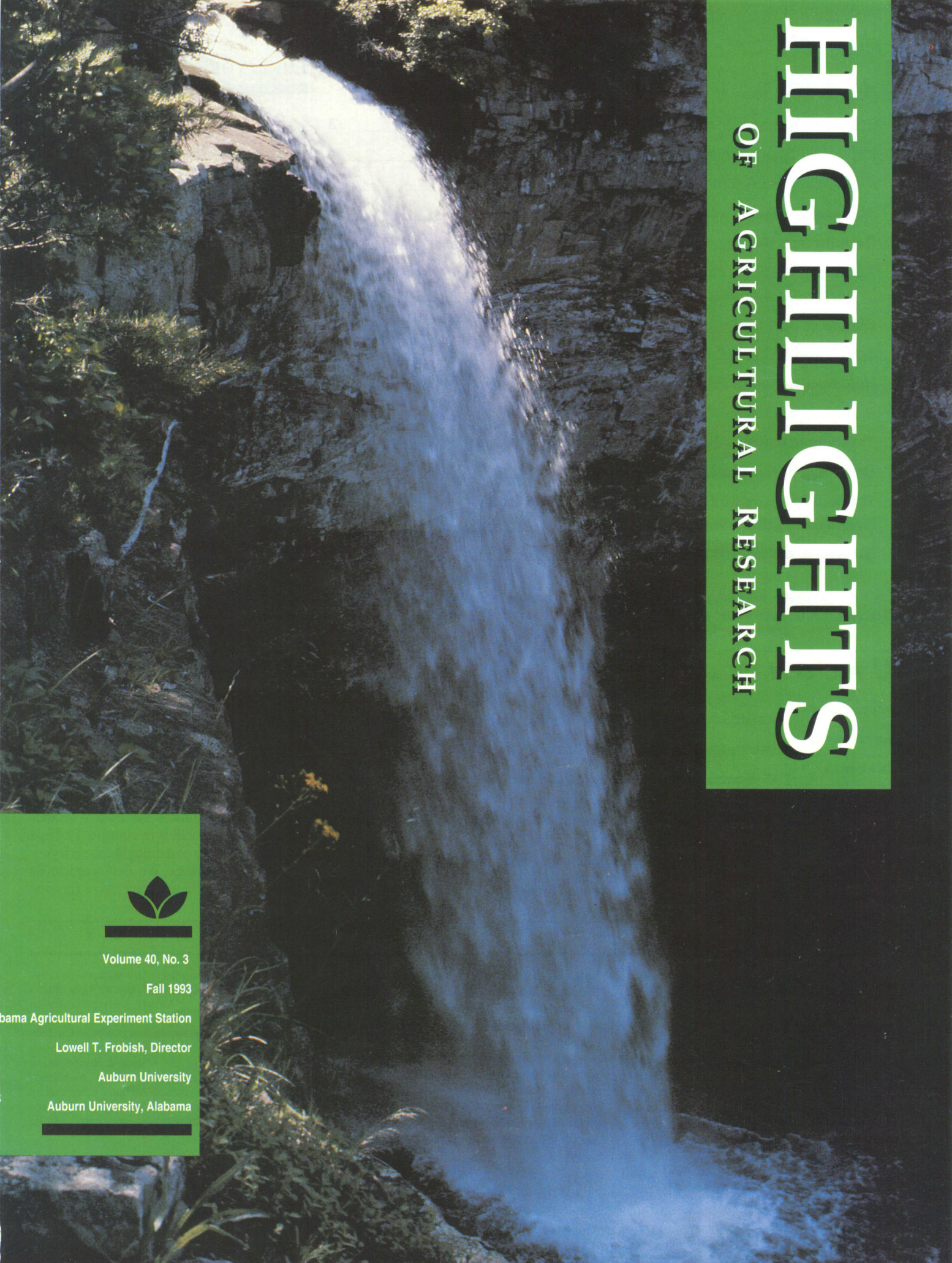

# HIGHLIGHTS

## OF AGRICULTURAL RESEARCH

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bama Agricultural Experiment Station

Lowell T. Frobish, Director

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# In This Issue



**ON THE COVER. Alabamians speak out on environmental issues that affect such treasures as Desoto Falls, see story on page 5.**

# Upcoming Events

| | |
|---|---|
| September 16-17 | Alabama Pecan Growers Association Annual Meeting, Fairhope |
| September 23 | Wildlife Field Day, Piedmont Substation, Camp Hill |
| October 12 | Ornamental Horticulture Field Day, Ornamental Horticulture Substation, Mobile |
| October 21 | Fall Color Home Landscape and Shade Tree Field Day, Piedmont Substation, Camp Hill |
| November 10-12 | Alabama Fruit and Vegetable Growers Annual Meeting, Huntsville |
| December 4-7 | Alabama Farmers Federation Annual Meeting |

# Director's Comments

Water, water everywhere and not a drop to spare. In some places like the midwest, water covers barren fields or drowns out newly planted crops. Then in the South, fields are bare not because of too much water but because of a lack of it. We never seem to get just the right amount of that precious natural resource, water, when needed.

Irrigation is one alternative to combat drought if one has a readily available source of water. For most producers groundwater is the major water source for irrigation. Research at the Tennessee Valley Substation, however, is addressing an alternative source of water. Water will be harvested during the rainy season and stored in man-made or natural ponds for use in the dry season. Farmers may be able to form irrigation associations to collect, store, and distribute the water as needed.

Irrigation is effective but it can be expensive. The right amount of water needs to be applied at the right time. Another AAES project is concerned with developing computer models that will assist farmers in determining how much water to apply and when. Also new, more efficient methods of delivering water to plants are under investigation.

Drip irrigation in combination with plastic covering appears beneficial for vegetable crops. A side benefit of drip irrigation under plastic is the ability to apply fertilizer and chemicals to control plant diseases and at the same time suppress weed growth.

Either too much or not enough water continues to plague farmers. The ideal situation would be to turn on the rain when needed and to control the flow. Mother nature, however, still is in control. Perhaps through the floods and droughts she is trying to tell us something. We may need to sit back, listen, watch, and then move forward slowly.


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EDITOR'S NOTE. Mention of trade names does not indicate endorsement by the Alabama Agricultural Experiment Station or Auburn University of one brand over another. Any use of pesticide rates in excess of labeled amounts in research reported does not constitute recommendation of such rate. Such use is simply part of the scientific investigation necessary to evaluate various materials. No chemical should be used at rates above those permitted by the label. Information contained herein is available to all persons without regard to race, color, sex, or national origin.

R.H. WALKER, J.H. EDWARDS, AND C.C. MITCHELL

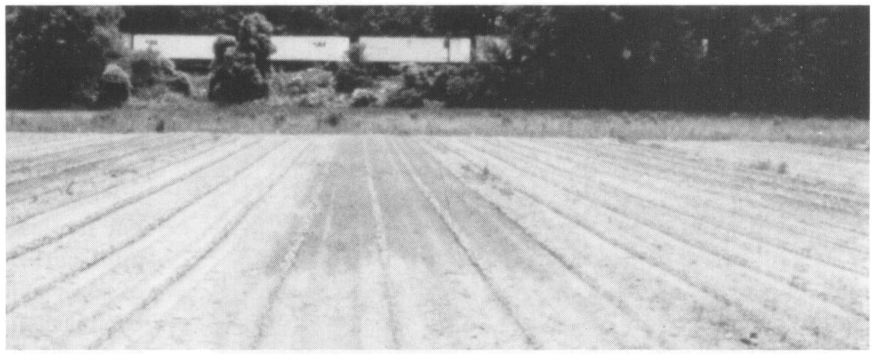
# Effects of Noncomposted Waste Materials on Weed Control in Crops

Municipal landfill space is quickly declining. Alternative methods must be developed to dispose of organic waste materials, such as yard wastes and newsprint. Because increasing soil organic matter enhances plant growth, many of these waste materials may be applied to agricultural lands where soil microorganisms eventually incorporate them into soil organic matter. However, interacting factors affecting the recycling of organic wastes by land application must be balanced. Research underway through the AAES and USDA-ARS is attempting to determine some of the best management practices for the land application of organic wastes.

Field studies were initiated in 1992 at the E. V. Smith Research Center, Shorter, and Upper Coastal Plain Substation, Winfield. Two additional locations, the Tennessee Valley Substation, Belle Mina, and the Sand Mountain Substation, Crossville, were added in 1993. Crops include cotton, corn, soybean, and tomato. Factors being evaluated include: (1) how much waste can be applied; (2) the best time of year to apply waste; (3) types of waste materials (newsprint, yard waste, gin trash, wood chips); (4) ways to improve the suitability; (5) crop response to waste application; and (6) pest control.

