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Volume 38, No. 4

Winter 1991

Alabama Agricultural Experiment Station

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Auburn University

Auburn University, Alabama



HIGHLIGHTS

OF AGRICULTURAL RESEARCH

A FINAL WORD WITH THE EDITOR

MAY WE SALUTE...

AFTER MORE THAN 36 years as a part of the Alabama Agricultural Experiment Station (AAES) at Auburn, my feelings at retirement are clearly expressed by Bob Hope's familiar refrain, "Thanks for the memories."

These memories take many forms. Some are very serious remembrances of major scientific breakthroughs by AAES researchers, many times working with limited resources that would have discouraged all but the most dedicated. At the same time, I also have happy memories of years when the Alabama Legislature and other funding agencies provided major increases in support that allowed researchers and administrators to expand their horizons and reach for the stars. But the thing I noted early on was that the truly dedicated researchers found a way to serve agriculture through good times and bad. This trait exemplifies Auburn agriculture to me, and it has been my pleasure to be a part of such a program of work since 1955.

One of my greatest personal satisfactions has been my work in editing and producing this magazine, *Highlights of Agricultural Research*. Volume 2, Number 2 was published before I came on the job, but I have had a hand in every issue since that time, up to the current Volume 38, No. 4. From its very beginning, *Highlights* has had a constant and well defined mission: to inform members of Alabama's agricultural industry of new research findings that can be of value to the industry. Similar publications around the United States have shifted back and forth in their approach as administrators and communicators have felt the need for public relations or for promotion of various causes. *Highlights* has never wavered, and for that I am proud. Changes have been made as we attempted to do a better job of presenting the research story, but the aim has been constant.

The personal associations I have enjoyed represent another area of happy memories. Working with Auburn's agricultural faculty and staff has been a source of satisfaction and pride. But equally satisfying have been my opportunities to interact with farmers and agricultural support groups around the State. You, the readers of *Highlights*, have helped keep me focused on what is important, and this has helped me do my job better. Your response to Experiment Station bulletins and other research reports published through the years has convinced me of the value of the AAES information program, and this has made my work especially rewarding.

For obvious reasons, I have avoided mentioning names. But for all of you who made these 36+ years so meaningful and pleasant, I offer my sincere thanks.

Thanks for the memories.



R. E. STEVENSON

R.E. (Gene) Stevenson, who has worked on *Highlights* for the past 36 years, including the past 9 years as Editor. With publication of this issue, Gene will retire, leaving a legacy of excellence that will challenge current and future generations of writers and editors, who work on *Highlights of Agricultural Research*.

For over 36 years Gene has made a craft of making the complex scientific technology of modern agriculture more understandable and interesting through his reporting in newspapers, popular agricultural magazines, and *Highlights*. Gene is one of only a few true agricultural communicators left in Alabama, and he remains one of the strongest promoters of the State's agricultural and forest interests.

We will not say goodbye to Gene because that is too final. Rather, until we meet again, take care and best wishes in retirement to a truly fine Southern gentleman.

Lowell T. Frobish, Director
Alabama Agricultural Experiment Station



ON THE COVER. Nest boxes increase gray squirrel populations in mixed pine-hardwood forests. (See story on page 5.)

Winter 1991 Vol. 38, No. 4

A quarterly report of research published by the Alabama Agricultural Experiment Station, Auburn University.

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LESSER CORNSTALK BORER AND AFLATOXINS DOUBLE TROUBLE FOR PEANUT GROWERS

LESSER cornstalk borers and aflatoxins appear to have more in common than hot weather, according to recent Alabama Agricultural Experiment Station research. In tests at the Wiregrass Substation, there was a close relationship between damage by lesser cornstalk borers and visible *Aspergillus flavus*, the aflatoxin-producing fungi (94% correlation). However, the use of insecticides reduced this relationship.

Aflatoxin-producing fungi are predominant in the light soils in which peanuts are grown, and occur most frequently when hot dry conditions prevail. High temperatures favor growth of these fungi, limit growth of competing organisms, and stress peanut plants, thereby making infection more likely. Infestation of seed by aflatoxin-producing fungi also is greater in peanuts that are damaged in any way.

Hot and dry conditions also favor population outbreaks of the lesser cornstalk borer. Larvae of this insect feed on peanut root hypocotyls, developing pegs, and pods, and can be a devastating pest of peanuts. In feeding on the developing pods, lesser cornstalk borers cause damage to pods and seeds. Thus, larval feeding may provide a means of entry for *A. flavus* into the peanut seed.

In a 1990 study, plant and insect samples were collected from unirrigated plots used in insecticide trials on peanuts. All plots were conventionally tilled and planted with Florunner peanuts. Trials included a comparative insecticide study and a study on the date of application of the insecticide Lorsban. Peanuts were planted May 7. On July 5, at early bloom, plots were treated with Lorsban at 2 lb. active ingredient (a.i.) per acre, Mocap at 3 lb., Dyfonate at 2 lb., Fortress¹ 10G at 0.5 lb., and Counter¹ at 2 lb. Untreated control plots were left for comparison.

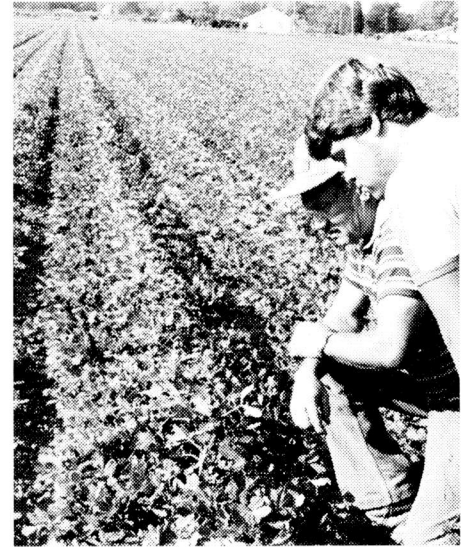
A second trial was planted on May 23 and consisted of four treatments: an untreated control and Lorsban at 2 lb. a.i. applied either 30, 45, or 71 days after planting.

¹Not labeled for use on peanuts.

Initially, larvae were collected from these field trials to determine if the lesser cornstalk borer carried aflatoxin-producing fungi. These larvae were collected by uprooting plants and taking larvae back to the laboratory. In addition, relative abundance of lesser cornstalk borers was determined with pitfall traps on a weekly basis during the growing season. Incidence of aflatoxigenic fungi was determined on several dates in August and September by randomly selecting and pulling five whole plants from which 10 pegs and 10 pods were removed. These pegs and pods, once removed from plants, were surface sterilized and incubated for 3 days, after which aflatoxigenic fungi were visually identified by conidial color and morphology.

After harvest, peanut pods were collected from experimental plots and rated on the occurrence of damage by lesser cornstalk borer, scarification and other hull or pod damage, and presence of visible aflatoxigenic fungi. Samples of harvested peanuts were graded and incubated to determine if aflatoxigenic fungi colonized peanut tissue.

Field-collected larvae did carry spores of aflatoxin-producing fungi on their cuticles or 'skin', as well as internally. Additionally, as lesser cornstalk borer populations increased in the latter part of the season, incidence of *A. flavus* on developing pegs and pods increased. In fact, in peanuts that had not been treated with any insecticide, where there was



damage by the lesser cornstalk borer, there was almost always aflatoxigenic fungi present. This relationship changed somewhat when insecticides were applied, generally decreasing the apparent interaction between these two organisms.

Peanuts treated with a single application of Lorsban at 30, 45, or 71 days after planting had consistently less damage by lesser cornstalk borer, less visible *A. flavus*, lower levels of aflatoxins, and greater yields, see table. Plants treated 45 days after planting (at flowering) had better grades and yields than those in the other treatments.

Since it is currently not possible to treat a peanut field with a fungicide for *A. flavus*, it is important to understand the relationship between contamination with this fungus

and damage due to lesser cornstalk borer. Such information may provide growers the option of treating for an infestation of lesser cornstalk borer, thereby decreasing the risk of aflatoxin contamination in peanuts.

Bowen is Assistant Professor of Plant Pathology; Mack is Associate Professor of Entomology.

