronomic Crops

Potassium Requirements of Sweet Sorghum

Soil Fertility and Fertilizer Requirements
Soil Testing and Plant Analysis
The Nature of Soil Acidity and Its Effect on
Agronomic Crops in Alabama

Soil Physics

Movement and Retention of Water and Solutes in
Selected Southern Region Field Soils
Water Movement in Selected Alabama Soils
Water Transport Phenomena in the Soil-plant
System

Soybean Production

Cultural and Environmental Factors Influencing
Soybean Yields in Alabama
Enhancing Biological Dinitrogen Fixation in
Soybeans and Other Legumes
Herbicide Tillage Interactions on Soybean and on
Soil in Monoculture System
Soybean Variety and Experimental Strain Evalu-
ation Program for Alabama

Sweet Sorghum

Determining Nutritional Needs of Sweet Sor-
ghum
Enhancing Sugar Production with Growth Regu-
lators
Evaluation of Sweet Sorghum Varieties for Sugar
Production

Turfgrass

Production and Management of Turfgrass
Selecting a Better Centipedegrass

Weed Science

Biology and Control of Weeds
Competitiveness and Control of Weeds in Soy-
beans
Cultural and Environmental Effects on Herbicide
Persistence
National Agricultural Pesticide Impact Assess-
ment Program
Turf Weed Control

ANIMAL AND DAIRY SCIENCES

Biochemistry

Metabolic Role of Uric Acid Riboside and Nu-
cleotides in Cattle Red Blood Cells
Kinetics of Bacterial Thymidylate Synthetase and
Its Inhibition by Substrate Analogs
Oxidation and Conjugation of Carcinogenic Hy-
drocarbons in Marine Animals
Relationship of Diet to Cholesterol Concentra-
tions, Pool Size, and Turnover in Tissues of Rats

Breeding

Evaluation of Crossbred Beef Cattle Under Dif-
ferent Growing and Finishing Regimes
Genetic Improvement of Efficiency in the Produc-
tion of Quality Pork
Parameters Associated with Growth Rate Curves
in Beef Cattle
Performance Testing of Prospective Sires as an
Aid to Selection
Selection at Two Weights and Its Effects on Effi-
ciency of Swine Production
The Effects of Breed and Breed Crosses on Milk
Production and Other Production Factors in a
Grade Beef Herd

Dairy Production

Buffered Diets for Dairy Cattle Confined on Con-
crete
Evaluation of Phalaris and Phalaris-ladino Clo-
ver Pastures for Dairy Cattle
Relation of Feet and Leg Conformation to Lame-
ness Diseases of Dairy Cows Confined to Con-
crete Floors
Relationship Between Bacterial Quality of Raw
Milk and Subsequent Pasteurized Milk
Whole Gin-run Cottonseed in Lactating Rations

Meat Science

Marketability of Beef Produced Under Forage-
grain Management Systems

Physiology

Effects of Environmental Stress and Endocrine
Function on Growth and Reproduction in Swine
Selected Reproductive Phenomena in Cattle and
Swine

Ruminant Nutrition

Beef Production on Selected Forage Systems
Effect of Feeding Systems and Animal Size on Ef-
ficiency of Beef Production
Evaluation of Pastures for Yearling Beef Steers
Gluconeogenesis and Amino Acid Metabolism in
Ruminants
Growing-finishing Systems for Beef Steers in
North Alabama
Growing-finishing Systems for Steers in the
Coastal Plains Area
Increasing Protein and Energy Utilization by Beef
Cattle
Systems for Growing-finishing Stocker Cattle in
the Gulf Coast Area

Swine Nutrition

Nutrition and Physiology of Gestating and Neo-
natal Swine
Nutritional Systems for Swine to Increase Repro-
ductive Efficiency

Waste Management

Animal Health and Food Safety Aspects of Feed-
ing Animal Waste
Development of an Integrated System for Total
Utilization of Swine Waste
Evaluation of a Lagoon Waste Management and
Recycling System for Confined Dairy Cattle
Liquid Fuel and Chemical Production from Cel-
lulosic Biomass