An important area is weed control. While high levels of soil organic matter are good for crop production, they may require that the rates of many soil-applied herbicides be increased (organic matter "ties up" much of the chemical) which increases production costs. When soil organic matter exceeds about 5% many soil-applied herbicides become ineffective for weed control and the producer must rely on alternative methods of control. However, selective postemergence-applied herbicides may be able to fill this void.

Preliminary data from Shorter indicates that the effectiveness of the soil-applied herbicides Prowl, Zorial, and Cotoran were not affected by the addition of organic wastes on a cotton crop. Weeds also could be controlled in the cotton with selective postemergence applications of Fusilade, Bueno 6, Probe, and Cotoran with minimum yield loss.



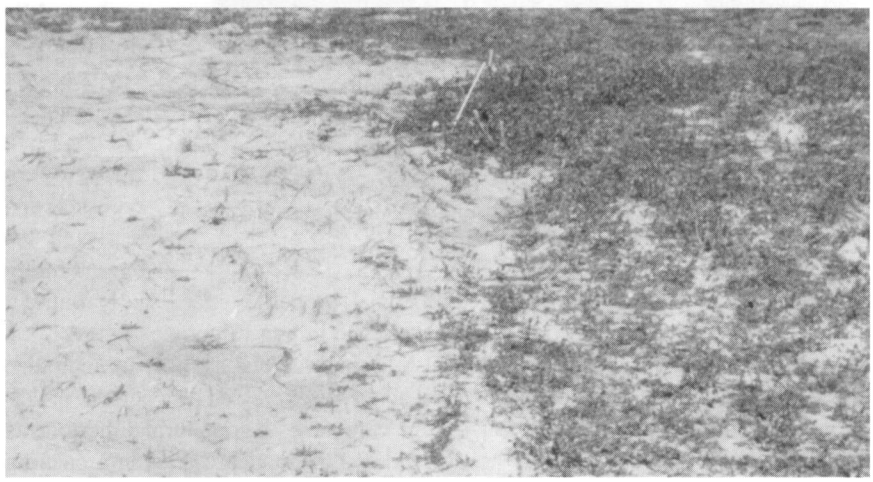


**Figure 1 (above). Control of crabgrass in cotton with spring application of newsprint.**
**Figure 2 (below). Control of winter annuals with fall application of newsprint, on the left.**

An unexpected bonus of some waste materials was the control of large crabgrass (Figure 1). For example, newsprint plus broiler litter reduced the number of large crabgrass seedlings by 65% when compared to the standard control treatment. Application of newsprint to these plots in the fall of 1992 also showed good control of winter annual weeds such as henbit, cutleaf evening primrose, and bitter cress (Figure 2).

Control of certain weeds with organic wastes illustrates the potential of reducing herbicide use in cotton. However, several more years of research are required to better understand the many interacting factors. It is unclear whether this suppression in both cotton and corn growth is due to simply the physical presence of the organic waste and/or some unknown toxic component of the organic waste.

Preliminary data from Winfield indicates that the soil-applied herbicides Dual and AAtrex were not affected by the addition of the wastes in a corn crop. Weeds also could be controlled in the corn with selective postemergence-applied herbicides of Accent and 2,4-D. Fall application of newsprint again provided significant control of common winter annual weeds.

Walker is Professor of Agronomy and Soils; Edwards is Adjunct Associate Professor of SWR-ARS, USDA; Mitchell is Associate Professor of Agronomy and Soils.

J.K. MUSE AND C.C. MITCHELL

# Paper Mill Byproducts Find a Home on the Farm

**Boiler wood ashes are becoming a valuable alternative soil liming material on Alabama farms.**

A new AAES study illustrates the potential of using byproducts from Alabama's huge pulp and paper industry as valuable soil amendments on the state's pastures and farmland.

Alabama has 14 pulp and paper mills, which produce over 20,000 tons of products each day. Byproducts of this daily process include approximately 700 tons of de-watered sludge, 700 tons of boiler ash, 600 tons of lime wastes, and 500 tons of wood wastes.

Most of the byproducts generated in the Southeast are dumped in landfills or sludge ponds. However, increasing landfill costs and decreasing landfill space are forcing many mills to seek alternative disposal methods. Fortunately, land application of these wastes provides farmers with inexpensive alternatives to soil liming materials, fertilizers, or sources of organic matter.

In a survey of more than 80 Southeastern paper mills, 60 percent of the responding mills reported an interest in land application. However, less than 10 percent were actually applying byproducts to land. In the Northeast, up to 80% of the boiler ash is spread on agricultural land, indicating the potential for land application of paper mill byproducts in the Southeast.

In addition to the survey, samples from selected Alabama mills were collected and analyzed for agriculturally beneficial properties, particularly nutrient content and liming value.

A liming material's ability to neutralize soil acidity is expressed as a percent of calcium carbonate. Agricultural limestone is considered the standard, having a calcium carbonate equivalency of at least 90%. The average neutralizing value for lime byproducts in this study was 99%, indicating that they are as effective as agricultural limestone in neutralizing soil acidity. The average neutralizing value of boiler ash was 38% of calcium carbonate. However, an equivalent increase in soil pH can be attained by applying more of the byproduct with the lower neutralizing value. Boiler ash also provides potassium, phosphorus, and other plant nutrients, (table).

Sludge and wood wastes are other paper mill byproducts that can be land applied. These materials are typically used as a source of plant nutrients and organic matter, although sludge can have a liming effect when applied at high rates. The amount of sludge or wood waste applied is usually determined by nutrient content (see table).

A greenhouse study revealed that the byproducts can increase soil concentrations of phosphorous, potassium, calcium, magnesium, and other plant nutrients.

The greenhouse study also demonstrated that nitrogen immobilization may occur when some organic byproducts are added to soil. In order to decompose large quantities of land-applied organic matter, microorganisms metabolize soil nitrogen that would otherwise be utilized by plants (immobilization). As a result, supplemental fertilizer nitrogen may be required to replace immobilized nitrogen. This phenomenon is expected when using any woody soil amendments.

Field and greenhouse research have confirmed the safety and practicality of recycling some of these materials on agricultural lands. The results are savings for industry, an opportunity for agriculture, conservation of our resources, and protection for the environment.

Average Analyses of Paper Mill Byproducts

| Boiler | Ash[1] | Sludge[1] | Wood Wastes[1] |
|---|---|---|---|
| Neutralizing value[2], pct. | 38 | 13 | — |
| C:N ratio[3] | — | 44 | 76 |
| Moisture, pct. | 26 | 65 | 60 |
| Ash, pct. | 70 | 33 | 6 |
| Nutrients and Metals:[4] | | | |
| Nitrogen | 10 | 18 | 12 |
| Phosphate | 14 | 6 | 1 |
| Potash | 32 | 2 | 2 |
| Calcium | 240 | 120 | 20 |
| Magnesium | 16 | 4 | 1 |
| Zinc | 0.40 | 4.8 | 0.12 |
| Copper | 0.14 | 0.06 | 0.04 |
| Cadmium | <0.01 | <0.01 | <0.01 |

[1]There were 19 samples of boiler ash, 16 of sludge, and five of wood wastes.

[2]Neutralizing value is defined as a percent of calcium carbonate.

[3]Carbon to nitrogen ratio.

[4]Nutrients and metals are measured in pounds per ton of pulp and paper mill byproduct.

Muse is a Graduate Research Assistant and Mitchell is Associate Professor in Agronomy and Soils.

L.J. VINING, J.J. MOLNAR, AND W.D. DAVIES

# ALABAMIANS RANK ENVIRONMENTAL PROBLEMS

Public perceptions of environmental problems have a powerful influence on environmental policy, and in many ways have shaped policy more than scientific assessment of actual risks. A recent survey revealed that Alabamians seem to have very different environmental views than those of technical experts.

Survey respondents ranked the more cosmetic problem of litter as Alabama's greatest environmental risk, while problems such as loss of wetlands and global warming were viewed as much less important. The Environmental Protection Agency's recent Comparative Risk Assessment of Environmental Problems in the Southeast established the latter two problems as more significant risks. These findings indicate a need for better public education concerning actual environmental threats.

**Protection of natural settings, such as this fern cave in Jackson county, is important to everyone, but an AAES study indicates the way scientists and laymen prioritize environmental concerns may vary greatly.**

In the statewide telephone survey, a random sample of 540 Alabama residents was asked to assess risk from 25 environmental problems in three categories: environment, personal health, and the local economy. The 57 percent who participated in the survey rated each risk as very serious, somewhat serious, not very serious, or not serious at all. The table shows the rankings of perceived risk from the top 12 of the 25 problems.