INCIDENCE OF POD DAMAGE AND FUNGAL OCCURRENCE, YIELD, AND TOTAL AFLATOXIN CONTENT IN PEANUTS FROM LORSBAN TIMING TRIAL, 1990

Treatment	Visible LCB damage ¹	Scarification	Observed	Yield/	Aflatoxin
			<i>A. flavus</i>	acre	level
			Pct.	Lb.	p.p.b. ²
Untreated	2.25	43.5	11.0	709	114
30 days after planting	1.75	35.5	6.2	1,243	5
45 days after planting	1.75	22.5	3.6	1,454	16
71 days after planting	1.75	37.1	4.9	1,063	31

¹Determined by presence of a silken tube or larvae in the pod.

²Aflatoxin content determined by HPLC. Authors' note: Aflatoxin levels are known to vary dramatically.

ENTERIC SEPTICEMIA OF CATFISH IMPORTANT PROBLEM FOR PRODUCERS

ENTERIC SEPTICEMIA of catfish (ESC), caused by the pathogen *Edwardsiella ictaluri*, is the most serious infectious disease agent in Alabama's channel catfish industry. Research by the Alabama Agricultural Experiment Station indicates the disease is more deadly in ponds with poor water quality, high stocking rates, and high feeding rates, and when found in combination with the bacterial infection known as Columnaris disease.

In 1990, ESC was diagnosed 290 times in Alabama. Since its appearance in 1976, fish killed by the organism and expenditures on treatments have cost Alabama fish farmers millions of dollars. The disease occurs primarily in the spring and fall when water temperatures are in the 70 to 80°F range. Both fingerlings and production size fish are affected, and there may be over 50% mortality in infected populations, if not successfully treated.

The disease produces hemorrhaged and necrotic lesions on the skin of infected fish, as shown by the photo, but little is known of its epidemiology. Much is still unknown about the disease, such as how the organism travels from farm to farm, how it survives in the fish between epidemics, where it persists in the environment, or what conditions other than temperature affect outbreaks of the disease.

An ongoing study examines a broad aspect of the impact of ESC on Alabama's catfish industry and what conditions contribute to its severity. This has been accomplished through interviews with farmers, water quality measurements in ponds where ESC occurs, and analysis of



Disease-free channel catfish (bottom) is compared to fish with *Edwardsiella ictaluri* infection. The top fish has small depigmented areas in the skin and the middle fish has hemorrhaging of the skin.

management practices.

Preliminary results indicate ESC outbreaks in many instances are concurrent with Columnaris disease. Columnaris is an opportunistic bacterial infection which increases the mortality, but requires a different treatment procedure than ESC.

Poor water quality and heavy stocking rates do not always cause outbreaks of ESC; however, the greatest mortalities are associated with ponds that have the highest stocking rates, especially when fingerlings are stocked "under" older catfish. Also, high feeding rates, which can contribute to poorer water quality, often coincide with increased mortality.

A corollary study of epidemiological relationships and interactions among the bacterial pathogen, fish host, and the culture environment produced a nonlethal method of detecting ESC in fish that have been exposed and may be carriers.

Pathogen-environment interactions are another important focus of the epidemiology study. *E. ictaluri* is known to survive for over 3 months in pond mud, and these muds could conceivably serve as a reservoir for the pathogen. Pond mud and water may contain 100,000 or more bacteria per milliliter, but except during an active ESC outbreak, only a few of these are *E. ictaluri*.

In the ongoing research effort, proce-

dures have been developed to detect and enumerate *E. ictaluri* in nonsterile substrates. Using this procedure, fresh, undiluted pond water and mud samples are plated onto *E. ictaluri* media which is specific for *E. ictaluri* and will eliminate more than 99% of the fish pond bacteria. Incubation is halted while the surviving bacterial colonies, including *E. ictaluri*, are still individually distinct. To differentiate the slow growing colonies of *E. ictaluri*, often outnumbered hundreds to one by rapidly growing bacteria, an imprint of the plate is made by blotting the entire agar surface onto a circle of nitrocellulose membrane the same size of the culture plate. This technique allows the enumeration of less than 10 *E. ictaluri* cells per milliliter of substrate (mud or water), which may contain enormous numbers of bacteria.

Information gathered by these methods may help researchers learn where *E. ictaluri* lives in the pond and how fish that survive the infections can become carriers and reservoirs for uninfected fish. Being able to determine which populations of channel catfish are carriers of *E. ictaluri* and which ponds are contaminated with the pathogen will allow fish farm managers to avoid infections in their stock.

Plumb is Professor, Earlix and Goldsby are Research Assistants, and Rogers is Professor of Fisheries and Allied Aquacultures.

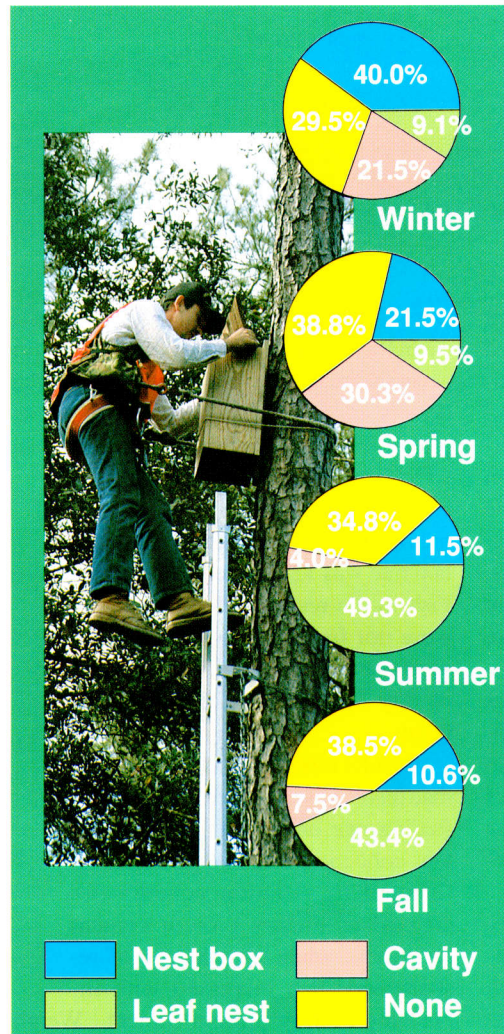
NEST BOXES BOOST GRAY SQUIRREL POPULATIONS IN MIXED PINE-HARDWOOD FORESTS

MUCH OF Alabama's land has come into active timber production in recent years, a situation that has raised concern among biologists and land managers interested in forest wildlife. Gray squirrels are one such area of concern because forestry practices often remove mature hardwood trees that furnish both food and nesting sites for gray squirrels.

Tree cavities are important nesting sites for squirrels. Many hardwood tree species develop cavities with age (usually 50-100 years), yet pine trees rarely develop cavities. While most hardwoods start producing fruits and nuts at around 30 years of age, a young forest may provide sufficient food for squirrels but still have an insufficient number of nesting cavities. In these cases, the addition of artificial nest boxes may increase gray squirrel populations.

To investigate the impact of nest boxes on squirrel populations in even-age pine plantations and uneven-aged mixed pine-hardwood forests, a cooperative study was conducted between the Alabama Agricultural Experiment Station and the Game and Fish Division of the Alabama Department of Conservation and Natural Resources at the Solon Dixon Forestry Education Center near Andalusia.

A total of 360 nest boxes was erected in three representatives of each forest type at a density of two boxes per acre. Study grids of approximately 30 acres were established in pine areas. Grids of approximately 60 acres were established in mixed pine-hardwood areas. Half of each mixed pine-hardwood area received nest boxes, enabling researchers to compare gray squirrel populations over time between similar areas



Gray squirrel shelter use by season from radio-telemetry locations at the Solon Dixon Forestry Education Center, Andalusia. Photo: Checking a nest box for use.

equipped both with and without nest boxes. Pine areas were not split because a previous study indicated that squirrel populations in pine areas were small so any changes in populations would be easily recognized.

Data collection started in fall 1988 and concluded in summer 1990. Mixed pine-hardwood areas were live-trapped prior to installation of nest boxes to estimate existing population levels. Afterwards, all areas were live-trapped seasonally from fall 1989 to summer 1990. Throughout the study,

nest boxes were checked seasonally for evidence of use and presence of squirrel litters. Additionally, to evaluate gray squirrel use of nest boxes as daytime shelters, 34 squirrels were fitted with radio transmitters and located twice weekly.

