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Alabama Agricultural Experiment Station

Lowell T. Frobish, Director

Auburn University

Auburn University, Alabama

*Good, also*



# HIGHLIGHTS

OF AGRICULTURAL RESEARCH

# DIRECTOR'S COMMENTS

IN A PREVIOUS edition of Highlights, the implementation of new technologies was discussed in this column. Such happenings as substitution of animal power for human labor input, the development of the cotton gin (mechanization), point in time when the number of tractors exceeded the number of horses on farms, the introduction of biotechnology into agriculture, and the use of computers in the decision-making process were cited as major happenings in agricultural history. These technological advancements made possible today's agricultural production efficiency.

On July 24, 1991, another technological achievement was introduced that will benefit not only agricultural production, but also the health of today's and tomorrow's consumer. This was the date that a low-fat Auburn-developed sausage, the second of the family of AU Lean meat products, was introduced nationwide to U.S. consumers. The first, AU Lean ground beef, had been announced in late 1990. A significant point about this achievement is that it involved the efforts of many working as a team—the Alabama Legislature, Auburn University scientists, Alabama Cattlemen and Pork Producers Associations, agribusinesses, economic development groups, and national organizations.

The AU Lean story began in 1987 at Auburn when Dr. Dale Huffman initiated a project to develop a suitable low-fat ground beef patty. Dr. Huffman and his colleagues were successful in developing a ground beef that contains less than 10% fat and about 40% fewer calories. A 4-oz. (quarter pounder) lean patty, after cooking, yields a 3.5-oz. product with about 130 calories—down from the traditional quarter pounder patty's 220 calories.

Commercial acceptance of AU Lean beef came quickly. McDonald's went nationwide with its own version of the product in March 1991. Disney Land and Disney World theme parks now serve only low-fat hamburgers, based on the AU Lean development. Grocery chains throughout Alabama and the Nation are marketing low-fat ground beef products.

The newly released AU Lean sausage is equally outstanding. Traditional sausage requires at least 40% fat to provide the desired taste and cooking qualities. After much research and many taste panel tests, a product that contains only 12.5% fat and 114 calories per cooked 2-oz. serving was developed. This compares to 31% fat and 210 calories for a comparable serving of conventional sausage.

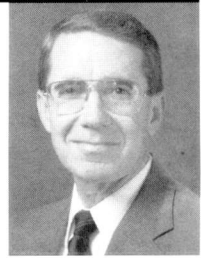
The Alabama Agricultural Experiment Station says thank you to the Alabama Legislature for providing funds for this research, and to the commodity organizations and agribusinesses that provided additional support. Alabama citizens must share the pride of this achievement. If possible, all the AU-Lean family should contain the label "Developed in Alabama."

Congratulations Alabama!



LOWELL T. FROBISH

# MAY WE INTRODUCE



Dr. Oyette Chambliss, Professor of Horticulture, Chambliss, a native of Butler County, Alabama, earned his B.S. degree in agricultural education at Auburn in 1958 and his M.S. degree in horticulture from Auburn in 1962. He went on to get the Ph.D. in plant breeding and genetics/horticulture from Purdue University in 1966.

Following his graduation from Purdue, Chambliss served as a research horticulturist with USDA/ARS in Charleston, South Carolina, for 3 years before joining Auburn's Department of Horticulture staff in 1970 as an associate professor. He was promoted to professor in 1978 and served as acting head of the Department during 1986-88.

Chambliss, who specializes in plant breeding and genetics for such vegetable crops as southernpeas and tomatoes, recently completed a year-long sabbatical which took him to Florida, Indiana, and California to study techniques used in molecular genetics and biotechnology and the application of these techniques in vegetable breeding. His work looked specifically at insect host plant resistance in cowpeas and tomatoes. An article on page 5 of this issue of Highlights discusses Chambliss' work with the development of a newly released blackeyed southernpea, AUBe, which is easy to harvest and shell and is resistant to root-knot nematodes.



**ON THE COVER.** AUBe is a new, easier to harvest blackeyed southernpea. See related story on page 5.

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# OATS AND WHEAT SUPERIOR TO RYE AS WINTER GRAZING CROP

**R**YE HAS BEEN the traditional winter cover crop grown in rotation with peanuts in Alabama's Wiregrass area. This use was based on rye's ability to reduce erosion, aid in control of nematodes, and furnish winter pasture.

Because rye seed are periodically unavailable or more expensive than oat and wheat seed, there has been interest in substituting oats for rye. Results of 1990 Alabama Agricultural Experiment Station research indicate that shifting to oats and wheat for winter grazing has merit. In this test, oats and wheat pasture provided higher animal gain and more gain per acre than rye pastures. And returns per acre were considerably higher for oats and wheat.

In October 1990, Wintergrazer 70 rye, Citation oats, and Coker 9766 wheat were each seeded in four 1.5-acre pastures at a seeding rate of 90 lb. per acre. Ammonium nitrate was applied at planting to supply 100 lb. N per acre and again in February to provide 60 lb. Phosphorous and potassium were applied according to soil test.

Beef heifers of mixed breed and with an average weight of 492 lb. were purchased for use in the study. Grazing started in mid-December and continued for 133 days. Each of the small grains was continuously grazed at stocking rates of 1.33 and 2.00 head per acre. Animals were weighed at 28-day intervals throughout the study.

The cost of purchasing, hauling, and inoculating animals was \$426 per head (\$86.55 per hundredweight). The sale price, including the promotion fee, was \$77.70 per hundredweight. Return to land and labor was based on the assumption that pasture production costs (including fertilizer, seed, and machinery costs) totalled \$90 per acre and was the same for each of the small grains. In addition, interest on the purchase price of animals was assumed to be 12%.

Because of limited forage and low gains, wheat and rye grazing at the high stocking rate had to be terminated after 99 days. At

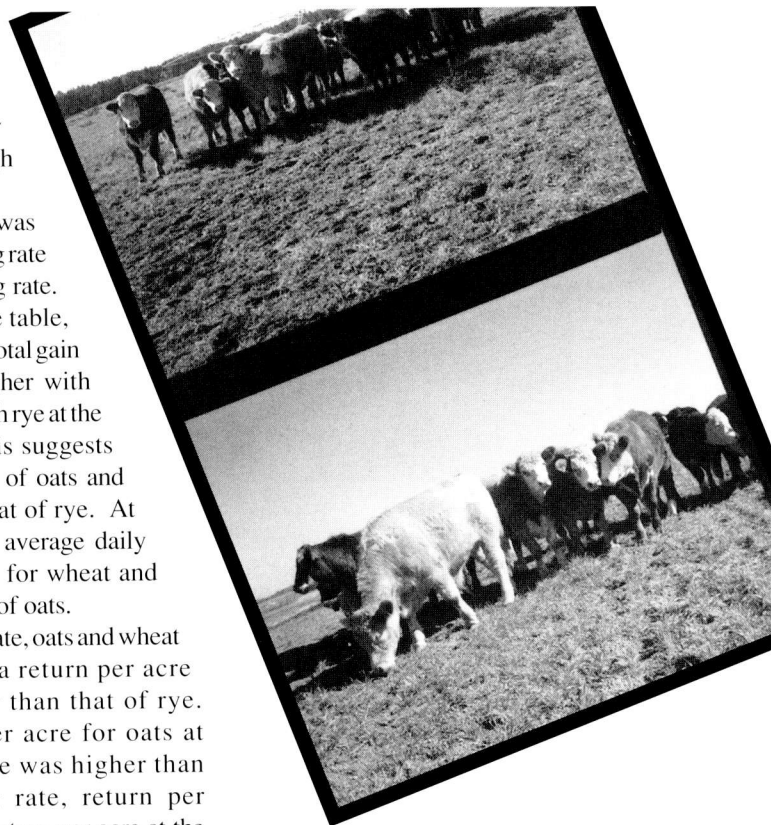
the low stocking rate, grazing continued for a total of 133 days. With oats, there was a 133-day grazing period at both high and low stocking rates.