The survey was initiated and sponsored by the Alabama Department of Environmental Management (ADEM) with support from the AAES. In a parallel study, ADEM conducted a technical assessment to rank the 25 problems. The results from both studies will be compared to determine differences between public and scientific perspectives on Alabama's environmental problems.

The problems ranked by Alabama residents as having the greatest environmental risk include litter, dust from cars and industry, loss of atmospheric ozone, and groundwater contamination. These four problems also rank highest as economic risks. As a risk to human health, litter drops to a 9th ranking, but dust, ozone depletion, and groundwater contamination remain as the greatest perceived risks.

Rating litter as such a major risk suggests that the public is less than fully informed about the actual likelihood of harm associated with various types of pollution. Litter is unsightly and unpleasant, which makes it more likely to attract public attention, but it is clearly not as serious an environmental threat as most of the other pollution problems.

Alabamians perceived the farm-related problems of groundwater contamination and pesticide runoff to be serious threats to their health and environment. Both were ranked within the top five problems in both categories. By comparison, EPA's technical ranking of these problems in the Southeast was considerably lower. It is unclear whether the differences in rankings are due to differences in lay/expert perspectives or whether they are related to differences in the geographic scope of the studies. ADEM's forthcoming technical assessment of Alabama's environmental problems should shed additional light on this question.

These findings make it clear that the public needs to become better informed about the relative seriousness of environmental problems. This study is one of several efforts by ADEM to improve communication with the public about environmental problems. These efforts should result in more coherent environmental policy and more efficient allocation of resources by public agencies.

HOW ALABAMIANS RANK 12 ENVIRONMENTAL PROBLEMS IN THREE CATEGORIES: ENVIRONMENT, PERSONAL HEALTH, AND LOCAL ECONOMY[1]

| Environmental Problem | Perceived Risk To: | | |
|---|---|---|---|
| | Environment | Health | Economy |
| Litter | 1 | 9 | 1 |
| Dust from Cars, Industry | 2 | 1 | 4 |
| Ozone Depletion | 3 | 2 | 2 |
| Groundwater Contamination | 4 | 3 | 3 |
| Pesticide Runoff | 5 | 5 | 10 |
| Landfills | 6 | 8 | 6 |
| Chemical Accidents | 7 | 4 | 5 |
| Mining/Roads/Trash | 8 | 12 | 9 |
| Contaminated Drinking Water | 9 | 6 | 8 |
| Air Pollution | 10 | 10 | 7 |
| Industrial Waste Water | 11 | 11 | 11 |
| Hazardous Waste | 12 | 7 | 12 |

[1]Ranks are based on mean scores; 1=greatest risk. Each respondent ranked risks in only one of the three categories: 193 ranked environmental risks; 187, health risks; and 160, economic risks. Respondents were randomly assigned one of the rating dimensions in order to reduce their inconvenience.

Vining is a Graduate Research Assistant of Fisheries and Allied Aquacultures; Molnar is Alumni Professor of Rural Sociology; and Davies is Butler-Cunningham Eminent Scholar in Agriculture and Environmental Issues.

E.W. ROCHESTER AND L.M. CURTIS

# ALABAMA STREAMS CAN PROVIDE MORE WATER FOR IRRIGATION

The dry summer of 1993 made farmers wish they had saved some of the rain that fell on Alabama during the wet winter months. Thanks to an AAES project, they may soon be able to do just that.

AU agricultural engineers are developing methods of storing excess stream water during the rainy season for use in summer irrigation. One goal is to evaluate the potential of pumping water into off-stream reservoirs. In an initial phase of the study, they examined water availability in representative Alabama streams. Their findings form the basis for developing a procedure to determine how much water can reasonably be removed from a stream.

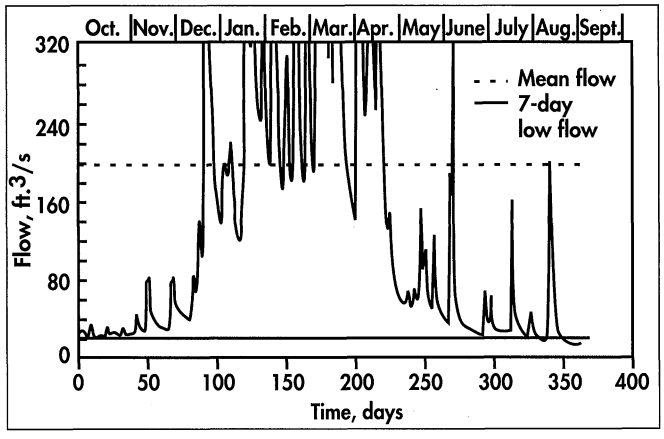
On-stream reservoirs can be used to store water from winter stream flows, but they are not always practical. Summer pumping provides water to a few farms, but problems arise when more users try to pump from the same streams.

Pumping water from streams during high flow and storing it in off-stream reservoirs appears to be one high-potential option. This method may alleviate problems related to competition for summer runoff, land ownership, reservoir site availability, and wetlands destruction, while making more water available for everybody.

Researchers studied three streams in the Tennessee Valley area: Piney, Limestone and Indian creeks. These streams are adjacent, flow through similar geological formations, have existing stream flow data, and are in an area where irrigation from streams is increasing.

Researchers used two stream flow measurements — (1) the mean flow, an average of stream flow over a relatively long time period, usually many years, and (2) the "seven-day $Q_2$," an average of the seven lowest consecutive daily flows in a two-year period.

They used this analysis to compute how much water could be removed during times when flow was above a given minimum level. Computations were made based only on flow rates from January to April, when Alabama receives much of its rainfall (see the figure). Having such data computed on an annual basis does not provide a good estimate of how much water can be expected, but using the information to make statistical predictions does provide the desired results. Preliminary results are shown in the table for Limestone Creek. The 90% probability shown in the table means that on average at least that amount of water will be available nine years out of 10. A larger amount of water can be expected one year in two (50% probability).




**Daily stream flow for Limestone Creek, 1969-1970. Data provided by the Tennessee Valley Authority.**

Values presented in the table are distributed over the entire watershed supplying the water. Since only a part of that land is farmed, and only a portion of the farm land will be irrigated, more water will be available to the irrigated land.

The amount of water needed varies with weather, crop type, and irrigation system efficiency. One rule is to store enough water to apply 12 inches to each acre irrigated. Using this rule, adequate water would be available from Limestone Creek nine years out of ten so long as the irrigated acreage does not exceed 17% of total watershed acreage if pumping is limited to flows above the mean flow. If pumping is initiated above the seven-day low, adequate water will be available as long as the irrigated acreage does not exceed 50% of the watershed acreage.

Having the flow data makes computing the amount of available water relatively easy, but farmers must also know when to stop pumping. This is a tougher question that deals with environmental impact and societal values. The AAES project sidestepped that question for now, but will address the issue later.

There may be competing uses for water to consider in determining availability. As the demand for water increases, there will be less available for pumping directly from streams. The use of water management districts might make the water more generally available and reduce the possibility of disputes over usage.

Of course, having water available affordably is a separate issue. Other studies will focus on the economics of off-stream storage and strategies for implementing long-range water resource development.

PREDICTED VOLUME OF AVAILABLE WATER FOR LIMESTONE CREEK, JANUARY-APRIL

| Probability | Minimum pumping rate[1] | |
|---|---|---|
| | Mean Flow | 7-day $Q_2$ |
| *Pct.* | *Acre-in./a.*[2] | *Acre-in./a.*[2] |
| 90 ..... | 2.0 | 5.9 |
| 50 ..... | 5.2 | 12.0 |

[1]Mean flow and seven-day $Q_2$ are defined in the text.

[2]Acre-inches/acre = the number of inches of water an acre of farm land can get per each acre of the watershed.

Rochester is Associate Professor and Curtis is Professor of Agricultural Engineering.

J.C. LIN, B.R. MOSS, K.A. CUMMINS, D.A. COLEMAN, AND R.C. SMITH, III

# Effects of Different Cooling and Management Regimes on Milk Production

A major concern of dairy producers throughout the South is the effect of prolonged heat stress on milk production. Cows often eat less during hot weather, which results in lower milk production. Modifying diet and employing management practices, such as providing shade or sprinkling animals with water, are generally recommended to reduce the effects of heat stress.

Many dairy operations throughout the state utilize fans and a water mist to assist in cooling both air and cows. However, this constant mist of water may layer a blanket of humidity on the cows, which would reduce the cooling effect. How such systems affect feed intake and milk production is not apparent, so an AAES study was conducted at the E.V. Smith Research Center Dairy Unit, Shorter, to compare feed intake, milk production, milk composition, and other factors of cows maintained under different cooling regimes during hot weather.