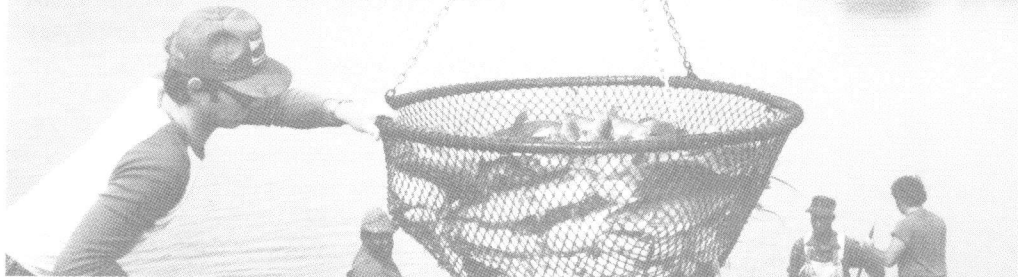
A total of 260 individual squirrels was captured. Only 20 were captured in pine areas, indicating that pine areas are poor gray squirrel habitat even after the addition of nest boxes. Of the 201 squirrels captured in mixed pine-hardwood areas after nest box installation, 125 were captured in areas equipped with boxes (boxed), while only 63 were captured in areas without boxes (unboxed). Thirteen squirrels considered to be transients were captured in both boxed and unboxed areas. Examination of population levels revealed that changes in populations occurred over time in both areas with boxes and those without them. Specifically, populations in boxed areas tended to increase over time, while populations in unboxed areas tended to decrease over time. Overall, gray squirrels preferentially chose areas that contained nest boxes.

Six seasonal nest box checks revealed a total of 51 litters and 149 nestlings, indicating that squirrels may be benefiting from the increased number of nest sites provided by the nest boxes. Radio-collared squirrels selected different shelter types during different seasons. As illustrated by the graph, nest boxes were used most frequently in the winter and spring. During these seasons, nest boxes may offer greater protection from the elements.

Results indicate that the addition of nest boxes in even-aged pine areas had little or no effect on squirrel populations. However, addition of nest boxes in mixed pine-hardwood areas increased populations in those areas and decreased populations in surrounding areas. Gray squirrels use nest boxes, as evidenced by the litters produced and the radiotelemetry data. For these reasons, nest boxes may be a valuable management tool for landowners with mixed pine-hardwood forests.

Nupp is Graduate Research Assistant of Zoology and Wildlife Science; Holler is Associate Professor of Zoology and Wildlife Science and Leader of the Cooperative Fish and Wildlife Research Unit.

ARE FISH FARMERS FEEDING TOO MUCH PROTEIN TO CATFISH?



THE DIETARY protein requirement of channel catfish has been reported to range from 25 to 44%, depending on fish size, diet quality, and daily feed allowance. Studies by the Alabama Agricultural Experiment Station (AAES) in the 1970's showed 32% to be optimum, and this is the protein concentration presently used in commercial feeds. However, changes in feeding rates since that time may make lower protein feeds more desirable.

In the early AAES studies, feeding rates were restricted to avoid water quality problems, whereas today's fish farmers tend to feed fish all they will eat. Recent studies indicate that catfish fed all they will eat may require less protein than those fed a restricted diet.

In light of more liberal, contemporary feeding practices, two pond feeding experiments were conducted at Auburn in which year-2 and year-3 catfish in earthen ponds were fed as much as they would eat for the entire growing season with various dietary protein concentrations.

Surprisingly, both experiments showed that weight gain did not increase as dietary protein increased above 24%. Therefore, a subsequent experiment was conducted with feeds similar to commercial catfish feeds to compare three protein levels (26%, 32%, and 38%) under unlimited (satiated) versus limited (restricted) feeding conditions. The protein concentration of the feeds was increased by substituting a fixed ratio of soybean meal-to-fish meal (5:1) for corn. Energy concentration of the feeds was not regulated, but essential amino acids in all diets

were adequate on a percent-of-protein basis.

In these tests, fish were grown from fingerlings to marketable size at a stocking density of 5,500 fish per acre in earthen ponds. Fish in the unlimited feeding group were fed as much as they would consume each day for the entire experimental period; the highest consumption rate was 125 lb. per acre per day. Fish in the restricted feeding group were not fed more than 65 lb. per acre per day; this rate was reached at day 70 of the 125-day experiment.

Results reported in the table show that there was a significant effect of feeding rate on optimum dietary protein concentration. Weight gain of fish fed to satiation actually decreased as dietary protein content increased, while weight gain of restricted-fed fish increased with increasing dietary protein content. Weight gain of fish fed to satiation increased with increasing feed consumption, but this relationship decreased as dietary protein content increased. Increasing dietary protein had no influence on feed conversion under unlimited feeding, but caused an improvement in feed conversion under controlled feeding. Feed required per unit of gain was higher for fish fed to satiation than for restricted-fed fish; thus amount of feed and cost per unit of weight gain was greater for fish fed to satiation.

These results indicate that channel catfish can obtain sufficient nutrients for maximum growth in a 26% protein diet when they are effectively fed to satiation through-

out the growing season. If the fish are fed to less than satiation, however, they require more protein in their feed. Feeding at less than satiation is more feed efficient.

Reason for the decrease in production as protein level increased in the satiation-fed group is not clear. It could be due to the increase in nitrite (from protein degradation) in pond water as dietary protein increased. The ratio of nitrite to chloride in satiate-fed ponds receiving 32% protein was considered stressful to channel catfish.

Results of this study may explain differences among previous experiments where the feeding rate was more restricted in some than in others. They also present the question, in light of more liberal feeding prac-

RESPONSES OF CHANNEL CATFISH TO FEEDS CONTAINING THREE LEVELS OF PROTEIN FED AT SATIATION OR RESTRICTED RATES FOR A GROWING SEASON

Dietary protein, pct.	Av. fish size	Fish/acre	Feed conversion, feed/lb. gain
	Lb.	Lb.	Lb.
Unlimited feeding			
26	1.31	7,205	1.47
32	1.24	6,820	1.40
38	1.19	6,545	1.46
Restricted feeding			
26	0.99	5,445	1.32
32	1.01	5,555	1.23
38	1.10	6,050	1.21

tics, should the protein content of catfish feeds be reduced below 32%? It is doubtful that commercial farmers actually feed to satiation. If they did, it would be time consuming and the amount of wasted feed would be much greater because of the large daily variation in food intake by satiate-fed catfish. With present management methods, most catfish farmers probably follow some sort of restricted feeding regime, in which case 32% protein may be on target. The fact that protein percentage in catfish feed can be dramatically reduced with controlled feeding suggests that improvements should be made in feeding methods.

Lovell is Professor and Li is former Graduate Assistant of Fisheries and Allied Aquacultures.

NONAGRICULTURAL FACTORS AFFECT VALUE OF LAND IN RURAL-URBAN FRINGE

URBANIZATION is an important factor affecting the use and value of agricultural land in the rural-urban fringe areas of larger southern cities. However, the extent of such impacts is less clear for smaller cities and metropolitan areas. To better understand this development process, the Alabama Agricultural Experiment Station analyzed the transitional agricultural land market in the periphery of the relatively small (population of about 55,000) but growing metropolitan area encompassing Dothan in southeast Alabama.

Data for the analysis were derived from a randomized sample of qualified land transfers between 1970 and 1990 involving agricultural land within 15 miles of the center of Dothan. The area encompassed parts of Dale, Geneva, Henry, and Houston counties.

Buyers indicated that half of the agriculturally oriented properties transferred in Dothan's fringe between 1970 and 1990 were purchased for nonagricultural uses. However, 15% of the surveyed agricultural tracts (9% of the acreage) within 15 miles of the city were converted to residential/commercial/industrial uses during 1970-1990. Two-thirds of these parcels were converted to nonagricultural uses after 1983. Within 8 miles of central Dothan, conversions to nonagricultural uses were more pronounced, accounting for about a fourth each of transferred tracts and acreage.

When evaluating potential impacts of development and loss of agricultural land in urbanizing areas, both the quantity and quality of agricultural land involved must be considered. An analysis of soil survey reports for the Dothan area indicates much of the land already under cultivation is high quality agricultural land. In Dothan's fringe area, 48% of the land transferred to nonagricultural uses was used for row crop production and 70% of the land within 8 miles of Dothan had been used for row crops. Since row crop land is typically of

higher quality than land allocated to other uses, this information suggests that high quality agricultural land in the Dothan area may be lost from agricultural production.