Average daily gain was higher at the low stocking rate than at the high stocking rate. As shown by data in the table, average daily gain and total gain per acre were 20% higher with oats and wheat than with rye at the low stocking rate. This suggests that the nutritive value of oats and wheat is higher than that of rye. At the high stocking rate, average daily gain and gain per acre for wheat and rye were only half that of oats.

At the low stocking rate, oats and wheat provided, on average, a return per acre that was 59% higher than that of rye. Even though gain per acre for oats at the high stocking rate was higher than at the low stocking rate, return per acre was similar. Return per acre at the high stocking rate was negative for wheat and rye because of low gains.

Although oats and wheat provided higher economic returns than rye from grazing in this first-year test, other research has shown that rye is more effective in reducing nematodes. This could affect yield and profit from subsequent peanut crops. In addition, oats and wheat are less cold-tolerant than rye. Further research is needed to determine whether the apparent economic advantage of oats and wheat for winter and spring grazing outweighs any advantage of rye in reducing nematodes and increasing profits from the subsequent peanut crop.

Bransby is Professor of Agronomy and Soils; Gamble is Assistant Superintendent and Ivey is Superintendent of the Wiregrass Substation.



AVERAGE DAILY GAIN, GAIN PER ACRE, AND RETURN PER ACRE FOR BEEF HEIFERS GRAZING OATS, WHEAT, AND RYE

Small grain	Result, by stocking rate					
	1.33 head/acre			2.00 head/acre		
	Av. daily gain	Gain/acre	Return per acre	Av. daily gain	Gain/acre	Return per acre
Oats .....	Lb. 2.30	Lb. 407	Dol. 143	Lb. 1.68	Lb. 447	Dol. 133
Wheat .....	2.20	389	130	.86	170	-73
Rye .....	1.88	333	86	.85	168	-74

# HIGH PRODUCTIVITY OF SWITCHGRASS CREATES ENTHUSIASM IN AAES RESEARCH



**A**NY PERENNIAL grass that can produce 15 tons of growth in a year is certain to create interest among farmers. That explains the enthusiasm about Alamo switchgrass, which is being studied in Alabama Agricultural Experiment Station (AAES) research. Even though this research has mainly centered on switchgrass as a possible biomass energy crop for conversion to ethanol or methanol, there is also interest in it as a potential forage crop.

A warm-season perennial, switchgrass is native to North America and grows from the Gulf of Mexico into Canada. Its varieties are either fine-stemmed, "upland types" with short rhizomes or robust, "lowland

types" that are thick-stemmed, erect, and tall.

The first AAES test evaluated the Cave-in-Rock variety, an upland type switchgrass that was developed in the Midwest. It yielded only 2.2 to 5.3 tons per acre from two cuts each season, which appeared to be too low for profitable production in Alabama. Thus, a planting was made at the E. V. Smith Research Center, Shorter, to evaluate both upland and lowland varieties as energy crops.

The experimental planting included Blackwell, Cave-in-Rock, Kansas Native, Pathfinder, Summer, and Trailblazer from the upland types and Alamo and Kanlow from the lowland types. Four 5-ft. x 20-ft. plots of each variety were seeded in summer of 1988. Seed were drilled into plots at a rate of 10 lb. per acre in rows 7 in. apart. All plots received a total of 100 lb. N per acre in two equal sidedressings during the summer. Phosphorus and potassium were applied according to soil test.

Plants were harvested twice during the season (mid-summer and early fall) when reproductive growth occurred. Dry matter yield was recorded in 1989 and 1990 and samples were analyzed for crude protein, neutral detergent fiber, and acid detergent fiber in 1990. Estimated cost of production, harvesting, and baling was \$139 per acre.

Dry matter yield was higher for the lowland types (Alamo and Kanlow) than for the upland types, see table. Furthermore, yields of Alamo and Kanlow were considerably higher in the second year than the first, whereas the other varieties had little difference in yield between years. This pattern was not related to rainfall, which was 42 in. for April-September in 1989 and 16 in. during the same period in 1990 (30-year average is 25 in. for the period).

The high yields of Alamo and Kanlow in the dry summer of 1990 are remarkable. The yield advantage of Alamo appears to

be at least partially due to early growth. In 1990, growth started in January, 6 to 8 weeks ahead of bermuda and bahiagrass, and several weeks ahead of the other switchgrass varieties in the study.

This early growth allows the plant to use residual soil moisture from winter rains for extended periods before evaporation rates increase sharply in summer. By that time, it is likely that roots are deep and well developed to cope with short droughts. Switchgrass also grows later into the fall than bermudagrass or bahiagrass, resulting in growing seasons of 6 to 8 months.

Frequent cutting of Alamo to harvest high quality hay would result in considerably lower yields than those reported from this study. Yields reported were from two cuttings per year, which promotes higher total production and lower forage quality. Doubling the number of cuttings to promote forage quality could reduce yield 30-40%.

Cost per ton of dry matter for Alamo was less than a third of that for the upland types. However, crude protein was lowest for Alamo and its fiber content was higher than for all except Kanlow. Despite the generally low protein and high fiber values, more frequent cutting would substantially improve the feeding value.

When the nitrogen content of Alamo (0.88%) is multiplied by the 1990 yield, the resultant absorption of nitrogen by the crop is 271 lb. per acre. Since only 100 lb. of nitrogen were applied per acre, this suggests that Alamo has an exceptional ability to extract nitrogen from the soil. In contrast, Cave-in-Rock absorbed only 110 lb. of nitrogen per acre. Despite the advantages found for switchgrass, its seedlings are not vigorous and are susceptible to weed competition, and little is known about the resistance of Alamo to grazing. Nevertheless, its desirable characteristics make it worthy of further study.

Sladden is Research Specialist, Bransby is Professor, and Aiken is Postdoctoral Fellow of Agronomy and Soils.

PRODUCTION AND FORAGE QUALITY OF EIGHT VARIETIES OF SWITCHGRASS HARVESTED TWICE PER SEASON AS ENERGY CROPS

Variety	Yield/acre		Cost per ton	Crude protein	NDF	ADF
	1989	1990				
	Tons	Tons	Dol.	Pct.	Pct.	Pct.
<b>Upland type</b>						
Blackwell .....	3.0	3.0	46	7.7	72	41
Cave-in-Rock ...	3.9	4.6	30	7.5	67	39
Kansas Native ..	3.8	3.8	37	7.7	71	40
Pathfinder .....	4.2	4.6	30	7.6	73	43
Summer .....	4.2	4.7	30	7.2	73	43
Trailblazer .....	4.0	4.2	33	8.1	73	42
<b>Lowland type</b>						
Alamo .....	7.8	15.4	9	5.5	76	45
Kanlow .....	6.1	10.3	13	6.2	77	47

# AUBE IS NAME FOR NEW SOUTHERNPEA DEVELOPED IN AUBURN RESEARCH

**T**HE NAME AUBE may sound like the Auburn University mascot, but actually it is the name of a new southernpea variety. Developed in the Alabama Agricultural Experiment Station vegetable breeding program, AUBE (short for AU Blackeye) is a unique type of blackeyed southernpea. It has several features which should make it especially appealing to home gardeners, and it also offers commercial production opportunities. These features include the following:

- A non-vining growth habit (no lateral or terminal vines and tall peduncles).
- Pods are easy to harvest because they are produced level with or above the foliage, and are easily detached from peduncles.
- Pods are easy to shell.
- Resistance to root-knot nematodes and cowpea curculio.