ANIMAL HEALTH RESEARCH

Cattle

Bovine Respiratory Viruses: Mechanisms Which
Affect Virus Replication and Respiratory Tract
Disease
Effect of Chlamydial-induced Infectious Orchitis,
Periorchitis, and Epididymitis on Sperm Matur-
ation
Immunopotential of Brucella Abortus Strain
19 Vaccine
Infectious Bovine Rhinotracheitis Virus, Latency
and Respiratory Disease
Neurology of the Reproductive System of the Bull
Pathogenesis and Immune Mechanisms to Blue-
tongue Virus Infections in Food Producing
Animals
Pathogenesis and Therapy of Intestinal Parasites
in Calves
Persistence of Natural Infection in Calves Born to
and Nursing Brucellosis-infected Dams
Prevalence, Transmission, and Immune Response
Associated with Bovine Leukosis Virus Infection
Relation of Feet and Leg Conformation to Lame-
ness Diseases of Dairy Cows Confined on Con-
crete Floors
Reproductive Diseases of Cattle
Transmission of Brucellosis from Cattle to Non-
ruminant Wildlife Mammals

Poultry

Interaction of Physical Conditioning with Repro-
ductive and Cardiovascular Parameters in Tur-
keys

Swine

A Study of Aflatoxin on Immune System of Tur-
key, Chicken, and Swine
Identification of Swine Dysentery Carrier Pigs
and the Morphology of the Colonic Lesions
Selected Factors Affecting the Immune Response
of Newborn Pigs

BOTANY, PLANT PATHOLOGY, AND MICROBIOLOGY

Biological Control

Biological Control of Selected Arthropod Pests

Diseases

Activities of Nematicides and Fungicides on Non-
target Soil Nematodes and Fungi
Biochemistry and Physiology of *Cronartium fusi-
forme* on Southern Pines
Disease Control Systems for Peanuts and Soy-
beans
Ecology and Control of Soil-borne Fungal Patho-
gens of Forest Tree Seedlings
Ecology and Management of Fusiform Rust on
Southern Pines
Effects of Seed Treatment Fungicides on the
Rhizobium Host Infection Process in LDC Leg-
umes
Epiphytology and Control of Apple and Peach
Diseases
Epidemiology and Control of Pecan Scab

Forage Legume Viruses

New or Unusual Plant Diseases in Alabama
Plant Diseases in Relation to Forage Crop Breed-
ing
Rhizosphere Ecology as Related to Plant Health
and Vigor
Soil-borne Pathogens of Peanuts, Their Com-
plexes and Control
Viral Diseases of Selected Grass: Identity, Con-
trol, and Role of Predisposition
Viruses and Mycoplasma-like Organism (MPLO)
Causing Diseases of Corn and Sorghum

Fungi and Mycotoxins

A Study of Toxicity of Aflatoxin BI on Immune
System of Turkey, Chicken, and Swine
Chemistry and Physiology of Mycotoxins
Mycotoxicology of Foods and Feeds
Mycotoxins of Corn and Other Feed Grain

Herbicides

Effect of Chloracetamide Herbicides on Plant
Membrane Integrity and Disease Susceptibility
Effects of Herbicides on Submerged Seed Plants
Minimum Tillage and Double Cropping on Weed
Populations and Persistence and Fate of Herbi-
cides

Miscellaneous

Auburn University Arboretum
Auburn University Herbarium
Auburn University Mycological Herbarium and
Culture Collection

Morphology, Physiology,

Taxonomy, and Ecology

Changes in Lipid Metabolism and Competition of
Water-stressed and Phytohormone Treated
Plants
Floc Formation and Bulking in Activated Sludge
Process for Treatment of Textile Wastewaters
Isolation and Identification of Odorous Metabo-
lites of Aquatic Actinomycetes
Systematic and Ecological Studies of Fungi in
Alabama
Taxonomy of Poisonous Vascular Plants of Ala-
bama
Water Conservation in Cotton by Drought In-
duced Leaf Surface Wax Synthesis
Water Transport Phenomena in the Soil-plant
System

Peanuts and Soybeans

Flower and Pod Abscission in Soybean (*Glycine
max* (L.) Merr.)
Fungal Spore Germination Inhibitors and Stimu-
lators Associated with Surface Waxes of Pea-
nuts