Distance to Dothan, distance to a U.S. highway, and size of the tract were found to vary inversely with bare land value in Dothan's periphery. Decreases in value became less pronounced as distance to Dothan's center and tract size increased. Presence of paved road frontage on a tract, use of a real estate agency to handle the transaction, and the proportion of a tract allocated to row crop or pasture uses were positively related to value.

A 10% increase in distance of a land tract from Dothan resulted in a 6.9% decline in value, while a similar increase in the distance to a U.S. highway resulted in a 1% decline. For example, a typical tract northwest of Dothan with paved road frontage and an urban influence would be valued at \$2,152 per acre if located 3 miles from Dothan and \$950 per acre if located 10 miles away. Similarly, the same example tract located 1/4 mile from a U.S. highway would have an estimated value of \$1,099 per acre; if 4 miles from a U.S. highway, its value would be \$856 per acre.

Value per acre declined 1.7% for each 10% increase in size of the tract. Estimates indicate that the example tract would have a bare land value of \$1,321 per acre if 10 acres in size and \$799 per acre if it involved 210 acres. Thus, incremental increases in size of tract resulted in a decreasing level of decline in value, with little reduction noted beyond 100 acres.

Proportion of a tract in row crop or pasture uses, representative measures for income-generating capacity, positively influenced value. A 10% increase in the proportion of a tract allocated to row crops resulted in a 4.9% increase in value, while a similar increase in the proportion of a tract

allocated to pasture resulted in a 2.4% upward adjustment. Thus, value was about twice as responsive to row crop acreage on a tract as to pasture acreage.

Bare land value in the fringe of Dothan increased 2% per year over the 1970-90 period, or approximately 50% overall. Adjustments in value were more pronounced in recent years.

The periphery of Dothan has experienced differing patterns of growth. Urban expansion to the north and west has been strong, while urban expansion to the southeast has been limited. Tracts located to the northwest

A 10% increase in distance of a land tract from Dothan resulted in a 6.9% decline in value.

of the central city had values almost 50% higher than for similar tracts in the southeastern quadrant. Values per acre were similar for tracts located in northwest, northeast, and southwest quadrants, other factors held constant.

Tracts with paved road frontage had values 35% higher than for similar tracts lacking such access. Also, transactions involving a real estate agency had values that were 28% higher than those handled without such facilitation.

In summary, Dothan's fringe remains intensely agriculturally oriented, but there are clearly accentuated nonagricultural pressures in the market, especially within 8 miles and to the west of the central city. Indications are that such pressures increased in the latter half of the 1980's and that agricultural land values are sensitive to stimuli for the nonagricultural sector. Barring unforeseen instability in the local economy, increased urban pressures on Dothan's fringe land market can be expected in the 1990's.

Adrian is Professor and Cannon is former Graduate Research Assistant of Agricultural Economics and Rural Sociology.

RESERVOIR TILLAGE REDUCES RUNOFF OF RAINFALL AND IRRIGATION WATER

IN ALABAMA, rainfall during spring and summer cropping seasons often comes from short, high intensity storms that produce more water than the soil is capable of absorbing. Thus, much of this water is lost to runoff, which also can be a source of non-point pollution of streams. Similarly, sprinkler irrigation, especially energy-saving low pressure systems, often causes runoff losses due to high application rates. Recent Alabama Agricultural Experiment Station research indicates a cultural practice, called reservoir tillage, could be used to save a portion of this valuable rainfall.

Reservoir tillage creates small depressions in the soil surface to hold water that might otherwise be lost as surface runoff during high intensity rainfall or irrigation. Water retained in the reservoirs has more opportunity to infiltrate into the soil profile for plant use.

The reservoirs were made with the tool shown in the photo, which consisted of

water over 3-ft. rows.

For the test at the E.V. Smith Research Center, Shorter, 12 plots were established on a Bassfield sandy loam soil with a 0.2% slope in the direction of the cultivation. Eight rows of McNair 220 cotton were planted at 30-in. spacings along the slope in each plot. Each plot was equipped with runoff measuring and collecting devices. A LEPA (Low Energy Precision Application) irrigation system, which allows water to be applied at rates higher than soil infiltration rates, was used to irrigate the plots. Plots also were treated with two levels of compaction with a double-wheel compactor attached to a "Wide Frame Tractive Vehicle."

Runoff samples from the plots were collected from each collection tank following each irrigation event and analyzed for sediment concentration. There were four treatments: (1) high compaction without reservoir tillage; (2) high compaction with reservoir tillage; (3) low compaction without reservoir tillage; and (4) low compaction with reservoir tillage.

The reservoirs, which were about 10 in. deep and 16-18 in. in diameter at the soil surface, were visually observed to determine changes in size and shape. The volume of the reservoirs was mainly reduced during intense spring rainfall. Silting of the reservoirs by the eroded soil from the edges of the reservoirs and consolidation were the major causes of the



Water-holding reservoirs were made with this Dammer Diker.

volume reduction. No additional changes in size or shape were observed throughout the summer.

Four 2-in. applications of irrigation water were tested late in the growing season to characterize the effect of reservoir tillage and soil compaction on runoff and sediment losses. As noted by data in the table, the amount of stored moisture in the soil was greater from the low compaction plots than from the high compaction ones, with or without reservoir tillage. For the high compaction level, runoff loss was lower from the plots with reservoir tillage than without it. The sediment loss from the high compaction treatments was significantly higher than that of the low compaction treatment.

Even though irrigation tests in this study were taken during the mature period of cotton, the LEPA method lessened the protection of the crop canopy against erosion by applying water 12 in. above the soil surface. Overall results of the study showed a potential for using reservoir tillage in Alabama to reduce surface runoff and sediment from heavy rainfall or irrigation.

Yoo and Rochester are Associate Professors of Agricultural Engineering.

AVERAGE DEPTH OF MOISTURE STORED IN SOIL, RUNOFF, AND SEDIMENT LOSSES FROM FOUR IRRIGATION EVENTS¹

Treatment	Moisture stored in soil	Runoff loss	Sediment loss/acre
	<i>In.</i>	<i>In.</i>	<i>Lb.</i>
High compaction			
With reservoirs	1.67	0.3	15.6
Without reservoirs	1.25	.72	44.2
Low compaction			
With reservoirs	1.95	.02	1.5
Without reservoirs	1.90	.07	3.2

¹An average of 1.97 in. was applied

mounted paddles on a freely turning wheel that was pulled behind a subsoiler shank. During operation, the forward pull of the shank forces the paddles into the soil. The resulting downward pressure and the forward movement turns the paddles in the soil, causing them to continuously dig reservoirs that are spaced about 27 in. apart and 10 in. deep. Each reservoir holds up to 3 gal. of water, which is equivalent to 0.5-0.75 in. of

HYBRID STRIPED BASS PROMISING FOR ALABAMA AQUACULTURE



THE HYBRID STRIPED bass is rapidly gaining the attention of fish producers and researchers throughout the country, and may soon be added to the list of suitable species for Alabama's growing aquaculture industry.

Preliminary research has shown the hybrid striped bass, a cross between the striped bass and the white bass, is well suited for successful aquacultural production. This fish is currently marketed as a substitute for the once plentiful saltwater striped bass, a native of the Atlantic Coastal region whose declining natural stocks can no longer support a commercial fishery.

The hybrid striped bass is thought to grow well at slightly cooler water temperatures than those required for optimum growth of channel catfish. Consequently, to determine initial suitability of the hybrid bass for commercial aquaculture in Alabama, the Tennessee Valley region was chosen as the site for a growth trial evaluation.

The Alabama Agricultural Experiment Station study was conducted in cooperation with the Tennessee Valley Authority's Agricultural Institute and a commercial fish producer in Jackson County. The study, conducted in two stages, included the pro-

duction of advanced fingerlings followed by the production and marketing of food fish.

Approximately 40,000 Phase I (1.5-in.) fingerlings were stocked into two ponds at an average density of 23,000 fish per acre in mid-June 1989. The fingerlings were fed three times daily during the first month with a slow-sinking pellet containing 44% crude protein and 16% fish meal. The fish were then switched to a floating catfish fingerling feed containing 36% crude protein. They were fed to satiation, once daily, and harvested as advanced fingerlings in March 1990.

At harvest, fingerlings were seined and moved to a holding net before they were loaded into a live-haul truck, containing a 1% salt solution, with the aid of a fish transfer pump.