AUBE was developed by the pedigree breeding method involving crosses among Giant Blackeye, Conch, and Princess Anne Blackeye. Giant Blackeye was selected as a parent because of its high yield potential, large, deep root system, and large seed. Conch is resistant to root-knot nematodes, and Princess Anne Blackeye is a compact plant with few lateral (side) vines.

Field resistance in AUBE to diseases and insects was evaluated in the Southernpea Cooperative Trials conducted at 13 locations in the South (Alabama, Arkansas, Georgia, Louisiana, Missouri, Oklahoma, South Carolina, Tennessee, and Texas). In these trials, AUBE exhibited few virus symptoms and had moderate resistance to bacterial leaf blight and root rots. *Cercospora* leaf spot was a problem in some locations.

In field screening tests in southeastern Alabama, AUBE ranked as

high in resistance to the cowpea curculio as the resistant check line Ala. 963.8. It was highly resistant to root-knot nematodes in greenhouse tests conducted at the U.S. Vegetable Laboratory, Charleston, South Carolina.

At each yield trial location in Alabama and across the South, all entries were tested at the same row spacing, usually 36-40 in. between rows, with plants spaced 3-4 in. apart. Standard cultural practices in Alabama include irrigation to supplement rainfall to supply 1 in. of water per week. Fertilizer practices followed Auburn soil test recommendations, which for average soil fertility requires 20 lb. N and 60 lb. each  $P_2O_5$  and  $K_2O$ .

AUBE produced well in yield trials both in Alabama and in the Cooperative Trials, tables 1 and 2. It has produced yields comparable to standard check varieties in



Mature seed of AUBE offer an attractive appearance.

multiple-harvest trials at the E.V. Smith Research Center, Shorter, and at the Chilton Area Horticulture Substation, Clanton, and in once-over harvest trials at the Gulf Coast Substation, Fairhope.

It is noteworthy that AUBE produces about as well as the popular Pinkeye Purple Hull and better than California Blackeye No. 5 among the less viney eye types and about the same as its parent line, Giant Blackeye, which is extremely viney. Mississippi Silver, the high yielding brown crowder type used as a check for high yield in trials, yields slightly better than AUBE at all locations. However, AUBE has produced yields comparable to Pinkeye Purple Hull and Mississippi Silver, both in multiple harvests and once-over harvests. Multiple harvest data from these trials are most relevant to gardening practices, but in some locations only once-over harvest data were taken. Yields of AUBE will probably be greater than those reported here when the advantage of its erect growth habit is utilized through closer row spacing.

Seed should be available in Alabama seed stores by 1993.

Chambliss is Professor and Hunter is Senior Research Associate of Horticulture.

TABLE 1. PERFORMANCE OF AUBE IN ALABAMA SOUTHERNPEA FIELD TRIALS, COMPARED TO STANDARD VARIETIES

Type harvest and location	In-pod yield/acre				
	AUBE	Pinkeye Purple Hull	Miss. Silver	Giant Blackeye	Calif. Blackeye #5
	Bu.	Bu.	Bu.	Bu.	Bu.
Multiple harvest					
Shorter .....	335	302	379	354	272
Clanton .....	216	221	272	219	223
Once-over harvest					
Fairhope .....	205	270	293	141	--

TABLE 2. FIVE-YEAR AVERAGE FOR AUBE AND TWO OTHER VARIETIES, SOUTHWIDE SOUTHERNPEA TRIALS

Measure	Result, by variety		
	AUBE	Pinkeye Purple Hull	Miss. Silver
Multiple harvest yield, bu. ....	145	162	171
Once-over harvest yield, bu. ....	130	114	158
Shellout percentage .....	52	54	56
Days from planting to mature green pods .....	62	62	66
Nematode damage rating (0=no galls, 5=severe galling) .....	1.8	4.3	2.3

# HERBICIDE, CULTIVATION COMBINATION PROVES BEST FOR COTTON WEED CONTROL

**M**ODERN WEED control programs include soil-applied residual herbicides, cultivation, and post-emergence directed sprays. All of these have a place in cotton weed control, but neither consistently does the job alone. The secret is to use the right combination of inputs that provides the level of control needed for high yields of good quality cotton—at a cost that allows a profit from production.

Finding the right combination of inputs was the objective of Alabama Agricultural Experiment Station research during 1987-89 at the Tennessee Valley Substation, Belle Mina. These field trials evaluated weed control, cotton yields, and net returns from several weed control systems.

Deltapine 50 variety was conventionally grown each year, fertilized for optimum production and with optimum insect and disease control programs used. Planting

dates were April 13, April 25, and April 18 for 1987, 1988, and 1989, respectively. Weeds infesting the experimental area included crabgrass, teaweed, and morningglory.

A soil-applied herbicide treatment of Cotoran® and Zorial® (1.5 lb. active each per treated acre) was used on all plots. This mixture was applied after planting—either

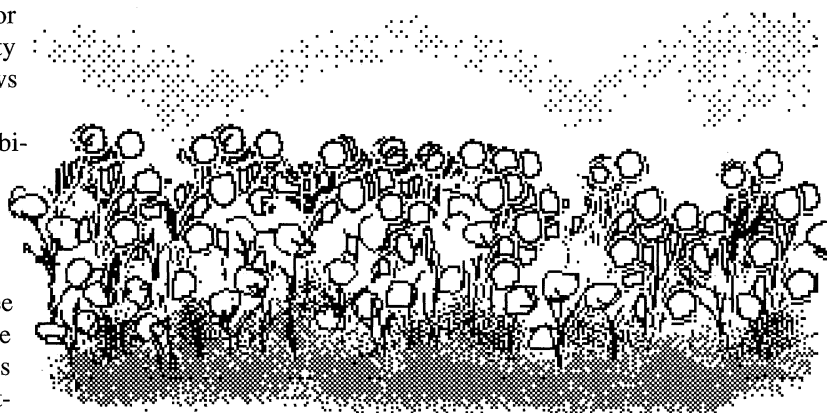
test years. Rainfall from April 14 to July 14 was 12.8 in. in 1987, 3.25 in. in 1988, and 21.6 in. in 1989. Obviously, such rainfall differences affected weed growth tremendously and, in turn, affected control from the different treatments.

Despite variations caused by weather, certain results were evident throughout the 3 years, and these are reported in the table. Applying a 16-in. band of Cotoran plus Zorial without further treatment gave poor results. Weed control was ineffective, yields were low, and there was a negative net return to the treatment.