Thirty-nine lactating Holsteins averaging 156 days in milk were assigned to three different environments from June 15 to September 7, 1992. Treatments were: (A) regular management as a control; (B) housed indoor with limited forced-air cooling from fans; and (C) housed indoor with Turbo-Aire fans and water sprinklers to reduce heat. Cows in the control group were outside five to six hours a day and at night. Cows in all three treatments were fed and milked at the same time. Fans and water operated when air temperature was greater than 78°F. For Treatment C, fans were on continuously when temperatures exceeded 78°F and intermittent water was sprinkled at 10 psi for four three-minute cycles per hour.

**Cows cooled with Turbo-Aire fans and water sprinklers at the E.V. Smith Research Center.**

The average maximum indoor temperature for treatments A and B were essentially the same (87.1°F). However, Treatment C had a significantly lower temperature (77.2°F) and reduced temperature over the use of a fan alone. The minimum indoor temperature of all treatments did not differ. As expected, the relative humidity was higher for Treatment C than for other two treatments (90% versus 70%), due to high moisture content in Treatment C caused by water sprinkling in the system.

Effects of treatments on cows are presented in the table. The respiration rate (breaths per minute) of cows under the two indoor treatments was lower than for cows under the control treatment; however, the indoor "cooled" treatment resulted in the lowest respiration rate of the three different treatments.

Dry matter intake (DMI) was slightly higher for cows under Treatment B (37.8 pounds per day) and considerably higher for cows under Treatment C (40.9 pounds per day) than for cows under the control (36.1 pounds per day). Treatment C stimulated feed intake, resulting in higher milk production by five and nine pounds per day over the other systems (treatments A and B, respectively) in dairy cows during hot weather. The milk fat content for cows under Treatment B (3.60%) tended to be higher than those under Treatment A (3.36%), but was not different from those under Treatment C (3.47%). Milk protein content (3.23%) was not affected by treatments.

In this study, DMI and milk production increased with decreasing maximum temperature. Reducing the environmental temperature by use of a proper cooling system during hot weather may increase DMI and milk production. Use of a combination of fans and water sprinklers increases DMI and milk production over the use of fans alone. Additional information on operation costs and comparison of other systems are needed.

Effects of Various Cooling Regimes on Lactating Dairy Cows

| | Cooling treatments | | |
|---|---|---|---|
| | (1)Control | (2)Indoor/fan | (3)Fan/sprinkler |
| Intake (lb/d) | | | |
| Dry matter | 36.1 | 37.8 | 40.9 |
| Yields, (lb/d) | | | |
| Milk | 49.3 | 45.3 | 54.3 |
| 3.5% FCM | 48.2 | 46.2 | 54.1 |
| Milk Composition (%) | | | |
| Fat | 3.36 | 3.60 | 3.47 |
| Protein | 3.19 | 3.24 | 3.27 |
| Respiration Rate per min. | 76.6 | 66.9 | 36.2 |
| Body score | | | |
| Initial | 2.62 | 2.62 | 2.54 |
| Final | 2.42 | 2.30 | 2.29 |
| Body weight | .62 | -.51 | .53 |

Lin is Research Associate, Moss is Professor, and Coleman and Cummins are Associate Professors of Animal and Dairy Sciences; Smith is Superintendent of the E.V. Smith Research Center Dairy Unit.

C. W. COOK, S. R. SHATTLER, H. L. STRIBLING, M. K. CAUSEY

# Survival and Dispersal of White-Tailed Deer Released in Northwest Alabama

Alabama currently has approximately 1.5 million white-tailed deer, with all counties having huntable populations. However, one area in Alabama where deer numbers have remained below desired levels is the 180,000 acre William B. Bankhead National Forest (BNF), in Lawrence and Winston counties. Hunter success has remained very poor despite conservative harvest of primarily "antlered only" deer. As a result, the Alabama Department of Conservation and Natural Resources Game and Fish Division, and the U.S. Forest Service began a restocking program on BNF in order to increase the size of the local deer herd.

In winter 1990, 114 deer from Fred T. Stimpson Sanctuary, located in Clarke County, were released in BNF. Return of ear tags placed in deer released in 1990 indicated relocated deer may be leaving BNF.

The restocking program was continued during winter 1991, releasing 148 deer onto the BNF. In order to determine the fate of stocked deer, wildlife researchers from Auburn University placed radio transmitters on a select group of deer during the 1991 release. Transmitters were placed on 11 males and 11 females of less than 1.5 years of age and 10 adult males over 2.5 years of age, to determine if the deer would remain in the area and survive.

The radio collars used on the deer were fitted with a small (1-2 inch) piece of latex surgical tubing. The tubing allowed the nylon collars to stretch and finally, due to deterioration of the latex tubing, fall off deer within one year. Radio collars also were mortality sensitive. Once a collar remained motionless for a period of approximately five hours, transmitted signals changed from a slow beep to a rapid beep.

Deer were located using aerial telemetry and locations were taken at least three times weekly for one year until radio collars fell off, failed, or until contact was lost. Each deer was located once per day and its location was plotted on a map.

A deer was considered to have survived the study period if it was still alive at the time its radio collar fell off or quit functioning. Dispersal was recorded as the maximum distance an individual was located from its release site and as the distance from the center of its home range to the release site.

Survival and Dispersal of Deer Released in Northwest Alabama

| | Adult males | Subadult males | Subadult females |
|---|---|---|---|
| Survival (%) | 100 | 81.8 | 81.8 |
| Mean Maximum Dispersal (miles) | 9.2 | 4.5 | 8.3 |
| Mean Distance to Center of Home Range (miles) | 4.5 | 3.8 | 5.9 |

One hundred percent of adult males and 82% of young males and young females survived the study period. Four animals (two young males, two young females) died soon after release. These animals likely died from the stress associated with relocation.

Deer dispersed over a total area of 221,614 acres around the release site. The maximum dispersal distance for all deer had a mean of 7.31 miles and varied from 1.04-16.40 miles. Adult male deer had the largest mean maximum dispersal distance of any group (9.23 miles). Young females showed a slightly smaller mean maximum dispersal distance of 8.32 miles, with young males having the smallest mean maximum dispersal distance of all groups (4.47 miles).

The distance from the release site to the center of the established home ranges for all deer had a mean of 4.8 miles. Adult males had a mean of 4.5 miles, young females had a mean of 5.9 miles, and young males had a mean of 3.8 miles. Eighteen deer established home ranges within six miles of the release site, with only two deer moving over 12 miles from the release site before establishing a home range.

These results suggest most of the deer released on BNF survived and remained on the area. Using these results as a guide, the restocking program should be viewed as a success. The translocated deer should begin to reproduce, eventually resulting in a larger deer herd.

Cook and Shattler are Graduate Research Assistants, Stribling is Associate Professor, and Causey is Professor of Zoology and Wildlife Sciences.

J. G. DYESS, M. K. CAUSEY, H. L. STRIBLING, AND B. G. LOCKABY

# Effects of Fertilization on Production and Quality of Japanese Honeysuckle Deer Browse

Japanese honeysuckle, a nutritious and widely distributed woody evergreen vine, can constitute a major portion of the seasonal diet, and in some cases the year-round diet, of white-tailed deer in the Southeast. The leaves and seeds also are eaten by cottontail rabbits, northern bobwhites, and eastern wild turkeys. Recent AAES studies indicate well managed honeysuckle can produce more food, higher quality, and at a lower cost than many planted wildlife food plots.

The study area, located in Randolph County, was a 2.5-acre natural opening covered with a dense growth of Japanese honeysuckle. The honeysuckle stand was mowed with a rotary cutter in February 1989 to a uniform height of approximately six inches and all trees and brush were removed to reduce the variability of shading. Soil samples were analyzed by the Auburn University Soil Testing Laboratory.

Across the site, 36 pairs of circular exclosures (1.5 square yards in area and six feet high) were used to restrict access by rabbits and deer.

In April 1989, one exclosure of each pair was selected at random to be limed and fertilized according to the soil analysis recommendations for honeysuckle (3.5 tons per acre lime and 136 pounds per acre) nitrogen). In June samples were taken from treatment and control plots to estimate growth and nutrient content. After samples were taken, treatment plots received an application of 70 pounds per acre N, 20 pounds per acre K, and 20 pounds per acre P in the form of ammonium nitrate (34-0-0) and a complete fertilizer (13-13-13). In late September and early October 1989, samples were collected and an application of fertilizer was applied at the same rates listed above. Plots were sampled and fertilized in a similar manner in 1990.

In 1989, treatment plots produced an average of 4,429 pounds per acre while control plots produced 2,348 pounds per acre. In 1990, similar results were observed. Treatment plots averaged 4,335 pounds per acre and control plots averaged 2,270 pounds per acre.