Overall survival during the advanced fingerling production stage was 59%. Mortality was greater than anticipated, due largely to the loss of fish in one pond during December and January from the bacterial pathogen, *Aeromonas hydrophila*. Total number of fingerlings harvested was 23,750, and their size ranged from 4 to 7 in. in total length.

Fingerlings were restocked for growout at 2,000 fish per acre. During the growout

phase the fish were fed once daily, to satiation, on a trout feed containing 40% crude protein and 10% fat. Feeding rates during growout approached 50 lb. per acre per day. The fish consumed feed at rates equal to approximately 5% of their body weight daily in April, decreasing to an estimated 2% daily by the end of September.

Feeding response of the hybrids decreased markedly after October and feeding frequency was reduced to one to three times weekly from November 1990 until harvest in March 1991. Fish were harvested and graded, again using a fish transfer pump, so that fish weighing less than 1 lb. were automatically returned to the pond. Additionally, an attempt was made to hand grade any undersize fish less than 1.5 lb., and return these to the pond for further growth. Few mortalities were observed during the harvesting and grading process.

Fish were immediately delivered to the processing facilities where they were sorted by weight and placed in shipping boxes with ice. Average fish weight was approximately 1.5 lb. Fish were picked up the day after harvest and delivered by a refrigerated carrier to the Fulton Fish Market in New York City. Price received for fish was \$2.75 per lb., less shipping cost and a \$0.25 per lb. brokerage fee.

The traditional East Coast ocean-caught striped bass markets are currently the primary outlets for aquacultured hybrid striped bass. These markets prefer larger fish, ranging from 1.5 to 3.0 lb. Additionally, there are new markets developing which will accept hybrids as small as 0.75 lb. Approximately 80% of the fish harvested reached the minimum traditional market size of 1.5 lb. in one growing season from the advanced fingerling stage.

Results of the study indicate that hybrid striped bass can be grown in ponds to market size (average 1.5 lb. each) in Alabama's Tennessee Valley in two growing seasons from a Phase I (1.5-in.) fingerling and in one growing season from a Phase II (5- to 7-in.) fingerling. By producing this fish species, southern producers who have traditionally grown catfish may be able to sell a new product in a market which previously has been limited.

Hyde is Aquaculturist of Fisheries and Allied Aquacultures.

AU-TRIUMPH AMONG THE BEST FUNGUS-FREE FESCUES UNDER GRAZING

IN THE LATE 1970's, Alabama Agricultural Experiment Station researchers discovered the association between the presence of an endophytic fungus, *Acremonium coenophialum*, in tall fescue and signs of toxicity in beef cattle. This discovery at the Black Belt Substation, Marion Junction, was a major break-through for the fescue belt, which encompasses a large proportion of the region east of the Mississippi River and includes about 35 million acres of fescue supporting 8-10 million brood cows.

Scientists began to develop fungus-free fescue varieties adapted to particular regions and with additional improvements, such as improved forage quality. AU-Triumph, a fungus-free variety of fescue developed at the Alabama Agricultural Experiment Station, was selected specially for early and late winter growth. This growth habit would extend the grazing season and also minimize overlap of fescue and warm-season grass growth in the April-May period when forage production often exceeds the needs of livestock producers.

Although many fungus-free fescues have been compared in small plot clipping experiments and laboratory analyses, little information is available for comparisons under grazing. Most of the initial grazing research compared infected and fungus-free fescue, and showed large advantages in animal weight gain when no fungus was present. However, subsequent observations and research have shown that fungus-free fescue is less tolerant of stress from heavy grazing, insect damage, drought, and heat when compared to infected fescue. There-



was stocked with steers at rates ranging from 1.0 to 2.5 animals per acre. On average, animals weighed 510 lb. when grazing started and pastures were grazed for 70 days in both fall and spring. Animals were weighed and pasture height was measured with a pasture disk meter every 28 days. Pastures were fertilized with 75 lb. N (nitrogen) per acre in fall and again in spring. Phosphorous and potassium were applied according to soil test.

AU-Triumph provided animal weight gain and carrying capacity equal to or higher than Forager or Kentucky 31 fungus-free fescues. At low to moderate stocking rates (1.0-2.0 animals per acre), differences among varieties were modest. Fairly sizable differences were evident at the high stocking rate, as shown in the table. In particular, average daily gains, gain per acre, and pasture height for AU-Triumph were similar to, or greater than, these measurements for the other two varieties. In addition, by late summer 1991, the stands of Forager and Kentucky 31 that were grazed at 2.5 head per acre were severely damaged.

Results from this experiment indicate that AU-Triumph can withstand higher stocking rates than Forager and Kentucky 31 before stand loss occurs. Since pasture height for AU-Triumph was not reduced substantially by the heaviest stocking rate tried, studies with higher stocking rates will be necessary to determine the highest stocking rate this variety can withstand without causing stand damage.

Bransby is Professor of Agronomy and Soils; Webster is Superintendent of the Tennessee Valley Substation.

AVERAGE DAILY GAIN, GAIN PER ACRE, AND PASTURE HEIGHT JUNE 11, 1991, FOR THREE VARIETIES OF FUNGUS-FREE FESCUE GRAZED AT FOUR STOCKING RATES

Measure and fescue variety	Result, by stocking rate/acre			
	1.0 head	1.5 head	2.0 head	2.5 head
Av. daily gain, lb.				
AU-Triumph	2.12	1.70	1.52	1.44
Forager	1.84	1.81	1.66	.62
Kentucky 31	2.00	1.96	1.51	1.12
Gain per acre, lb.				
AU Triumph	297	357	426	504
Forager	258	380	465	217
Kentucky 31	280	411	423	392
Pasture height, in.				
AU-Triumph	6.3	6.4	7.4	5.6
Forager	7.5	7.3	6.3	.3
Kentucky 31	7.8	5.5	3.1	.7

fore, this study evaluated three varieties of fungus-free fescue for stocker production under various grazing pressures.

Four 2-acre pastures were seeded to each of three varieties of fungus-free fescue (AU-Triumph, Forager, and Kentucky 31) in fall 1988 at the Tennessee Valley Substation, Belle Mina. These were allowed a full year to establish without grazing. In the fall of 1989 and 1990, each variety

PUSHING PIGS DURING GROWING PHASE MAY REDUCE EFFICIENCY OF PRODUCTION

WHEN YOUNG pigs grow slow, it is readily apparent to producers. As a result, there has been a strong emphasis on keeping young pigs growing at a rapid rate during starter and grower periods. Research on this topic has demonstrated conclusively that young pigs respond to diets high in amino acids or protein.

Unfortunately, little attention has been given to whether feeding for faster growth at young ages promotes overall productivity and efficiency from farrowing to finishing. In fact, reports of compensatory gain made by older pigs following restricted feeding at young ages suggests just the opposite. Feeding high levels of costly protein or amino acids for rapid growth of young pigs could very well result in higher feed costs and poorer growth efficiency over the full production cycle.

A recent study at the Alabama Agricultural Experiment Station sheds some light on the issue. The study used 24 gilts and 24 castrated males weighing 40 lb. each. Their performance was compared on grower diets containing 0.62% and 1.12% lysine, which is the first-limiting (or most important) amino acid in a typical swine diet [National Research Council (NRC) recommends 0.75% lysine].

When pigs reached about 110 lb. weight, half were slaughtered for evaluation of carcass traits. The others that had been fed each of the grower diets were assigned to diets containing either 0.62% or 0.90% lysine and grown to 220 lb. finished weight. The amino acid balance was maintained by using a fixed proportion of corn and soybean meal. Pigs were housed and fed individually and allowed free access to feed and water. All pigs were slaughtered at 220 lb. to assess carcass traits and to estimate lean gain.

Data on performance of pigs from 40 to 110 lb. shows that those fed the high-lysine diet gained 18% faster and were 23% more efficient than those fed the low-lysine diet. Time to reach 110-lb. size was

6.5 days less for the high-lysine group.

It is important to note that pigs fed the low-lysine diet gained faster than normal for pigs of that age. But even better performance resulted when a diet higher in lysine was fed. Thus, pigs with genetic ability to grow fast can express their ability when the opportunity is presented.

There was a turnaround, however, during the finishing phase (110-220 lb.). Pigs that had been fed the low-lysine diet tended to "catch up" with those that had been on the high-lysine diet. This is known as "compensatory gain." As shown by data in the table, there was no overall performance difference between the low- and high-lysine diets fed during the growing phase. These grower diets had no lasting effect on overall feed intake, weight gain, feed efficiency, or carcass characteristics.