Adding two timely cultivations to the soil-applied herbicide band provided acceptable weed control, yields

equal to the hoed check, and a positive net return. During the driest year (1988), the band-applied herbicide and one cultivation provided optimum returns. In the wet year (1989), however, more inputs were needed; best results were obtained with either (1) the herbicide band plus three cultivations, or (2) the herbicide band plus two cultivations and one directed postemergence spray.

Other systems that provided good to excellent weed control and positive net returns over the 3-year period included (1) a soil-applied band plus one cultivation and one postemergence spray, and (2) Cotoran plus Zorial broadcast with no additional treatment. Although the broadcast treatment cost \$39 per acre, it might be considered for use by growers with large acreages who may not be able to cultivate when needed.



broadcast or over the row in a 16-in. band. In addition to the soil-applied treatments, each plot received either zero, one, two, or three cultivations, plus either zero, one, or two postemergence directed sprays (Bladex® plus MSMA®, 0.75 and 2.0 lb. a.i. per acre).

With all possible combinations of the inputs, there were 24 individual treatments—ranging from extremes of a single soil-applied herbicide band used alone to a broadcast soil-applied treatment with three cultivations and two postemergence directed sprays. A hoed check treatment was also included for comparison.

Weather varied widely during the 3

Patterson is Associate Professor of Agronomy and Soils; Goodman is Assistant Professor of Agricultural Economics and Rural Sociology; Norris is Assistant Superintendent and Webster is Superintendent of the Tennessee Valley Substation.

EFFECT OF SELECTED COTTON WEED CONTROL TREATMENTS ON WEED CONTROL, COTTON YIELDS, AND NET RETURNS, 1987-89 AVERAGE

System <sup>1</sup> and cost/acre <sup>2</sup>	Weed control	Seed cotton yield/acre	Net returns per acre <sup>3</sup>
	Pct.	Lb.	Dol.
Cotoran + Zorial (band)/\$15.60 .....	16	805	-(209.69)
Cotoran + Zorial (band), two cultivations/\$24.08 .....	76	2,442	99.73
Cotoran + Zorial (band), one cultivation, one directed spray/\$27.18 .....	82	2,319	73.22
Cotoran + Zorial (broadcast)/\$39.00 .....	97	2,332	53.87
Hoed check/\$335.00 .....	97	2,276	-(270.15)

<sup>1</sup>Cotoran plus Zorial (1.5 + 1.5 lb. a.i. per acre), banded or broadcast; Bladex plus MSMA (0.75 + 2.0 lb. a.i. per acre).

<sup>2</sup>Includes cost of herbicides plus equipment for cultivation and directed sprays. Hoe labor based on minimum wage.

<sup>3</sup>Net returns above variable costs based on 35% gin turnout, \$0.55 per pound for lint, \$0.05 per pound for seed, and no government program participation.

# LONG-TERM CROP MANAGEMENT AFFECTS SOIL FERTILITY

**C**ROP YIELDS have increased dramatically in the Southeast since the 1930's due to improved varieties, fertilizers, and other factors.

However, crop production in the region may not be reaching its full potential due to losses of inherent soil productivity. Cropping practices and cropping systems which have lowered soil organic matter concentrations and have degraded the nutrient supplying capability of many soils have contributed to this problem. During the past 20 years, however, conservation tillage systems have been developed that maintain crop residues on the soil surface, thus decreasing the potential for erosion and losses of soil organic matter and inherent soil productivity.

Currently, 48% of cropland in the Southeast is managed under some form of conservation tillage. Along with widespread adoption of reduced tillage systems, interest has been renewed in crop rotations which increase yields, increase profitability and reduce risk through diversification, and decrease environmental hazards by reducing chemical inputs.

Alabama Agricultural Experiment Station research at the Sand Mountain Substation, Crossville, determined the effect of long-term tillage and crop management on surface soil fertility status. Cropping systems included continuous soybeans, continuous corn, and alternate corn-soybeans. Wheat was used as a winter cover crop in

all cropping systems. Conventional tillage (moldboard plowing the wheat cover in the spring, followed by incorporation of herbicide with a disk) and no-till (planting in killed wheat residue with a double-disk opener planter) tillage systems were evaluated.

The tillage and cropping systems were established in 1980, and all systems received the same amount of lime and P and K fertilizers. Cropping systems including corn received the greatest amounts of N fertilizer as ammonium nitrate. Soil samples were collected from the 0- to 8-in. soil depth in October 1990 after 10 growing seasons, and were evaluated for pH, organic matter, and organic N. Potential N release from soil organic N was determined in laboratory incubations under ideal conditions.

After 10 years, no-till had 50% more soil organic matter in the surface layer than conventionally tilled plots, see table. No-till also had 44% more organic N than conventional till. These large differences in soil organic matter and organic N between tillage systems were not caused by greater input of crop residues under no-till, because amounts of crop residues added to the soil during the 10-year cropping period differed by only 3%. Differences in soil organic matter and organic N among tillage systems were due to the nature of the tillage systems. Conventional tillage mixed crop residues into the soil surface, causing increased rates of decomposition. Crop residues remaining on the soil surface in no-till decomposed more slowly, allowing a buildup of soil organic matter and organic N.

Cropping systems had less effect on soil organic matter and organic N than tillage systems. Cropping systems that included corn in the rotation had slightly higher amounts of soil organic matter after 10 years, probably due to greater crop residue inputs.

**After 10 years, no-till had 50% more soil organic matter in the surface layer than conventionally tilled plots.**

Increases in soil organic matter and organic N under no-till promoted a higher potential for N release. Potential N release in laboratory incubations was 44% greater under no-till than conventional till. These results show that tillage systems can have a large impact on the nutrient supplying capability of Alabama soils. Similar to soil organic matter and organic N, cropping system had little effect on the potential for N release from soil organic N.

Cropping system, not tillage, affected soil pH in the 0- to 8-in. layer, even though all cropping systems received the same amount of lime during the 10-year cropping period. The continuous corn system had the lowest soil pH, followed by the alternate corn-soybean system and the continuous soybean system. Lower soil pH with higher frequencies of corn were due to greater input of N fertilizer (ammonium nitrate) that acidified the soil.

In summary, cropping practices had a substantial effect on the fertility status of a soil in the Sand Mountain region after 10 years. Tillage was more important than cropping system in altering soil organic matter, soil organic N, and the potential for N release from soil organic N. These results demonstrate the benefits of no-till and cropping systems in increasing native soil fertility. Differences in soil pH among cropping systems emphasize the need for soil testing and distinct soil fertility management under different cropping systems.

Wood is Assistant Professor of Agronomy and Soils; Edwards is Soil Scientist, USDA-ARS, National Soil Dynamics Laboratory; Ruf is Associate Superintendent and Eason is Superintendent of the Sand Mountain Substation.

SOIL PROPERTIES AND CROP RESIDUE PRODUCTION AS AFFECTED BY TILLAGE AND CROPPING SYSTEM

Tillage and cropping system	Organic matter	Organic N	Potential N release	pH	Crop <sup>1</sup> residue/acre
	<i>Pct.</i>	<i>Pct.</i>	<i>p.p.m.</i>		<i>Tons</i>
<b>Tillage</b>					
Conventional .....	1.0	0.05	9	5.8	59
No-till .....	1.5	.09	13	5.8	61
<b>Cropping system</b>					
Cont. soybeans .....	1.2	.06	12	6.1	53
Cont. corn .....	1.4	.06	11	5.5	63
Corn-soybeans .....	1.3	.06	11	5.9	63

<sup>1</sup>Amount added to the soil between 1980 and 1990.