Implementation of AMI Method for Determining Peanut Harvest Dates in Alabama
Systems for Disease Management in Peanuts and Soybeans

HOME ECONOMICS RESEARCH

Housing

Housing for Low and Moderate Income Families

Nutrition

Dietary Fat and Prostaglandin Content of Human Milk

Effect of Maternal Dietary Lipid on Prostaglandin Content of Human Milk

Metabolic and Histological Changes in Obese Adult Female Rats Fed Liquid Reducing Diets

Nutritional Health of Adolescent Females

Protein Utilization and Metabolism in Nutrition

The Essential Fatty Acid Deficient Chicken: A Model for the Study of Cystic Fibrosis

Vitamin C and Acute Physiological Responses to Cigarette Smoking

Textile Safety

Selected Factors Affecting the Consumer Use Performance of Flame Retardant Fabrics

Textile Utilization

Chemistry of Photo-degradation of Cotton Tenette Fabrics

Consumer Expectations, Consumer Satisfaction, and Performance of Upholstery Fabrics

HORTICULTURE

Breeding

Breeding Improved Tomato and Pepper Varieties for the South

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

Genetics and Breeding for Pest Resistance in Muskmelons and Watermelons

Genetics and Breeding of Plums

Southernpea Breeding and Nature of Resistance to Cowpea Curculio

Management

Chemical Modification of Plant Growth Habit for Potted Plant Production

Development and Evaluation of Rootstocks for Peach

Factors Influencing Vegetative and Reproductive Development of Young Pecan Trees

Nutritional, Cultural, and Varietal Improvements in Apples

Regulation of Pistillate Flower Developments in Pecan

Trickle Irrigation in Humid Regions

Ornamentals and Landscape Conservation

Economics of Producing and Marketing Woody Ornamentals in the South

Identification and Control of Diseases on Ornamental Plants

Improving Production Efficiency of Woody Ornamentals

Nitrogen Requirements for Containerized Nursery Plants in Bark Growth Mixes

Soil Fertility

Soil Test Calibration and Fertility Requirements for Selected Vegetable crops

Utilization

New Foods from the Southernpea
Quality Attributes of Selected Cultivars of Fruits and Vegetables

Varieties

Vegetable Variety Trails for Alabama

FISHERIES AND ALLIED AQUACULTURES

Aquaculture

Aquaculture

Culture Systems for Year-round Marketing of Fish From Watershed Ponds

Freshwater Food Animals I

Freshwater Food Animals II

Freshwater Food Animals IV

Integration of a Solar Greenhouse with a Recirculating Fish Culture System

The Culture of Fish, Shellfish, and Aquatic Plants in a Closed System

Aquatic Ecology

Stream and Impoundment Ecology

Fish Health

Cooperative Fish Parasite and Disease Study

Freshwater Food Animals III

Freshwater Food Animals V

Sportfish Management

Management of Aquatic Plants for Sportfish Production in Ponds

Pond Fertilization and Liming

FORESTRY

Forest Biology

Breeding Strategies for Genetic Improvement of Commercial Forest Trees in the South

Development, Production, and Marketing of Christmas Trees

Effectiveness of Site Preparation for Loblolly Pine Regeneration in the Hilly Coastal Plain in Alabama

Genetics and Breeding of Selected Southern Forest Tree Species

Growth and Nutrient Requirements of Selected Hardwoods

Leaf Reflectance and Biological Processes of Trees as Affected by Environmental Conditions

Natural Regeneration of Desirable Bottomland Hardwoods

Reclamation of Drastically Disturbed Soils

Forest Management and Economics

Production and Supply Relationships Involving Non-timber Forest Outputs

The Forest Economy of Alabama: Its Structure and Development

Forest Measurements

Evaluation of Site Potential for Yellow-poplar in the Hilly Coastal Plain

Total Tree Volume and Weight Equations for Selected Tree Species in Alabama

Forest Engineering and Timber Harvesting

Improved Methods for Thinning Southern Forests

The Construction, Verification, and Validation of a Southern Forest Timber Harvesting Computer Simulation Model