The results indicate that the advantages obtained during the grower phase by feeding a diet high in lysine were lost during the finishing phase. In addition, the finishing pigs seemed to respond to a lysine level that is much higher than the NRC recommendation (0.60%). Pigs fed the high-lysine diet during the finishing phase gained about 7% faster and were 8% more efficient than those on the low-lysine diet.

The current demand for low-fat meats was considered in relation to the test diets.

Not only is low-fat meat desired by consumers, but fattiness enters into the economics of production. Body fat is not only costly to produce, but also costly to eliminate in processing to produce low-fat products. Therefore, it would be desirable to produce animals with reduced fat in carcasses.

The estimated rate and efficiency of lean gain were similar among the pigs fed a low-lysine diet during the grower phase and those fed a high-lysine diet in the grower phase and then switched to a low-lysine diet for finishing. In contrast, pigs fed the high-lysine diets during both growing and finishing phases gained more lean (9%) and were more efficient (11%). For optimum leanness, therefore, it might be advantageous to feed high-lysine diets during both growing and finishing if the cost of protein supplements and sales price of lean hogs were favorable.

Based on the results reported, the "all-out" effort to gain peak performance of grower phase pigs may not be warranted in terms of overall productivity or efficiency. Pigs can be fed low levels of amino acids (20% below NRC recommendations) during the grower phase without adversely affecting overall performance.

Chiba is Assistant Professor of Animal and Dairy Sciences.

Measure	0.62% grower diet		1.12% grower diet	
	0.62% finisher diet	0.90% finisher diet	0.62% finisher diet	0.90% finisher diet
Feed intake, lb./day	6.23 (4.82) ²	6.24	6.23 (4.64) ²	6.11
Weight gain, lb./day	1.90 (1.68)	2.03	1.94 (1.98)	2.07
Lb. gain/lb. of feed	0.306 (0.350)	0.326	0.310 (0.431)	0.339
Backfat (10th. rib), in.	0.93	0.97	0.94	0.80
Loin muscle area, sq. in.	5.25	5.27	5.48	5.79
Lean gain, lb./day	0.75	0.75	0.75	0.82
Lean gain to DE intake, lb./Mcal	0.076	0.076	0.077	0.085

¹Lysine concentration of the diets expressed in terms of digestible energy (DE) were 1.77, 2.56, and 3.20 grams/Mcal for 0.62, 0.90, and 1.12%, respectively; constant proportions among amino acids were maintained in all diets.

²Values in parentheses are gain data during growth from 40 to 110 lb.

TICK PARALYSIS OBSERVED IN WILD BIRDS



Common grackle with *Ixodes brunneus* ticks.

ALTHOUGH wild birds are often heavily infested with mites and lice, these ectoparasites seldom cause the birds significant harm. This is not the case, however, when birds are parasitized by the bird tick (*Ixodes brunneus*), which can cause paralysis and even death in a single attack.

The bird tick is exclusively an avian parasite. All three of its developmental stages (larvae, nymphs, and adults) are found on birds. More than 20 species, primarily songbirds, have been reported as hosts. This tick occurs only in North America where it is common in the Southeastern States and along the Pacific coast.

Tick-induced paralysis occurs in a number of animals, including cattle, sheep, goats, dogs, and occasionally cats and humans. In each case, a feeding tick introduces a substance through its saliva that disrupts the normal transmission of electrical impulses along nerves leading to the muscles. The consequence is a progressive paralysis beginning in the lower or hind limbs and moving upward or forward, eventually reaching the chest area. Death results from respiratory failure when the diaphragm muscles can no longer function effectively.

Only a few cases of tick paralysis in wild birds have been documented in the United States. These involved the eastern bluebird, cedar waxwing, American goldfinch, dark-eyed junco, and yellow-rumped warbler. Commercially raised poultry occasionally suffer paralysis from the bite of the fowl tick (*Argas persicus*). This rarely occurs today in the United States because of im-

proved cage facilities that have eliminated this tick from most operations. Cases of paralysis in domestic birds have not been reported in Alabama for more than 25 years.

Studying tick paralysis in wild bird populations is difficult; however, records of reported cases maintained by the Alabama Agricultural Experiment Station have helped keep track of the frequency of this disorder. These data have revealed



Chipping sparrow killed by *I. brunneus* tick.

an unusually elevated number of cases in Alabama during two of the past four winters. From November to March 1987-88, six birds were found either partially paralyzed or dead in Lee County as a result of one or more engorged ticks attached to the head or neck. These birds included two common grackles, two chipping sparrows, a yellow-rumped warbler, and an American goldfinch. Each case involved the bird tick. With the exception of one grackle that was parasitized by 13 partially engorged ticks, there was only a single tick on each host. All of the birds were found dying or dead on residential properties.¹

Six more functionally impaired or dead birds parasitized by the same tick species were observed from December to April 1990-91 in Chambers, Lee, and Macon counties. These included two house finches, a chipping sparrow, a white-throated sparrow, a dark-eyed junco, and an American robin. The house finch was only one of several birds of this species behaving abnormally at a bird feeder in late

¹Contact with the dead bird poses no health threat.



House finch with single *I. brunneus* tick.

December. The observer reported seeing a number of house finches with attached ticks that were unsteady and staggering with their feathers fluffed.

Mourning doves with ticks attached to the top and sides of

their heads were observed at the same feeder but showed no discernible signs of paralysis or impaired function. The American robin, bearing a single engorged female tick, was caught in a small mammal trap being used in a Lyme disease study at Tuskegee National Forest during the first week of December. The bird walked with a staggered gait and was unable to fly when captured.

The chemical nature of the toxicant produced by this tick is unknown, but it appears to be similar to that of other ticks which cause paralysis in dogs, humans, and other animals. The substance is believed to be produced in specific cells of the salivary glands, but only in a small percentage of the ticks in any given area. Production of this paralytic agent apparently arises spontaneously in local tick populations and then disappears after one or a few generations. Particularly notable is the fact that the effects of the toxicant are completely reversible upon removal of the tick, resulting in full recovery of the host. A better understanding of the unique pharmacological properties of this substance could be of significant value in neuromedical research.

This information base will be expanded as researchers observe more cases and receive additional reports from homeowners and bird-watchers who notice unusual activity in birds or find dead birds with attached ticks.

Mullen is Professor and Hribar is a former Ph.D. Graduate Student of Entomology.

NEW DISEASE-RESISTANT WATERMELONS PRODUCED IN AAES RESEARCH

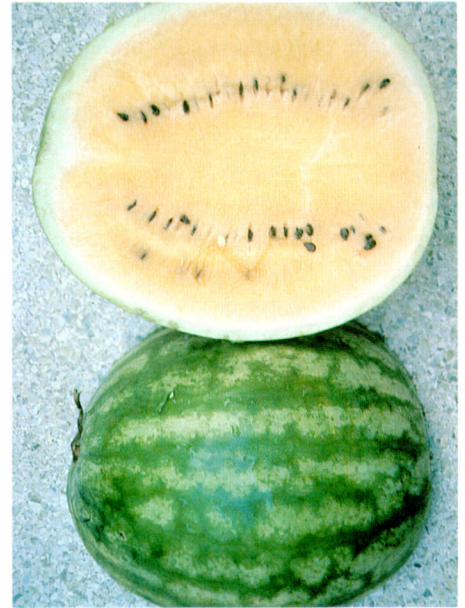
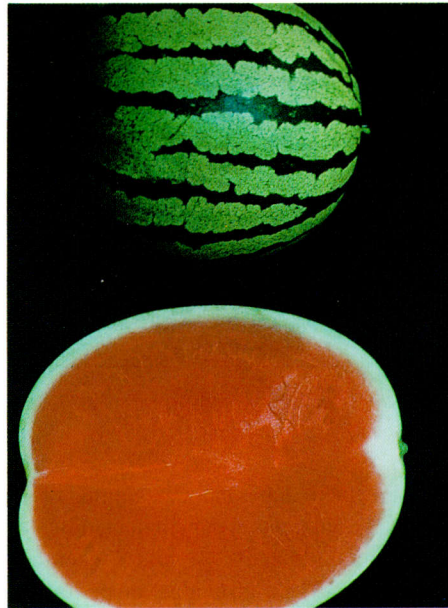
TWO NEW watermelon varieties developed in Alabama Agricultural Experiment Station research have advantages of disease resistance and high melon quality. Named AU-Sweet Scarlet and AU-Golden Producer, the varieties have been released following their testing at four Alabama locations.