# TINY TARNISHED PLANT BUGS CAUSE BIG PROBLEMS FOR PINE SEEDLINGS

**A**LABAMA Agricultural Experiment Station research recently unravelled the mystery of an increase in malformation of pine seedlings in Southern nurseries. The culprit is an insect commonly called tarnished plant bug (scientific name *Lygus lineolaris*), inset. Feeding by this insect causes seedlings to form multiple shoots, called "bushy top." Seedlings with this damage are often culled from the crop, costing nursery managers in the Southeast thousands of dollars annually.

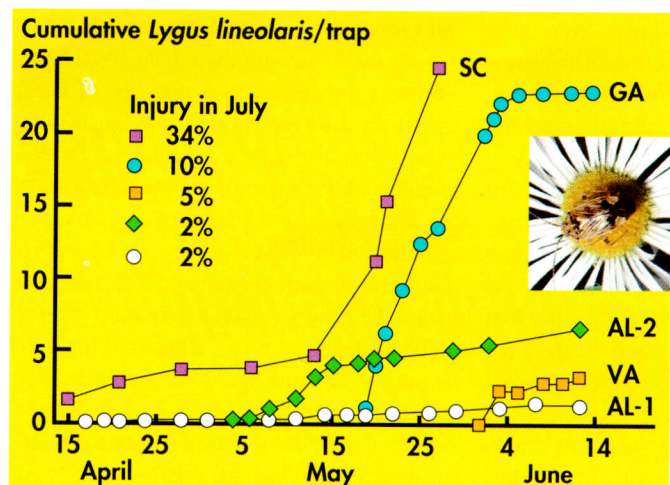
Bushy topped pine seedlings were first reported on loblolly pine in a nursery in Coosa Pines in 1982. Subsequently, seedling injury has been reported as far south as central Florida and as far north as Virginia. Pine species affected include loblolly, slash, longleaf, Virginia, sand, and Scots. Initially, damage was attributed to herbicide use, a fungus, thrips, a virus, a nutrient deficiency, a fertilizer burn, and even air pollution.

Auburn researchers were the first to suspect that loblolly southern pines were being injured by tarnished plant bugs. As a result, greenhouse tests were conducted by caging adult tarnished plant bugs with young pine seedlings. This demonstrated that feeding on the terminals of young loblolly pine seedlings results in malformed terminals, shown in figure 1, and the development of multiple shoots.

Tarnished plant bugs are very mobile, and by the time injury symptoms are visible the insect is gone. Within a few days the insects can move onto nursery beds, feed, and exit to adjacent areas that contain alternative hosts. These insects usually feed at night or early morning. The combination of these factors helps to explain the difficulty in associating tarnished



**FIG. 1.** Shoot deformity resulting from lygus bug feeding on young loblolly pine seedlings.



**FIG. 2.** Cumulative trapping of *Lygus lineolaris* at the Stauffer Nursery (Ala.-1) and Coosa Nursery (Ala.-2) in Alabama, the Carters Nursery (Ga.) in Georgia, the Piedmont Nursery (S.C.) in South Carolina, and the New Kent Nursery (Va.) in Virginia. Inset: An adult tarnished plant bug (*Lygus lineolaris*).

plant bugs with bushy topped seedlings.

In 1987, the Auburn University Southern Forest Nursery Management Cooperative installed monitoring studies at five nurseries throughout the South. Seedling injury at all five nurseries was first apparent by the end of May and the first week of June. Twelve white traps (Rebell®) were placed throughout each nursery. The cumulative number of tarnished plant bugs

caught per trap was determined for each nursery, figure 2.

Although trapping can be useful in determining when to begin spraying insecticides to control the pest, it has a major limitation. For example, at the New Kent Nursery, no tarnished plant bugs were trapped through May 31. During the next 2-day period, 2.5 per trap were caught. A

spray program initiated after scouting on June 2 would have protected the crop only from future injuries, but substantial damage would already exist. If only 4% of a crop of 30 million seedlings is culled due to bushy tops, a loss of \$36,000 could result. Therefore, nursery managers who previously have had their crops damaged by tarnished plant bugs usually spray prophylactically with an insecticide, such as ASANA XL®.

Instead of using traps, some nursery managers prefer to monitor known weed hosts each morning. If a single tarnished plant bug is found on host weeds during pine seedling germination, nursery managers often will spray with an insecticide. To reduce resident populations, some nursery managers attempt to control preferred weed hosts. In fact, a likely reason for the increase in tarnished plant bug damage to pine seedlings is due to changes in weed management practices, especially the curtailment of the use of mineral spirits for weed control. Mineral spirits has a strong petroleum odor and exhibits some contact insecticidal activity. The switch to more efficient diphenylether herbicides in the early 1980's coincides with increased damage.

Now that Auburn research has made nursery managers aware of the cause of bushy topped seedlings, measures to control tarnished plant bugs are routinely taken, resulting in a dramatic drop in damage. In one nursery, the percentage of trees damaged has been reduced from 17% with no control measures to less than 1% with timely applications of insecticides.

South is Associate Professor of Forestry.



# CATTLE PREFER ENDOPHYTE-FREE TALL FESCUE VARIETIES

**T**ALL FESCUE is the most important cool season forage for the Southeast, with over a million acres in Alabama alone. Several endophyte-free tall fescue varieties were developed in the 1970's and 1980's in response to production problems resulting from fescue toxicosis among cattle grazing tall fescue infected by a fungal endophyte.

Recent Alabama Agricultural Experiment Station (AAES) research indicates some of these new fungus-free varieties are grazed heavily while others are virtually ignored by cattle. If these palatability differences are not considered by plant breeders, potential new varieties may be rejected because of what would appear to be a lack of vigor, but in reality would be over-grazing based on animal preference.

In tests by the AAES, a set of tall fescue experimental populations and cultivars was evaluated in small plots under grazing at four stocking rates at the Black Belt Substation, Marion Junction, in the fall of 1989. Several days after the animals were put onto the pastures, the plot areas resembled a patchwork quilt. There were large differences in the amount of forage grazed from various plots, but extended rains made it impossible to take any measurements at that time.

The differences continued to exist, so the plots were rated during the spring 1990 and 1991 grazing seasons. The amount of available forage removed from plots was evaluated 3 days after animals were put onto pastures. Some plots were grazed to ground level, regardless of whether the stocking rate of cattle was low or high. One of the most preferred entries in this test was Kenhy, a fungus-free variety released by the University of Kentucky, from which 95% of all forage was removed by grazing. Most entries were less than half as attractive to cattle as Kenhy. However, Kenhy does not persist well in the humid South.

Comparison of Georgia-5 endophyte-free and Georgia-5 endophyte-infected tall fes-



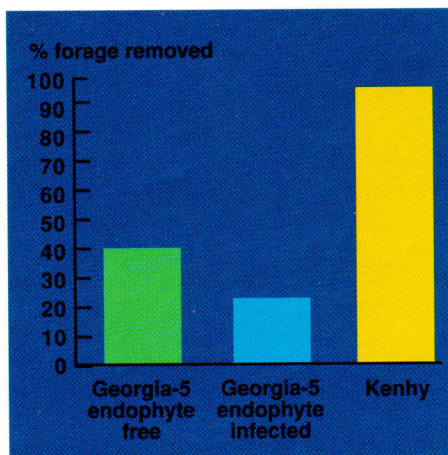
**Cattle graze more palatable tall fescue varieties to ground level, but virtually ignore other varieties at the Black Belt Substation.**

cue was of particular interest, because the varieties are identical, except that one is fungus-free. The figure shows animals removed almost twice as much Georgia-5 endophyte-free forage over two spring grazing periods.