Because deer appear to selectively browse on the leaves, leaf production in treatment plots was compared to control plots. Using leaf percentages and total production for 1989, treated plots produced more than twice the quantity of leaves (2,481 vs. 1,127 pounds per acre) as control plots. Nutritional analyses of leaf samples indicated that for all seasons during both years, samples from treatment plots contained higher crude protein (16.5%) than controls (11.1%).

This research demonstrates that fertilization can often double year-round production and improve nutritional quality in Japanese honeysuckle browse, which may be especially important during the critical fall and winter period.

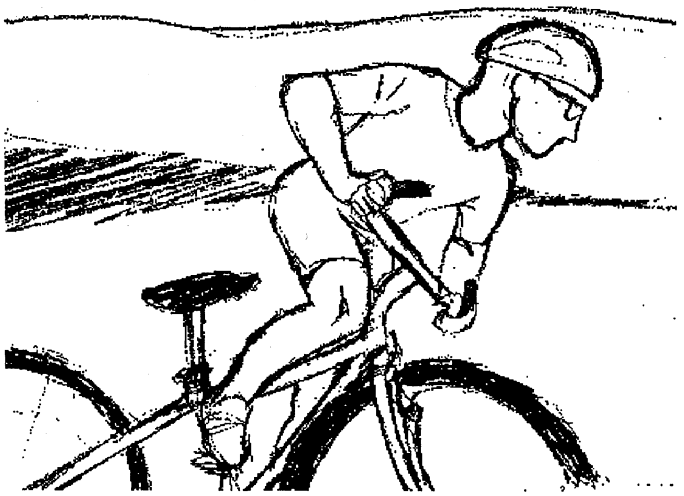
On a large scale, forest fertilization could become quite expensive, but if limited to selected patches, could prove to be a cost-effective alternative to cultivated food plots. For example, honeysuckle forage production in 1989 averaged 2,481 pounds per acre at an initial cost per acre of approximately $134.00 (3.5 tons lime @ $22 per ton, 300 pounds 13-13-13 @ $9.50 per 100 pounds, and 300 pounds ammonium nitrate @ $9.50 per 100 pounds). A cultivated food plot on a similar area, containing a biennial red clover, could be expected to produce an average 1,115 pounds per acre of browse which would be unavailable to wildlife from September through December. The clover planting would thus produce less than half the forage compared to the fertilized honeysuckle, and would cost more to establish at approximately $150 per acre (3.5 tons lime @ $22 per ton, 300 pounds 13-13-13 @ $9.50 per 100 pounds, and 25 pounds seed @ $1.75 per pound), and would not be as available when it is most needed.

Dyess is Graduate Research Assistant, Causey is Professor, and Stribling is Associate Professor of Zoology and Wildlife Sciences; and Lockaby is Professor of Forestry.

**Healthy stand of Japanese honeysuckle.**

R. E. KEITH, C. L. CONNELL AND M. SUN

# STRESS AND VITAMIN C REQUIREMENTS



High vitamin C intake was shown to reduce the harmful effects of stress in recent AAES studies. Stress may be defined as a strain, pressure, or force exerted upon the body. Short-term stress is beneficial, but prolonged stress can have detrimental effects. Stress can be physical — smoking or exhaustive exercise; psychological — job or school pressures; or social — peer pressure to take drugs.

No matter what causes stress, the body's response is similar. Increased blood pressure, heart rate, and release of certain hormones such as cortisol and adrenaline are typical responses. Prolonged stress can decrease immune system function, cause a loss of muscle tissue, and increase the incidence of stroke, heart attacks, and other conditions. Vitamin C has been shown to decrease blood pressure in some people and to exhibit other anti-stress properties.

Historically, the Recommended Dietary Allowance (RDA) for vitamin C has been set at an amount that satisfactorily prevents symptoms of vitamin C deficiency. However, current research is looking at vitamin C needs from the point of view of optimal health and the intake that might be needed to reduce the detrimental effects of stress. Recently, the RDA for vitamin C was increased from 60 milligrams (mg) per day to 100 mg per day to cover the stress on the body from smoking cigarettes.

Exercise stresses the body. Like many other stressors, some exercise is beneficial, but excessive exercise can be harmful. For example, exercise is known to increase the production of the stress-related hormone cortisol, high concentrations of which can break down lean body mass and depress the immune system over a prolonged period. Since cortisol is an indicator of stress, exercise can be used as a model for determining how vitamin C might help the body cope with stress.

AAES studies have focused on the effects of consuming supplemental vitamin C while undergoing a strenuous exercise regimen. In one study, guinea pigs were exercised in an animal treadmill. Half the animals received vitamin C at the requirement level. The other half received vitamin C at three times the required intake. After exercise, guinea pigs receiving extra vitamins had almost 30 percent less plasma cortisol. This finding indicates that the stress response to exercise was not as great in animals receiving more vitamin C.

Another study used trained male and female cyclists as subjects. Researchers first established the workload necessary on a stationary bicycle for each cyclist to maintain maximum heart rate. After receiving dietary vitamin C at the RDA of 60 mg per day for two weeks, the subjects rode for one hour at 80% of their maximum effort. They repeated the ride after receiving 600 mg for another two weeks. Results indicated that plasma cortisol concentrations (Table 1), blood pressure measurements (Table 2), and working heart rates were all lower when the subjects received the higher amounts of vitamin C. Thus, as in the animal work, response to exercise-induced stress was not as great in subjects receiving higher amounts of vitamin C.

These studies support the concept that vitamin C has some anti-stress properties. Doses of vitamin C that were above current RDA values seemed to benefit subjects undergoing exercise stress as evidenced by reduced plasma cortisol and blood pressure rates.

While vitamin C intake above current recommendations may have some benefit in controlling stress, supplements are not necessary if one's diet includes plenty of the vitamin. For example, a cup of broccoli contains 120 mg of vitamin C; a 12-ounce glass of orange juice, 180 mg; one-third of a cantaloupe, 60 mg; and a baked potato, 30 mg. Other good sources of vitamin C include citrus fruit, strawberries, green peppers, and green leafy vegetables.

TABLE 1. PLASMA CORTISOL CONCENTRATIONS IN CYCLISTS

| Vitamin C Intake | Cortisol Concentrations[1] Resting | 10-min. post-exercise | 15-hr. post-exercise |
|---|---|---|---|
| RDA (60 mg) | 21 | 25 | 27 |
| 10 x RDA (600 mg) | 18 | 17 | 23 |

[1]Cortisol concentrations are measured in nanograms/milliliter.

TABLE 2. BLOOD PRESSURE MEASUREMENTS IN CYCLISTS

| Vitamin C Intake | Blood pressure measurement Resting | 10-min. post-exercise | 15-hr. post-exercise |
|---|---|---|---|
| RDA, 60 mg | | | |
| Systolic | 120 | 112 | 121 |
| Diastolic | 79 | 72 | 73 |
| 10 x RDA, 600 mg | | | |
| Systolic | 114 | 110 | 113 |
| Diastolic | 70 | 69 | 72 |

Keith is Professor, Connell and Sun are former graduate students of Nutrition and Food Sciences.

D.E. CONNER, D.L. HUFFMAN, AND N.M. AHMED

# HEAT RESISTANCE OF *ESCHERICHIA COLI* O157:H7 IN LOW-FAT MEAT AND POULTRY PRODUCTS

*Escherichia coli* bacteria are common, usually harmless inhabitants of all warm-blooded animals including humans. However, the serotype known as *E. coli* O157:H7 is a highly virulent pathogen that causes severe disease of the colon and kidneys, and is a leading cause of kidney failure in children.

Cattle and poultry are apparently sources of this pathogen. Undercooked ground beef and raw milk have been associated with disease outbreaks. Of the 16 foodborne disease outbreaks caused by *E. coli* O157:H7, six have been attributed to mishandled ground beef. The latest, occurring from November 1992 to February 1993 and caused by under-cooked hamburgers from a fast-food restaurant in several western states, has received tremendous media attention. Two earlier outbreaks in Europe were attributed to consumption of contaminated poultry.

AAES research is focusing on characterizing the heat resistance of *E. coli* O157:H7 as influenced by internal and external factors. Previous AAES research showed that heat-resistance among various isolates from retail meats differ significantly. Furthermore, AAES work in this area has identified methodologies that permit the generation of more reliable heat resistance data.

It is known that product composition and environmental conditions affect the lethality of heat toward *E. coli* O157:H7; therefore, this research targeted the influence of fat-reduction formulations (AU Lean™) on the survival of the pathogen in cooked beef, pork, and poultry (chicken and turkey). Products were prepared, placed in glass tubes, inoculated with a known population of *E. coli* O157:H7, sealed, and immersed in a shaking water bath at 122, 130, or 140°F. The sealed tube method is considered to be a highly reliable means of determining cooking processes. At prescribed times, three tubes were removed, immediately cooled, and the contents were analyzed for numbers of surviving *E. coli* O157:H7. From this, "thermal death" or "survivor" curves were plotted and D-values were calculated.