The new varieties are the latest releases from an AAES project designed to develop melons that can withstand gummy stem blight, anthracnose, and fusarium wilt. These diseases cause severe yield and quality losses in many commercial varieties planted in hot and humid areas, such as Alabama. Although fungicide applications may control gummy stem blight and anthracnose under favorable weather conditions, resistant varieties are needed to assure success in wet, humid years.

AU-Sweet Scarlet is an inbred line from a program of crossing, backcrossing, and bulking. It produces round melons, with a rind that has a light green background with dark green irregular stripes running the length of the melon. The rind is hard and tough, and is about 1/2 in. thick. Its flesh is firm and of an attractive red color.

AU-Golden Producer is a mutant of AU-Producer, an earlier release from the AAES project. It, like AU-Sweet Scarlet, originated from a program of backcrossing and inbreeding for resistance to gummy stem blight, anthracnose, and fusarium wilt. Melons of this variety are similar in size and shape to AU-Sweet Scarlet, but have bright yellow-orange flesh. Otherwise the variety is similar to AU-Producer.

Superior disease resistance of the new varieties was established in comparisons with commercial varieties in north, central, and south Alabama, table 1. Yield and melon quality were equal or better than those of the commercial varieties, table 2.



Left: AU-Sweet Scarlet. Right: AU-Golden Producer.

Similar results were reported from the Southern Cooperative Watermelon Variety Trials conducted across the South.

Norton is Professor, Boyhan is Senior Research Associate, and Abrahams is Research Technician of Horticulture; Bannon is Superintendent of the E. V. Smith Research Center; Pitts is Superintendent of the Chilton Area Horticulture Substation; Hollingsworth is Superintendent of the North Alabama Horticulture Substation; Eason is Superintendent of the Sand Mountain Substation.

TABLE 1. COMPARATIVE DISEASE RESISTANCE OF WATERMELON VARIETIES AT FOUR ALABAMA LOCATIONS¹

Variety	Disease index ²		
	Anthracnose	Fusarium wilt	Gummy stem blight
Charleston Gray	5	3	5
Crimson Sweet	5	2	5
Jubilee	3	3	5
AU-Producer	2	1	2
AU-Golden Producer ...	2	1	2
AU-Sweet Scarlet	2	1	2

¹Comparisons made at the E.V. Smith Research Center, Shorter; Chilton Area Horticulture Substation, Clanton; North Alabama Horticulture Substation, Cullman; and Sand Mountain Substation, Crossville.

²Disease index: 0 = no injury, 5 = all plants severely injured.

Table 2. Yield and Fruit Characteristics of Varieties of Watermelons, Four Alabama Locations¹

Variety	Yield			Width/ length ratio	Days to maturity	Rind thickness (in.)	Flesh thickness (in.)	Color
	Lb.	Lb.	Pct.					
Charleston Gray	37,850	19.2	9.8	7.3	0.44	0.56	80	Gray
Crimson Sweet	31,974	18.0	10.4	8.0	.62	.86	75	Striped
Jubilee	37,696	21.3	9.6	7.9	.43	1.00	90	Striped
AU-Producer	39,558	19.0	10.8	8.2	.84	.75	75	Striped
AU-Golden Producer	39,393	18.8	10.8	8.2	.84	.75	75	Striped
AU-Sweet Scarlet	31,666	19.3	11.4	9.0	.86	.50	75	Striped

¹Test locations are the same as listed in table 1.

²Quality preference: 10 = best, 5 and below = unacceptable.

COCKROACH CONTROL DIFFICULT EVEN WITH NEWEST SPRAYS

ALABAMA PEST control operators rate German cockroaches as the most troublesome pests for which they treat. Homeowners would probably agree. These persistent pests infest food, cabinets, and appliances. Not only are cockroaches a nuisance, they also may spread diseases and cause allergies.

Many people prefer to employ professional pest control operators to control German cockroaches. Because of their training, licensed operators can use certain restricted pesticide formulations that are not available to the public. Thus, they have more control weapons at their disposal.

Pest control operators have traditionally used emulsifiable concentrate formulations of insecticides. These formulations mix well and do not leave a noticeable residue, but they do have shortcomings. They can be absorbed by unpainted wood and other surfaces, thereby removing the insecticide from the surface where it could be contacted by cockroaches. To overcome this problem, insecticide manufacturers have developed wettable powders and, more recently, microencapsulated formulations. These formulations remain in place on surfaces so they can be contacted by cockroaches.

Three of these newer products—one wettable powder and two microencapsulated products—were evaluated in a recent Alabama Agricultural Experiment Station study to determine their effectiveness. The insecticides tested¹ were Demon® wettable powder applied at 0.2% concentration, Diacap® microencapsulate applied at 1.2% concentration, and Empire® microencapsulate applied at 0.5% concentration.

Initially, over 200 prospective apartments were inspected for severity of cockroach infestation. The 36 with the greatest infestation were chosen for the test.

Apartments were assigned to treatments so that each treatment group had similar

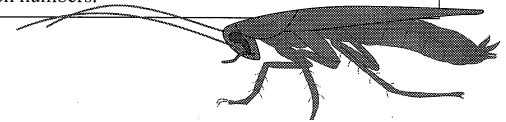
¹Demon is cypermethrin, Diacap is diazinon, and Empire 20 is chlorpyrifos.

EFFICACY OF PROFESSIONAL-USE INSECTICIDES FOR THE CONTROL OF GERMAN COCKROACHES IN APARTMENTS

Treatment ¹	Cockroaches/apartment pretreat, average	Reduction of cockroaches/apartment, average at			
		1 week	2 weeks	4 weeks	8 weeks
	No.	Pct.	Pct.	Pct.	Pct.
Control	344	3	19	27	26
Demon (0.2%)	510	26	56	58	65
Diacap (1.2%)	520	45	54	60	56
Empire 20 (0.5%)	514	+13 ²	25	35	25

¹Eight to 11 apartments in each treatment. Demon is a wettable powder, the others are microencapsulated products.

²Plus sign indicates an increase in cockroach numbers.



numbers of cockroaches at the beginning of the study. Evaluations were conducted before treatment and at 1, 2, 4, and 8 weeks after treatment. For each evaluation period, which lasted 1 week, apartments were trapped using 10 sticky traps (Mr. Sticky®) per apartment. Six traps were placed in cabinets around the sink, two in the pantry, and one each by the stove and refrigerator.

The highest labeled spray concentration was used for each product. The insecticides were mixed according to label direction, and about 1 qt. of the finished material was applied in the kitchen of the test apartments. Treatments were made with a 1-gal. compressed air sprayer pressurized to approximately 30 p.s.i. Kitchen cabinets were emptied and sprayed, as were areas around the stove, refrigerator, and other appliances. Where appropriate, crack and crevice treatments were made. Otherwise, insecticides were applied using a fan spray nozzle.

After treatment, the total number of cockroaches trapped per treatment in each apartment was recorded, and the percent change from pretreatment was calculated.

Overall, these treatments provided less than 60% control. This level of control is considered marginal, especially since untreated apartments had a reduction in German cockroaches of 27% after 4 weeks and 26% after 8 weeks. However, these

reductions may have been influenced by the fact that this study was done in the fall. Even though German cockroaches are indoor pests, fall and winter decreases in their populations have been documented in other studies.

Comparing the products, Diacap and Demon provided the best control. After 1 and 4 weeks post-treatment, Diacap provided 45% and 60% control, respectively, compared with 26% and 58% for Demon for the same time periods. After 2 and 8 weeks, control by Demon was 56% and 65%, respectively, compared with 54% and 56% for Diacap.

Cockroach numbers were greater in the Empire 20-treated apartments. Cockroach numbers increased 13% after 1 week, but declined to their lowest point of 35% after 4 weeks.

Based on the results reported, Demon and Diacap performed similarly and were better than Empire for controlling cockroaches. Still, overall control success was marginal. In apartments where German cockroaches are a serious problem, it appears that more than just insecticide sprays, no matter what the formulation, are needed to effectively reduce cockroach numbers.

Benson is Assistant Professor and Appel is Associate Professor of Entomology.