This research established that endophyte removal increases the attractiveness of tall

fescue forage to cattle. Animal preference ratings should therefore accompany evaluation of breeding material under grazing. Animal preference of endophyte-free fescue also may have implications regarding persistence of tall fescue in mixed pastures with legumes under grazing.

Furthermore, maintaining endophyte-free plants in pastures with low to medium infection levels may be difficult due to possible selective grazing of endophyte-free plants. It is not known whether ergot alkaloids, suspected of causing fescue toxicosis in cattle, also cause the avoidance of infected fescue plants. However, research in other states indicates that sheep avoid reed canarygrass plants containing high levels of alkaloids, which are chemically related to alkaloids produced by the endophyte in fescue.



**Preference in cattle grazing tall fescue.**

van Santen is Assistant Professor and Horton is Research Technician of Agronomy and Soils; Holliman is Superintendent of the Black Belt Substation.

# ENDOPHYTE-INFECTED FESCUE MAY AFFECT EMBRYOS DURING EARLY PREGNANCY

**H**EIFERS GRAZING tall fescue infected with the endophyte fungus *Acremonium coenophialum* often appear to have normal estrous cycles at the time of breeding, but have reduced conception rates compared to heifers grazing endophyte-free fescue. Unfortunately, many livestock producers are unaware until late in the season that the female is not pregnant. This situation can be expensive when a producer loses the value of the calf and must replace the breeding animal or maintain her until the next breeding season.

To help clarify when pregnancy is lost, Alabama Agricultural Experiment Station studies were conducted to learn more about the effects of the endophyte on reproductive performance from day 7 to day 42, the earliest date when pregnancy can be accurately determined through rectal palpation. Results suggest that fungus-infected fescue may affect the embryos early in gestation.

In a study conducted at the E.V. Smith Research Center, Shorter, 39 Angus and 45 Hereford-Angus heifers weighing approximately 800 lb. and exhibiting normal estrous cycles were assigned randomly to pastures that were either endophyte free (containing less than 5% infection) or endophyte infected (greater than 90% infected). Pastures were divided into 4-acre paddocks, and heifers grazed these pastures rotationally at a stocking rate of two animals per acre. Pastures were fertilized according to soil test analysis.

Trial 1 was conducted in May 1990. Following a 42-day grazing period on the two types of pastures, Angus heifers were selected randomly from each treatment, given hormonal injections to induce multiple egg development (superovulated) and estrus, and artificially inseminated. Embryos from these animals were harvested 7 days after breeding, graded, and high quality embryos

were transferred into recipient heifers that also had been grazing either endophyte-free or infected pastures. Using embryo transfer ensured that the study animals were carrying viable 7-day-old embryos at the start of the experiment, something which could not be guaranteed if more traditional breeding practices were used.

Pregnancy rates at 42 days of gestation were higher for heifers grazing the endophyte-free pastures than for those grazing the infected pastures, as shown in the table. Because the yield of high quality embryos in Trial 1 was lower than expected, but ap-

PERCENT PREGNANT AT DAY 42 OF GESTATION FOLLOWING TRANSFER OF EMBRYOS INTO HEIFERS GRAZING FUNGUS-INFECTED AND FUNGUS-FREE TALL FESCUE

Item	Result, by fungus status	
	Fungus-free	Fungus-infected
Trial 1 <sup>1</sup> .....	n = 15	n = 14
Pregnancy rate .....	73	57
Trial 2 <sup>2</sup> .....	n = 15	n = 16
Pregnancy rate .....	72	31

<sup>1</sup>Conducted in May.  
<sup>2</sup>Conducted in June.

parently unrelated to the fescue treatment, a second study was conducted.

In Trial 2, which was conducted 3 weeks after Trial 1, the embryos were harvested from four Charolais cows that had not grazed tall fescue pasture. Fifteen heifers in the endophyte-free treatment and 16 heifers in the endophyte-infected treatment that had not been used in Trial 1 were kept in their respective paddocks and were estrus-synchronized after 66 days of grazing. Treatment of donor and recipient animals was similar to those in Trial 1. At 42 days of gestation, 72% of the heifers from the endophyte-free paddocks were pregnant, while only 31% of heifers grazing the infected paddocks were pregnant.

These results indicate that embryo survival decreased in beef heifers grazing endophyte-infected tall fescue. Because high environmental temperatures appear to magnify clinical signs of fescue toxicosis in beef cattle, it is likely that the poorer survival of embryos observed in Trial 2 among heifers grazing infected pastures occurred as a result of higher daily temperatures which may have affected the embryo's ability to survive.

Rahe and Schmidt are Associate Professors of Animal and Dairy Sciences; Bransby is Professor of Agronomy and Soils; Carson is Associate Professor of Large Animal Surgery & Medicine; Stringfellow is Associate Professor of Animal Health Research (Pathobiology); Griffin is President, Reproductive Technology International, Inc., Plant City, Florida.



# COTTONTAIL RABBITS ADAPT WELL TO COVER LEFT FROM PRESCRIBED BURNING

**A**LABAMA HUNTERS bag over 400,000 cottontail rabbits annually, making it the fourth most popular game species in the State. In recent years, cottontail numbers have declined, primarily due to changing land use patterns. In an effort to develop management programs critical to cottontail rabbit survival, research in the Alabama Agricultural Experiment Station found that these animals adapt well to cover left after prescribed burning, a forest management practice which also generates more high quality forage for rabbits and other wildlife species.

The response of both rabbits and vegetation to two fire intensities and cover enhancement practices was investigated at the Piedmont Substation, Camp Hill. Four forested areas, each approximately 80 acres, received either a mild burn, which leaves patchy vegetation on about 25% of the area, or a hot burn, which destroys over 90% of the vegetation. Following each burn, half of each area was provided with artificial cover in the form of brush piles. For comparison, an additional 80 acres was left as a control and was not burned or provided with artificial cover.

The movement of cottontails before and after burning was monitored by trapping and placing a radio transmitter on the animals. Prior to burning, cottontails on both burn treatments used above ground herbaceous cover as daytime resting places more than they used stump holes, burrows, artificial brush piles, or unburned areas adjacent to the burned study area. The use of alternative cover types increased dramatically during the post-burn period on the areas subjected to hot burns. Brush pile use increased from 4% to 67% and use of adjacent

unburned areas increased from 29% to 45% on the hot burn treatments. Similar, though less dramatic, use of alternative cover was recorded on the mild burn areas.

In spite of the widespread loss of cover following the intense burn, no cottontails died in the period immediately following the burn and before re-establishment of artificial cover (about 12 days). Likewise, cottontail mortality did not increase on the mild burn treatment during the post burn period and no radio-collared cottontails were directly killed by fire under either burning intensity.

The effect of prescribed fire and cover enhancement on relative cottontail densities was monitored by comparing pellet group densities (groups of rabbit droppings) among the various treatments. Permanent line transects were established on each 80-acre block. During the fall (November-December) and winter (February-March), transects were traversed and all pellet groups were counted and recorded. Mean pellet densities were calculated and compared for all combinations of burn/cover treatments.