Forest Products

Chemicals and Energy from Bark Resources
Design, Development, and Reliability of Wood-based Composite Beams

Evaluation of Floor, Wall, and Ceiling Systems in Housing for Maximum Energy Conservation

Evaluation of Structural Properties of Southern Yellow Pine Plywood

Flakeboard and Composite Wood Panels from Small Dimension Southern Yellow Pine and Low Grade Hardwoods

POULTRY SCIENCE

Breeding

Bi-directional Selection for Long and Short Fertility Duration in Broiler Breeder Females

Reproductive Performance of Broiler Breeders Influenced by Management

Disease Control

Avian Coccidiosis: Immunological Resistance

Against Clinical Infection
A Study of Toxicity of Aflatoxin BI on Immune System of Turkey, Chicken, and Swine

Coccidia and Coccidiosis of Poultry
Coccidiosis Study

Developments of Adjuvants for Immunopotentialization of Inactivated Microbial Antigens for Poultry

Diagnostic Service—Poultry
Differentiation Between Skin Leukosis (Marek's) and Skin Abnormalities from Other Causes

Genetic Bases for Resistance to Avian Diseases
Immunization for the Control of Coccidiosis of Poultry

Infection and Immunity in Poultry
Interactions of Physical Conditioning with Reproductive and Cardiovascular Parameters in Turkeys

Interactions of Physical Conditioning with Reproductive and Cardiovascular Parameters in Turkeys

Interactions of Physical Conditioning with Reproductive and Cardiovascular Parameters in Turkeys

Environment

Eggshell Quality of Domestic Fowl
Environmental Influences on Poultry

Heating of Poultry Houses with Multiple Forms of Solar Energy

Optimize Efficiency of Energy Utilization in Agricultural Housing Systems

ZOOLOGY-ENTOMOLOGY

Ecology

Ecological Impacts of Wading Birds on Aquatic Environment

Natural History of the Alabama Red-bellied Turtle

Miscellaneous

Auburn University Entomological Museum
Endocrine and Muscle Relationships in Swine and Cattle

Herpetology Museum
Reproductive Physiology of Farm Animals

Structure and Function of Chemical Messengers

Pest Control

Action of Anti-hormones on Reproductive Potential of Striped Ground Cricket

An Integrated System for the Suppression of Boll Weevil

Biological Control of Selected Arthropod Pests
Biology and Control of Arthropod Pests

Biology and Control of Arthropod Pests of Pecans

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

Biology and Control of Insect Pests of Peanuts
Biology, Ecology, and Control of Forest and Shade Tree Insects

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

Bionomics and Control of the Face Fly and Other Diptera

Bionomics and Control of the Pecan Weevil
Biosystematics of Scale Insects of Alabama

Control Tactics and Management Systems for Arthropod Pests of Soybeans

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

Integrated Management of Key Arthropod Pests of Cotton

Southern Pine Beetle
Vegetable Insects Research

Wildlife Management

Ecological Studies of Wild Turkeys
Factors Affecting Natality and Mortality of Alabama Mourning Doves

Furbearer and Mammalian Predator Studies

Expenditure of Appropriated Funds

BEEF CATTLE.....	14.7
COTTON.....	3.6
DAIRY CATTLE.....	4.5
FEED GRAINS.....	3.4
FISH & WILDLIFE.....	6.1
FORESTRY.....	9.9
FRUITS, NUTS, & VEGETABLES.....	10.5
HUMAN & RESOURCE DEVELOPMENT.....	3.9
ORNAMENTALS & TURF.....	2.5
PASTURE & FORAGE.....	6.4
PEANUTS.....	2.2
POULTRY.....	9.9
RECREATION.....	0.1
SOILS, LAND, & WATER.....	4.6
SOYBEANS.....	6.0
SWINE.....	8.6
OTHER.....	<u>3.1</u>
	100.0%

Appropriated Funds

FEDERAL.....	\$3,025,839
STATE.....	6,812,134

Other Funds

GRANTS.....	\$ 3,030,173	TOTAL FUNDS
SALES.....	3,329,529	<u>\$16,197,675</u>

FINANCIAL REPORT
\$
\$
\$



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