AGRICULTURE SECTOR RESILIENT DURING 1980'S

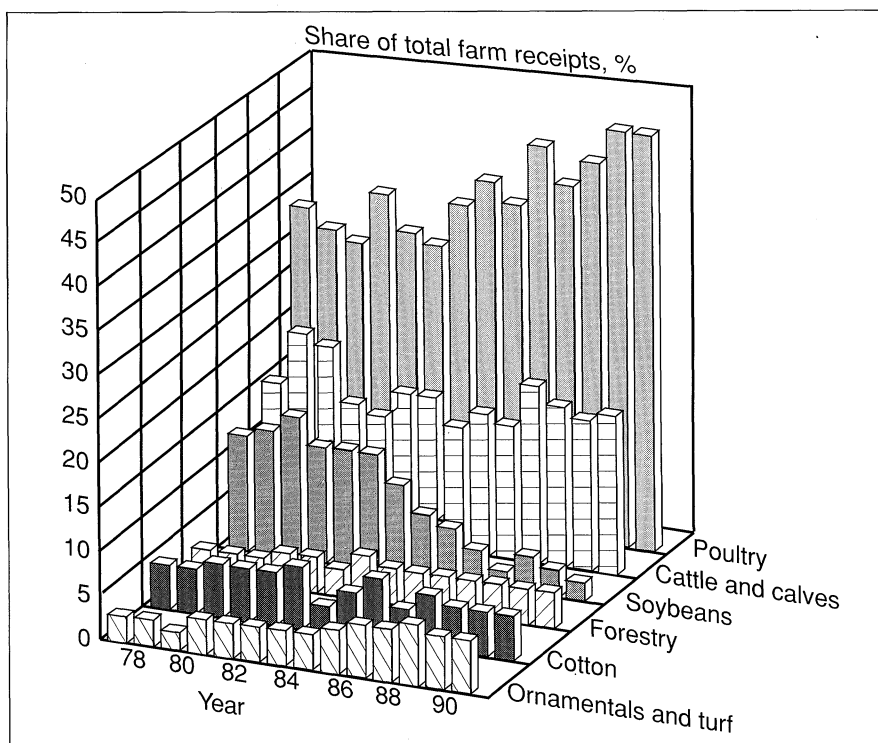
ALABAMA'S agricultural sector showed major changes during the 1980's. There were important adjustments in the aggregate levels of debt, assets, and owner's equity and a shift in the mix of farm enterprises. The result is optimism for the 1990's, according to an Alabama Agricultural Experiment Station study using data from USDA Economic Research Service and Alabama Agricultural Statistics Service.

The sector carried a heavy debt burden at the beginning of the decade. The ratio of debt to farm equity swelled to an unprecedented 28% in 1983, before falling to a level more in line with historical levels. This compares to levels of 25% and 21% nationally for the same years. Although the value of farm assets in Alabama tumbled by 40% between 1980 and 1989, agriculture was able to cope by reducing debt at an even faster rate. The worst of the financial adjustment process now appears to be over since the real value of assets has remained unchanged since 1987.

Financial restructuring of the sector lifted the rate of return to equity from 4-5% to a healthier 8%. The fact that net farm income improved after the debt reduction suggests that much of the borrowed capital was not being productively employed in the earlier period.

Off-farm income plays an important role in Alabama, accounting for approximately two-thirds of total income for farm households. This continues to provide a stable source of liquidity. Relatively stable farm prices also helped the sector during the 1980's.

In addition to the dramatic shedding of debt, Alabama's farm sector also evolved a different mix of enterprises by the end of the eighties. Three major changes in the composition of Alabama's farm output are obvious in the graph. Poultry and nursery crop production had large increases, but soybeans became a relatively minor crop. Cotton production is currently on the in-



Changes in share of farm receipts by six major farm commodities, 1977-1990.

crease, but it was maintained at a fairly constant share of total farm production. The same is true for peanuts and livestock. Animal enterprises (including cattle, dairy, hogs, poultry, and catfish) have increased in importance relative to crops, moving from 60% of total receipts in 1977 to 71% in 1989. Farm forest products accounted for a nearly constant 4% of gross receipts.

The rise of nursery and sod products has, in many ways, been as remarkable as the more widely recognized growth in poultry. The value of ornamental crops has been greater than the value of cotton production in Alabama in every year since 1986. In 1989, the value of ornamental crops exceeded the value of the peanut crop, making ornamentals the most important nonanimal commodity category in the State.

Among noncrop enterprises, wildlife brought in a small amount of additional income to Alabama farms.

Catfish marketings have grown rapidly, but have yet to exceed 1% of Alabama's

total gross receipts. The importance of government payments has increased from 1% to 4% of gross receipts during the 1980's; nevertheless, government programs are still less important in Alabama than in many other farm states.

Finally, the long-term trend towards fewer, but larger, farms and the decline in total farm acreage continued during the 1980's. The number of farms fell by 20% between 1979 and 1989, but this is less than the 31% decline during the 1970's. Total farmland dropped 17% in the 1970's and 15% in the 1980's. Average farm size was 176 acres in 1969, 212 acres in 1979, and 226 acres in 1989.

The improving economic viability of Alabama agriculture is good news, but real interest rates and uncertain markets remain challenges for the future.

Traxler is Assistant Professor and Molnar is Alumni Professor of Agricultural Economics and Rural Sociology.

PROGRESS BEING MADE TOWARD CONTROLLING AVIAN CRYPTOSPORIDIOSIS



Young broiler shows effects of respiratory distress caused by *C. baileyi*.

IN RECENT years, improved diagnostics and disease control have played a key role in Alabama's broiler industry becoming the nation's second largest. Yet, even as old disease problems are solved, new ones emerge.

One of these new ones is cryptosporidiosis, which is caused by a protozoan organism (*Cryptosporidium baileyi*) that parasitizes the respiratory and digestive tracts of poultry. First described over 80 years ago, *Cryptosporidium* was, until 1980, regarded as a medical curiosity, of little significance. Today, primarily through Alabama Agricultural Experiment Station (AAES) research, it is recognized as an important avian pathogen, which can result in severe respiratory disease and reduced weight gain in broilers.

To date, no effective drug for treatment of cryptosporidiosis exists. Therefore, research at Auburn is studying the immune response of broiler chicks against *Cryptosporidium* infection.

This research has developed an enzyme-labeled immunoassay (ELISA) to detect the presence of anti-*Cryptosporidium* antibodies in body fluids, such as serum and bile. ELISA testing revealed chickens produce three different classes of antibodies (IgA in the bile and IgM and IgG in the blood) against the disease pathogen. These antibodies appear at different intervals following experimental infection. For example, 1-day-old chicks infected with the pathogen

expressed IgM and IgG 9 days post-inoculation (DPI). However, IgA was not detected in bile until 28 DPI. When 14-day-old chicks were inoculated with the pathogen, all three antibodies were detected 4 DPI.

To learn if these antibodies produced by chickens protect against cryptosporidiosis, the disease pathogen was inoculated into birds that were hormonally and chemically treated to block antibody production. Birds with high levels of antibody exhibited as severe a *Cryptosporidium* infection as birds deficient in antibodies. Results, therefore, suggest that cell-mediated immunity (CMI) may be more important than antibody in controlling cryptosporidiosis. Cell-

mediated immunity is the part of the immune system which relies on specific, sensitized cells from the thymus to attack and destroy threatening organisms.

To determine the importance of CMI in the development of resistance against *Cryptosporidium*, the CMI-depressing drug cyclosporin was administered to two groups of birds at 7 and 28 days of age to inhibit CMI. Fourteen days after the second dose of the pathogen, antigen prepared from the parasite was injected into the wattle skin of all birds to measure delayed hypersensitivity, a correlate of CMI. Birds which did not receive the drug had almost a 6-fold increase in delayed hypersensitivity as measured by the swelling of their wattles, compared to the CMI-deficient birds.

In a similar experiment, two groups of 28-day-old chickens were dosed with the disease-causing pathogen and one of the two groups also was given cyclosporin. At 44 days of age, the birds were killed and examined for the pathogen. The parasite was found in 40% of birds with deficient CMI, whereas birds not given cyclosporin were pathogen free. In both experiments, antibody production was unaffected by cyclosporin.

Results suggest that CMI is more important than antibody in controlling cryptosporidiosis. Therefore, for effective control of cryptosporidiosis, vaccines which induce CMI need to be developed.

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