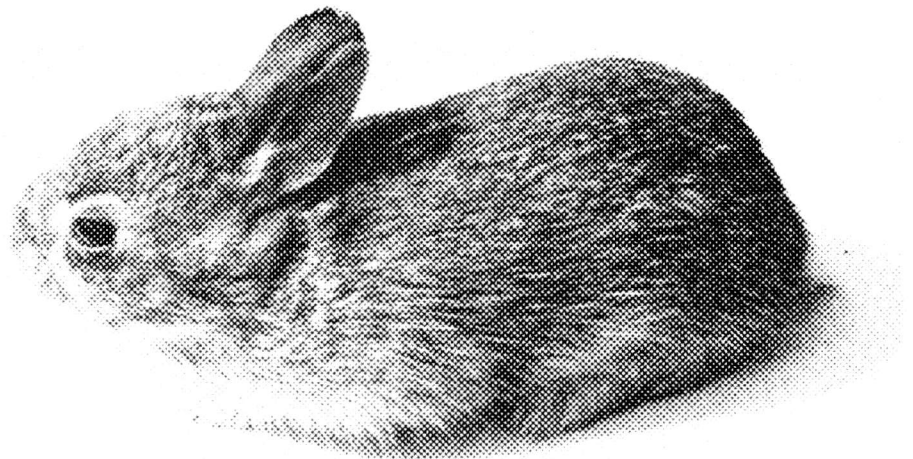
Vegetation analyses were conducted each fall at designated plots along the previously described transect lines. Leaf

litter, legume coverage, understory coverage, midstory stem density, basal area, canopy closure, and horizontal cover density were measured at each plot. Though most habitat variables did not differ according to treatment, legume coverage and understory coverage increased on both burning treatments. On the unburned area, legume coverage and understory coverage increased from initial values but remained lower than values from burned areas.

The lack of differences between habitat variables for the burn treatments in this 3-year study may have been affected by the previous fire history of the study area and the severe drought experienced during the study. Fires were virtually excluded from the study area for a period of at least 30 years before initiation of this study. In the prolonged absence of fire, annuals and legumes are virtually eliminated by competition, and a considerable amount of time is required for re-growth of original vegetation communities.

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King is Research Associate, Stribling is Assistant Professor, and Speake is Associate Professor of Zoology and Wildlife Science.



# RECYCLED PAPER CHIPS USED FOR BROILER LITTER

**P**INE SHAVINGS have been the traditional litter material used by Alabama poultry producers, but continued expansion of the poultry industry and the development of alternative uses for this wood byproduct have caused the supply to go down and the cost to go up. However, recent Alabama Agricultural Experiment Station research indicates broilers perform comparably on recycled paper chips, which have the potential to make up the shortfall of pine shavings.

Due to higher moisture content and caking tendency, the use of litter materials derived from recycled paper has been associated with increased incidences of leg and foot abnormalities and breast blisters in broilers. To overcome these problems, Auburn researchers tested highly absorbent chips developed by Advanced Material Technology, Inc., in Ashville. This material is formed by completely reprocessing waste paper into chips that average 1.6 in. long, 0.4 in. wide, and 0.1 in. thick.

Two successive trials were conducted to compare production and litter performance characteristics when broilers were grown on either recycled paper chips or pine shavings, see table. In the first trial, 600 broilers



**Chicks perform well on litter material made from recycled paper.**

were grown to 51 days on the two litter materials. For the second trial, used litter remaining from the first trials was top-dressed with a thin layer of either clean recycled paper chips or clean pine shavings, and a second brood of 600 broilers was grown to 50 days.

Litter moisture and the percentage of floor space covered with a solid layer of caked litter were determined at 3 and 7 weeks in both trials. Body weight, feed conversion, mortality, leg abnormalities, and breast blisters were determined at the end of each trial. Yeast and mold populations were determined in clean litter samples collected prior to the first trial and from used litter samples collected prior to the second trial.

Body weight, feed conversion, and mortality were similar in broilers reared on recycled paper chips and pine shavings in the two trials. The incidence of breast blisters and leg abnormalities in broilers grown on the two litter types did not differ in either trial. However, birds grown on paper had lower gizzard weights, indicating they consume less litter material than those reared on pine shavings.

With both new and used litter materials, moisture content

increased more rapidly in recycled paper chips and was higher than that of pine shavings 3 weeks after chicks were placed. However, litter moisture did not differ between litter types at 7 weeks. Litter caking was greater in recycled paper chips than in pine shavings 7 weeks after placement in both trials.

Though leg abnormalities and breast blisters are commonly associated with increased litter moisture and caking, other characteristics, such as abrasiveness and moisture absorbing and cushioning capabilities, also affect these defects. Since

leg abnormalities and breast blisters were not increased in broilers grown on recycled paper chips, it appears that some of these characteristics may have compensated for the increased moisture and caking levels of this material.

Yeast and mold populations were greater in clean pine shavings than in clean recycled paper chips prior to the first trial and also were greater in used pine shavings than in used recycled paper chips prior to the second trial. Yeast and mold populations may be of concern to the producer since some of these organisms are pathogenic and/or produce toxins which are detrimental to the livability and performance of broilers. Although no adverse affects of the higher yeast and mold populations were observed in the study, the recycled paper chips appeared to have slightly better microbiological characteristics than pine shavings.

In light of broiler performance and litter microbiology characteristics observed in the two trials, the recycled paper chips offer a promising alternative litter material for growing broilers. However, since moisture content and caking level were greater with the recycled paper chips, large scale field trials should be conducted to fully assess the suitability of this material under commercial conditions.

Lien and Connor are Assistant Professors and Bilgili is Associate Professor of Poultry Science.

**EFFECT OF LITTER TYPE AND CONDITION ON BROILER PRODUCTION AND LITTER PERFORMANCE CHARACTERISTICS**

Measure	First trial		Second trial	
	Clean shavings	Clean paper chips	Used shavings	Used paper chips
Mortality, pct. ....	5.0	3.0	4.0	2.6
7-week weight, lb. ....	5.22	5.23	5.44	5.42
Feed conversion <sup>1</sup> .....	2.08	2.12	2.04	2.02
Breast blisters, pct. ....	13.2	10.7	26.6	24.6
Leg abnormalities, pct. ....	8.2	6.9	4.0	4.2
Litter moisture, pct.				
3-week .....	22.4	30.2	23.6	29.3
7-week .....	30.9	31.1	29.7	30.3
Litter caking, pct.				
3-week .....	5.8	11.7	15.0	16.8
7-week .....	22.5	44.2	20.8	26.7
Yeasts and molds/gram, thousands .....	588.8	1.8	812.8	72.4

<sup>1</sup>Pounds of feed per pound of gain.