HEATING TIMES AT VARIOUS PRODUCT TEMPERATURES REQUIRED TO KILL 100,000 CELLS OF *ESCHERICHIA COLI* 0157:H7

| | Product | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ground chicken | | Ground turkey | | Ground beef | | | Pork sausage | | |
| Temperature | 3% fat | 11% fat | 3% fat | 11% fat | 8% fat | 20% fat | AU Lean[1] | 8% fat | 30% fat | AU Lean[2] |
| 122°F | 5.4 hr | 8.8 hr | 5.9 hr | 9.6 hr | 6.7 hr | 7.7 hr | 4.6 hr | 5.2 hr | 6.7 hr | 4.1 hr |
| 130°F | 44 min | 49 min | 32 min | 48 min | 76 min | 96 min | 57 min | 39 min | 56 min | 44 min |
| 140°F | 144 sec | 165 sec | 165 sec | 175 sec | 135 sec | 132 sec | 135 sec | 138 sec | 135 sec | 111 sec |
| 150°F | 9 sec | 9 sec | 11 sec | 10 sec | 10 sec | 10 sec | 12 sec | 10 sec | 9 sec | 8 sec |
| 155°F | 3 sec | 3 sec | 3 sec | 2 sec | 2 sec | 2 sec | 3 sec | 3 sec | 2 sec | 2 sec |
| 160°F | <1 sec | <1 sec | <1 sec | <1 sec | <1 sec | <1 sec | <1 sec | <1 sec | <1 sec | <1 sec |

[1] Total fat content, 8%.
[2] Total fat content, 7% .

**At prescribed times, three tubes were removed, immediately cooled, and the contents were analyzed**

Food safety officials recommend a value of "5D" cook for meat and poultry products. This means that cooking time and temperature will destroy 100,000 cells of *E. coli* O157:H7. It is likely that a contaminated product would contain lower (less than 10-100) numbers, thus a 5D process represents a large safety margin. Data from the survivor curves were used to calculate 5D values (expressed in time units) at various cooking temperatures (see table). The greatest differences were seen at the lower temperatures (122 and 130°F), at which the pathogen survived well in all products. Increasing fat levels further protected *E. coli* O157:H7 from heat. For AU Lean products cooked at these temperatures, less time would be required to provide the 5D kill as compared to the other beef and pork products tested. This indicates that *E. coli* O157:H7 is killed more rapidly in AU Lean products, probably due to reduced fat and increased water levels. At 140 and 150°F, these differences were not seen except in the AU Lean pork sausage in which the pathogen was killed more rapidly than in other products. At 155 and 160°F, *E. coli* O157:H7 are rapidly killed in all products.

These data indicate that cooking processes of at least 140°F for two to three minutes provides a reasonable margin of safety from *E. coli* O157:H7. At lower temperatures, which would be indicative of under cooking, AU Lean ground beef and pork sausage provide an additional degree of safety over traditional products. Also, *E. coli* O157:H7 is more sensitive to lower cooking temperatures (less than 140°F) in poultry products than in other meat products.

These results generally agree with previously reported data, but provide additional information regarding product formulation effects on heat destruction of an important emerging foodborne pathogen. Results also reconfirm that proper handling and cooking of meat and poultry are the best means of preventing foodborne diseases.

Conner is Assistant Professor and Ahmed is Graduate Research Assistant of Poultry Science; Huffman is Professor of Animal and Dairy Sciences.

G.B. RUNION, H.H. ROGERS, S.A. PRIOR, R.J. MITCHELL, AND F.P. HENNING

# PLANT RESPONSES TO ATMOSPHERIC $CO_2$ ENRICHMENT: LOCAL RESEARCH ON GLOBAL CHANGE

Although many aspects of global change remain controversial, there is incontestable evidence that the concentration of carbon dioxide ($CO_2$) in the Earth's atmosphere is increasing. This concentration may double from its present level during the next century. Carbon dioxide is essential for photosynthesis, which sustains plant life (the basis of the entire food chain), and plants will likely be directly affected by increasing levels of $CO_2$.

Studies involving effects of elevated $CO_2$ on plants have proceeded with increasing intensity during the past few decades and much is now known about how plants, particularly crop plants, respond to higher levels of atmospheric $CO_2$. In the agricultural context, many benefits of extra $CO_2$ have been observed. The growing season has been shortened for some crops, the effects of many environmental stresses (drought, temperature, salt, damage from air pollutants, etc.) have been reduced, and less water use has generally been observed.

Virtually all studies to date have shown enhanced crop growth and greater yield; doubling normal (ambient) $CO_2$ concentration results in yield increases of about 33% for many crops. However, gaps in understanding plant responses to elevated $CO_2$ still exist, particularly in regard to root growth and other below-ground processes; the fate of "extra" carbon within the plant/soil/atmosphere system; effects on natural, non-agricultural plant communities; and the mechanisms responsible for the observed responses.

Plant responses to elevated $CO_2$ are currently being researched at the USDA-ARS National Soil Dynamics Laboratory. Results of these studies will provide information to help fill several major gaps in the $CO_2$ database. This research is jointly funded by the USDA-ARS, AAES, and the U.S. Department of Energy's National Institute for Global Environmental Change. This work is a large collaborative effort among USDA-ARS scientists, cooperators from other institutions (The Woods Hole Research Institute, Oak Ridge National Laboratory, and Duke University), and scientists from Auburn.

This $CO_2$ research is being conducted as an integrated, multi-species project with two main research thrusts; one study uses sorghum and soybeans as model plant species and the other involves longleaf pine. All $CO_2$ investigations are currently taking place within open top chambers where these plant species are exposed to air with an ambient concentration of $CO_2$ (about 360 parts per million) or to air with twice that amount of $CO_2$.

**Open top chambers, used to generate large-scale $CO_2$ test atmospheres, during the first year of the sorghum and soybean study at the USDA-ARS National Soil Dynamics Laboratory. (Photo courtesy of Paul J. Hammock)**

The sorghum and soybean study has two primary focal points. The first is to determine what plants do with extra atmospheric carbon dioxide. The second major focus of this study is to investigate the effects of higher $CO_2$ on root growth and other below-ground processes, such as changes in the composition and activity of populations of fungi, bacteria, and nematodes in the rhizosphere. Many other investigations also are occurring that utilize these plant species, such as effects of elevated $CO_2$ on nitrogen uptake by plants and its effect on water quality, $CO_2$-induced changes on soil processes, and $CO_2$ effects on seed quality.

The longleaf pine study is primarily examining the interacting effects of elevated $CO_2$ and resource availability (namely differences in nitrogen and water) on carbon allocation patterns, respiration, and root function. The long-range goal of this research is to examine, in addition to longleaf pine, the response of other species (wiregrass, wax myrtle, etc.) that comprise a natural and endangered ecosystem. Ultimately, this research will examine effects of competition among species, as influenced by $CO_2$, by growing them together to simulate a typical environment. Other issues being addressed by this study include changes in the flammability of plant tissue and the effects of fire-related plant metabolites on water quality.

During the first year of the sorghum and soybean study growth and yield responses were similar to trends from earlier reports that indicated $CO_2$ enrichment increased growth and yield of both species. The largest response of sorghum and soybean to elevated $CO_2$ occurred in the roots, which corroborates other reports by members of this $CO_2$ research team.

Although this $CO_2$ research was only begun in 1992, this state-of-the-art, multi-species study will help eliminate uncertainties regarding plant responses to increasing concentrations of atmospheric $CO_2$ and will contribute to the knowledge base upon which future environmental strategies can be based.

Runion is Research Fellow of Forestry; Rogers is Adjunct Professor of Agronomy and Soils and Forestry and Plant Physiologist with the USDA-ARS Soil Dynamics Laboratory; Prior is Plant Physiologist, USDA-ARS Soil Dynamics Laboratory; Mitchell is Associate Professor of Forestry; and Henning is Graduate Research Assocate of Agronomy and Soils.

M.G. PATTERSON AND B.E. NORRIS

# TRANSGENIC COTTON ALLOWS OVER-THE-TOP WEED CONTROL

AAES tests indicate a new cotton variety which contains a gene making it immune to damage from specific herbicides may prove to be a valuable weed control tool for Alabama cotton farmers.

The new variety, BXN, was developed by Calgene Inc., a California-based company. It contains a gene from a bacteria that makes it resistant to bromoxynil, which is sold by the trade name Buctril. Bromoxynil is registered for broadleaf weed control in corn and small grains, but will kill cotton. It is a contact herbicide which has little soil activity.

BXN cotton has been tested for three years by the AAES to determine its potential use by growers. Field trials were initiated in 1991 at the Tennessee Valley Substation, Belle Mina, to evaluate weed control and crop tolerance using bromoxynil on transgenic BXN cotton. Cotton weed control systems using bromoxynil in conjunction with currently registered herbicides were evaluated in 1992 and 1993. Bromoxynil treatments were applied over-the-top of transgenic cotton in 15 gallons of spray solution per acre when the crop was four inches and/or eight inches tall.

No visual injury was seen on BXN cotton treated with bromoxynil at rates up to 1.5 pounds of active ingredient applied twice. Non-transgenic cotton (eight inches tall) sprayed with 0.5 pounds bromoxynil per acre was killed.

**BXN cotton (right) sprayed with Buctril was not affected, but adjacent non-transgenic cotton was killed by the herbicide.**

TABLE 1. CONTROL OF 2-4 INCH WEEDS WITH BROMOXYNIL APPLIED AT DIFFERENT RATES

| | Weed Species[1] | | | | |
|---|---|---|---|---|---|
| Bromoxynil rate | MG | VL | PS | TC | SP |
| *Lb./a.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| 0.25 | 90a | 88b | 88b | 80b | 0 |
| 0.5 | 95a | 95a | 95a | 95a | 0 |
| 1.0 | 95a | 95a | 95a | 95a | 5 |
| 1.5 | 95a | 95a | 95a | 95a | 8 |

[1] MG= entire leaf morningglory; VL = velvetleaf; PS = prickly sida; TC = tropic croton; and SP = sicklepod.

TABLE 2. WEED CONTROL SYSTEMS USING BROMOXYNIL

| System[2] | Herbicide rate | Control by species[1] SP | MG | VL | PS |
|---|---|---|---|---|---|
| | *Lb./a.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| Bromoxynil (OT4) | 1.5 | 27c | 95a | 95a | 93a |
| Methazole (PD4) | 0.5 | 57b | 72c | 72b | 77b |
| Methazole (PD4) + Cyanazine (PD8) | 0.5 + 0.75 | 53b | 85b | 67b | 80b |
| Fluometuron (PRE) | 1.5 | 83a | 85b | 58c | 82b |
| Fluometuron (PRE) + Bromoxynil (OT4) | 1.5 | 82a | 95a | 95a | 93a |

[1] SP = sicklepod, MG = morningglory, VL = velvetleaf, and PS = prickly sida.
[2] OT4 = over-the-top to 4 inch cotton; PD4 = post directed to 4-inch cotton; PRE = preemergence.

Weed control by species for different bromoxynil rates is shown in Table 1. Excellent control of velvetleaf, entireleaf morningglory, prickly sida, and tropic croton was obtained with bromoxynil applications of 0.5 pounds per acre or higher. Although not shown, bromoxynil will control common cocklebur, bristly starbur, Florida beggarweed, and other broadleaf weeds. Sicklepod is one important weed which bromoxynil will not control (Table 1).

Bromoxynil will not control annual grasses; therefore, weed control systems must be employed using bromoxynil as one component. Table 2 shows weed control provided by standard herbicide and bromoxynil systems.

All treatments received trifluralin at 0.5 pounds per acre preplant incorporated for annual grass control. Bromoxynil applied over-the-top when cotton was four inches tall provided excellent control of morningglory, velvetleaf, and prickly sida, but did not control sicklepod. Fluometuron (Cotoran) applied preemergence provided good control of sicklepod but did not adequately control velvetleaf. Combining the two treatments provided good to excellent control of all weeds. Over-the-top sprays are easier to apply than post-directed sprays which can injure cotton.

Yields were not obtained due to USDA regulations. However, Calgene anticipates BXN cotton will have good agronomic characteristics. Cotton is expected to be grown on an experimental use permit in 1994, and seed should be commercially available by 1995.

Patterson is Associate Professor of Agronomy and Soils and Norris is Assistant Superintendent of the Tennessee Valley Substation.

D.W. REEVES, P.L. MASK, C.W. WOOD, AND D.P. DELANEY

# CAN CHLOROPHYLL METERS PREDICT WHEAT YIELDS?

Farmers need a reliable, easy-to-use method for determining the nitrogen (N) status of wheat that can be used to better manage N fertilizer applications. Applying too little N reduces wheat yields, while applying too much is not economical and poses a threat to water quality. Nitrogen fertilizer applications to wheat can be particularly inefficient because wheat is grown during the winter when rainfall is high and loss of water by evaporation and plant use (evapotranspiration) is low. If researchers can determine the wheat N status at critical growth stages, the information could be used to help predict how much N should be applied to a wheat crop.

Recently, hand-held meters that measure leaf greenness as an indicator of chlorophyll concentration in the plant have become available in the United States. Because chlorophyll is largely made up of nitrogen, readings from these meters may be useful for determining the N status of crops, such as wheat. Unlike other methods of determining N status of crops that require sending plant samples to a laboratory for analysis, chlorophyll meter measurements are easily made in the field.

A field study at the E. V. Smith Research Center, Shorter, recently evaluated the ability of these meters to determine the N status of wheat grown with different management conditions. The study was a cooperative effort by the AAES and the USDA Agricultural Research Service and was supported in part by the Alabama Farmers Federation's Wheat and Feed Grain Check-Off Program.

Saluda wheat was sown following disk harrowing with and without deep tillage using a paraplow. Nitrogen rates of 0, 40, 80, 120, and 160 pounds per acre were applied to the wheat with 20 pounds per acre applied at planting and the remainder applied in mid-February. Half the plots received an application of Tilt® fungicide when the flag leaf was just visible (Feekes Growth Stage 8). Whole plant samples were collected at the late tillering stage (Feekes Growth Stage 3) and just prior to jointing (Feekes Growth Stage 5) for determination of dry weight and N concentration. At flowering (Feekes Growth Stage 10.5), flag leaf samples were taken for N analysis. In 1991, at these three sampling times, leaf greenness also was measured with a Minolta SPAD-502® chlorophyll meter.

EFFECT OF MANAGEMENT PRACTICES ON WHEAT GRAIN YIELD AT E.V. SMITH RESEARCH CENTER IN 1990 AND 1991

| | Nitrogen, lb./a. | | | | |
|---|---|---|---|---|---|
| | 0 | 40 | 80 | 120 | 160 |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* |
| 1990 | | | | | |
| Paraplow | | | | | |
| Tilt® | 11 | 22 | 40 | 43 | 44 |
| No fungicide | 10 | 20 | 37 | 40 | 35 |
| Disk | | | | | |
| Tilt® | 10 | 21 | 38 | 47 | 45 |
| No fungicide | 8 | 19 | 36 | 37 | 41 |
| 1991 | | | | | |
| Paraplow | | | | | |
| Tilt® | 7 | 18 | 23 | 27 | 24 |
| No fungicide | 6 | 14 | 17 | 16 | 16 |
| Disk | | | | | |
| Tilt® | 7 | 12 | 18 | 22 | 22 |
| No fungicide | 2 | 10 | 12 | 13 | 13 |

In 1990, there was little response to paraplowing, but application of Tilt increased yields and maximum yields were obtained with 120 pounds N per acre (see table). At the 160 pounds per acre N rate, paraplowing without Tilt application actually reduced yield. Wheat yields throughout the state were low in 1991 due to scab head blight. In 1991 the highest yields were obtained with 120 pounds N per acre in conjunction with paraplowing and Tilt application.

Nitrogen concentrations in wheat plants were highly correlated to chlorophyll meter readings at all three growth stages. Management factors, paraplowing, and application of Tilt not only affected yields but also affected the relationship between plant N content and meter readings. Chlorophyll meter readings also can be affected by factors such as cold stress and choice of wheat variety.

Chlorophyll meter readings taken at Feekes Growth Stage 3 were not good predictors of yield. This growth stage proved too early to accurately predict wheat N needs. Of all the measurements taken, the best predictor of yield was plant N uptake just prior to jointing. Eighty-five percent of the variation in yield among treatments could be explained by plant N uptake at this time. Plant N uptake requires measurements of wheat dry weight in a determined area, for example one-square yard, and laboratory analysis to determine the N concentration in the plant sample. A combination of dry matter measurements and chlorophyll meter readings taken just prior to jointing was nearly equal to plant N uptake measurements in predicting wheat yield. Eighty-one percent of the variation in yield was explained by these two measurements used together.

The ability for dry matter weights and chlorophyll meter readings taken just prior to jointing to account for such a high amount of the variation in yield in this experiment suggests that these two measurements hold promise as a means to predict the amount of N fertilizer needed by wheat at this growth stage. Since this is the growth stage of wheat when the bulk of N fertilizer is applied, and since both of these measurements can be conducted easily on the farm without sending samples to the laboratory, this technology is very practical. Additional research is being conducted to test this technology in combination with soil nitrate tests to develop improved quick and reliable methods for predicting N fertilizer requirements for winter wheat.

Reeves is Affiliate Associate Professor of Agronomy and Soils and Research Agronomist with USDA-ARS-NSDL; Mask is Associate Professor, Wood is Associate Professor, and Delaney is Resource Conservation Research Associate.

D.R. MULVANEY, J.D. HOUGH, W. McELHENNEY, AND J.L. HOLLIMAN

# Growth and Carcass Traits of Progeny Sired by Hereford, Brahman, And Beefmaster Bulls with High Accuracy EPD's

Lean, tender beef can be produced in Alabama using different sire breeds if attention is paid to the quality of sires used in breeding programs. That's what results from the first year of a multi-year study looking at expected progeny differences (EPD's) suggest.

EPD's have had incredible impact on the purebreed and commercial cattle industry. However, EPD's should not be compared across breeds until adequate, accurate data have been generated and analyzed. Considerable interest has been expressed in using EPD's to accurately compare cattle within breeds for many traits, especially growth and carcass traits. Degree of heterosis, which is the average superiority of a crossbred animal compared to the average of the purebreds that make up the cross, among different sire breeds makes comparison of data between breed groups difficult. Any future across-breed EPD estimates of genetic worth will need to account for heterosis. The beef industry also could benefit if accurate across-breed EPD's were available.

A long-term study was initiated at the Black Belt Substation, Marion Junction, to learn more about the accuracy of EPD's within and across selected sire breeds. Short-term goals of the study are to determine relative differences in muscle growth and fat deposition rates between sire breeds.

In the first year of the study, Brahman, Beefmaster, and Hereford sires with high accuracy weaning weight EPD's according to the National Cattle Evaluation were used on Simmental X Angus females. The sires chosen for the study ranked in the upper 10% of their breed and had EPD's with greater than 0.9 accuracy. Bulls were not randomly chosen, however the 0.9 accuracy ensured that each bull has been extensively used and had significant impact on their breed. Cattle were maintained under commercial cattle management conditions. Bull calves were castrated at birth and placed in a confinement feedlot immediately at weaning (240 days of age). Feedlot diets consisted of grain concentrates. Steers were slaughtered when ultrasound back fat depths of 0.4 inch were achieved, and the average age at slaughter was 13.9 months.

Selected Growth and Carcass Data of Calves Sired by Three Breeds

| Sire breed | Birth weight | Wean wt. | Year wt. | ADG[1] wean-year | REA[1]/ cwt. carcass | % choice | Yield grade |
|---|---|---|---|---|---|---|---|
| | | *Lb.* | *Lb.* | *Lb./day* | *In.²/cwt* | | |
| Hereford ..... | 84 | 654 | 1,005 | 2.79 | 1.91 | 80.0 | 2.4 |
| Brahman ..... | 94 | 683 | 1,069 | 3.06 | 1.76 | 86.7 | 2.5 |
| Beefmaster ... | 89 | 663 | 1,078 | 3.42 | 1.73 | 67.0 | 2.8 |

[1]REA = ribeye area; ADG = average daily gain

Data from the first year of this study are presented in the table. Minimal differences in growth and carcass traits were observed between sire groups. Brahman bulls tended to sire calves with heavier births. A national beef industry quality audit indicated that Brahaman- influenced feeder calves receive price discounts from feed yard buyers because of perceived growth and carcass characteristics at slaughter, particularly reduced tenderness of selected muscle cuts. These results suggest that calves sired by Brahman-influenced bulls with high growth EPD's may be unfairly discriminated against for growth and carcass grade traits.

Youthfulness of the beef animal is highly associated with tenderness. Based on laboratory tests, no breed differences were found for tenderness. These results effectively demonstrate that young lean cattle with desirable quality grades and tender cuts can be produced in Alabama.

As additional data are generated, comparisons will be made to the averages of respective breeds and across breeds.

**Calves sired by Brahman-influenced bulls with high growth EPD's may be unfairly discriminated against for growth and carcass grade traits.**

Mulvaney is Associate Professor and McElhenney is Research Fellow of Animal and Dairy Sciences; Holliman is Superintendent of the Black Belt Substation; and Hough is Vice-President for American Polled Hereford Association.

E. van SANTEN, J.T. TOUCHTON, J.F. PEDERSEN, AND D.M. BALL

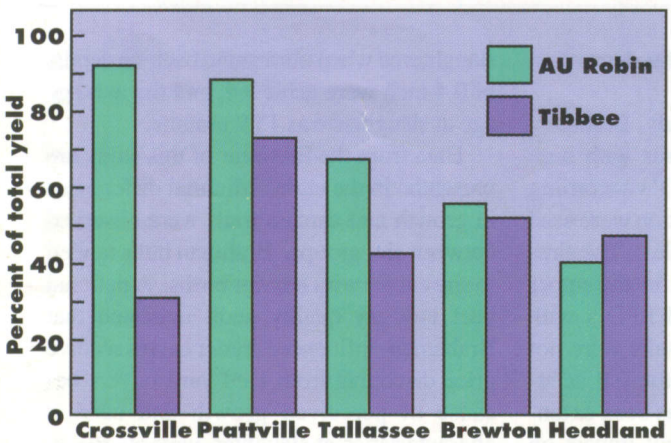
# AU Robin, a New Crimson Clover

The early bird gets the worm was the idea behind the breeding program for AU Robin, an early maturing crimson clover cultivar released by the AAES at Auburn University in August 1991.

Crimson clover has long been recognized as an excellent winter cover crop for Alabama, providing erosion control by covering soil during the heavy rainfall months of winter. For subsequent crops, it also provides nitrogen that is fixed from the air during the clover's growth. However, timely planting is critical for most summer crops to reach their full yield potential. Producer awareness of this fact results in many cover crops being burned down or plowed under before they are physiologically mature. While such cover crops provide soil protection during winter, the nitrogen contribution to subsequent crops is less than it could be.

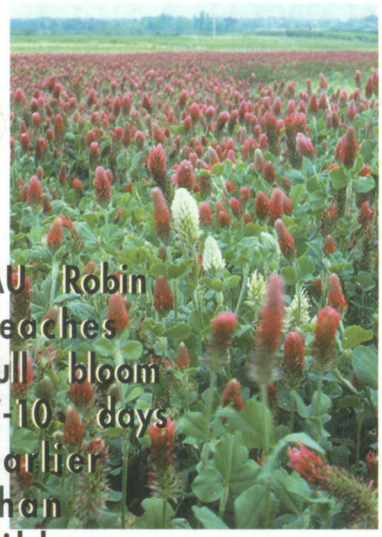
AU Robin was developed specifically to address the need for an early-maturing winter legume cover crop. AU Robin reaches full bloom 7-10 days earlier than Tibbee, the earliest maturing crimson clover available thus far. Earlier flowering and seed maturity of AU Robin will allow producers to prepare fields for summer row crops earlier than they would with other cultivars, while obtaining benefits which would otherwise only be obtained by delaying cover crop termination. AU Robin also expands the possibility of reseeding systems which would be more economical than planting a cover crop every autumn.

AU Robin has been extensively tested in Alabama, Florida, and South Carolina. In 15 trials conducted over a period of five years, AU Robin yielded an average of 3,513 pounds of dry matter per acre, compared to 3,447 pounds for Tibbee. The earlier flowering is accompanied by earlier dry matter accumulation which can either be used as N-releasing mulch in conservation tillage systems or used to provide nutrition for livestock. AU Robin had from 40-92% of its total seasonal yield at the first cutting, compared to 31-72% for Tibbee (see figure). These first cuttings were taken in February, March, and early April for South, Central, and North Alabama, respectively.




First cut dry matter yields of AU Robin and Tibbee expressed in percent of the total seasonal yield.

AU Robin seed produced in Oregon has approximately 1% of hard seed, compared to 7% for Dixie. This enables the cultivar to become reestablished the following autumn. In trials conducted at Crossville and Tallassee, AU Robin's reseeding ability was similar to Tibbee.



AU Robin reaches full bloom 7-10 days earlier than Tibbee

Stand counts for AU Robin were about 3,000 plants per acre higher than Tibbee at the E.V. Smith Research Center in Shorter and about 1,000 plants per acre lower at the Sand Mountain Substation.

In Central Alabama, seed of AU Robin will normally be physiologically mature by mid-May, resulting in maximum reseeding. At the Field Crops Unit of the E.V. Smith Research Center, sorghum grain yield following AU Robin was equivalent to yields following Tibbee, or winter-fallowed plots receiving 120 pounds N per acre. AU Robin seed should be available for the 1993-94 cropping season and based on its genetic background, it is expected that AU Robin will be adapted throughout the Southeast.

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