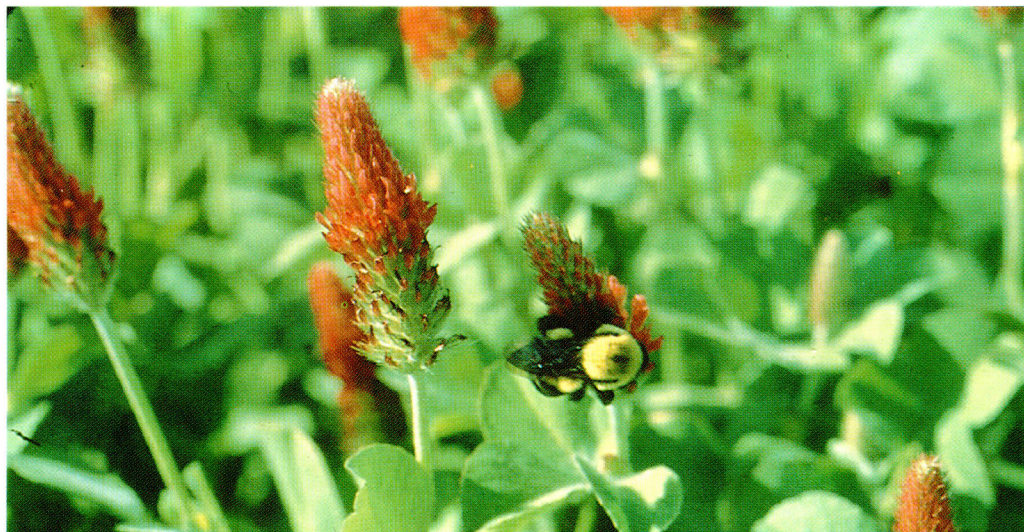
# NITROGEN-FIXING BACTERIA ESSENTIAL FOR CRIMSON CLOVER

**C** RIMSON CLOVER is a favorite forage of Alabama cattlemen, and its distinctive red flowers and green foliage add color to spring landscapes in the State. As with other legumes, providing proper nutrition for crimson clover is a long-standing problem for Alabama growers. However, recent Alabama Agricultural Experiment Station research indicates that soil conditions such as phosphorus deficiency or strong acidity not only limit crimson clover but also reduce the number and effectiveness of the nitrogen-fixing bacteria *Rhizobium trifolii*.

The rhizobia enter the clover roots in the seedling stage during the fall. The plant forms nodules that feed the rhizobia while they fix nitrogen for the plant. In the spring, after the clover has been grazed, or matured seed, or turned into the soil as green manure, the rhizobia are left in decaying nodules to survive until clover is reseeded. The rhizobia may live several months or years in the soil independent of the clover host. They are exposed to competition from other microorganisms and stresses from such chemical conditions as nutrient deficiencies or soil acidity. Stress may cause a genetic change in the rhizobia, such as loss of nitrogen-fixing effectiveness. Some stresses are severe enough to cause death of the rhizobia population. It is important to identify any soil factor that may induce a loss of quality in the rhizobia population.

Plots in the 80-year-old Cullars Rotation at Auburn were sampled to determine the effects of phosphorus and potassium deficiencies and strong acidity on the number and nitrogen-fixing effectiveness of clover rhizobia in the soil. In one 3-year rotation of cotton, corn, and soybeans, crimson clover and vetch were seeded in the fall after cotton, then turned as green manure ahead of corn. Soil from this experiment was planted with crimson clover in a greenhouse experiment.

The number of clover rhizobia in soil of each field treatment was determined. In



**Soil nutrient deficiencies reduce number and efficiency of nitrogen-fixing bacteria, which are critical to crimson clover production.**

addition, 50 isolates of *R. trifolii* were obtained from each field by isolation from nodules of clover plants growing on these soils. These isolates were compared for nitrogen-fixing effectiveness when applied in pure culture to crimson clover grown in a sterilized soil-sand mixture.

After 6 weeks of growth, total dry weight and N content of the plants were determined. Percent nitrogen in the clover plants was the measure used to distinguish ineffective isolates. Uninoculated control plants averaged 1.45% N. Unless a rhizobia isolate produced more than 1.6% N in plants, it was considered ineffective. Effective isolates produced plants that averaged 2.8% N.

Soil acidity limited growth and N content of crimson clover to half that in soil maintained adequately with fertilizer and lime, see table. Most of the clover plants on strongly acid soil were without nodules, stunted, and chlorotic. Rhizobia counts in soil at pH 5 showed the population had died.

Phosphorus deficiency was the most severe stress on crimson clover growth

and N content. In addition to the shortage of phosphorus, crimson clover was confronted with a high proportion of ineffective rhizobia. One out of three clover rhizobia present in the phosphorus-deficient soil was ineffective. Plants inoculated with ineffective rhizobia have numerous small, white nodules, but suffer N deficiency. This stress, added to that of phosphorus deficiency, severely limits clover yields.

This research indicates part of the problem with nutrition of legumes may be indirect, through loss of rhizobia populations or reduced effectiveness of these bacteria in nutrient-deficient or acid soils.

Hiltbold is Professor Emeritus of Agronomy and Soils.

EFFECTS OF FERTILITY TREATMENT ON YIELD AND NITROGEN CONTENT OF CRIMSON CLOVER AND NUMBER AND EFFECTIVENESS OF *RHIZOBIUM TRIFOLIUM* IN SOIL, 1990

Fertility treatment	Crimson clover		<i>R. trifolii</i> in soil	
	Relative yield	Relative N content	Population	Ineffective
	Pct.	Pct.	No./gram	Pct.
Phosphorus deficient .....	42	35	1,350	32
Potassium deficient .....	77	81	800	8
Strongly acid, pH 5 .....	54	45	1	8
Fertilized and limed .....	100	100	5,900	10

# WILL QUALITY PRENATAL AND POSTNATAL INFANT CARE BE AVAILABLE FOR ALL ALABAMIANS IN THE YEAR 2000?

**T**HE UNITED STATES leads the world in the development of life-saving medical technology, and yet the country's prenatal and postnatal infant mortality rate is higher than almost every other nation in the western, industrialized world. In Alabama, the infant mortality rate of 12.1 per 1,000 live births (1988 data) is excessively high, even compared to the 9.9 per 1,000 rate for the United States as a whole.

The single most effective treatment for infant mortality/morbidity is regular prenatal care for the mother during pregnancy, and postnatal pediatric care during the first year of life. In many states, especially states such as Alabama with large rural populations, such care is becoming less available. As of 1989, more than half of the counties in Alabama had no resident obstetrician or pediatrician; in many of these counties, neither medical specialty was represented.

There is a serious lack of information concerning future changes in the population of obstetric and pediatric specialists that may affect the quality of care provided for Alabamians. An Alabama Agricultural Experiment Station survey of obstetricians and pediatricians is an initial effort to estimate the changes in health care availability Alabamians will face in the 1990's and into the 21st century.

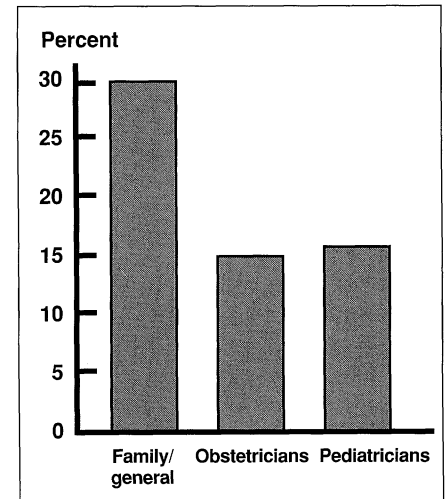
A survey was mailed to all obstetricians and pediatricians listed in the 1990 membership roster of the Medical Association of the State of Alabama, and to all family practice and general practice physicians in those counties without resident specialists. From this population of 798 physicians, 427 responses were obtained (195 from obstetricians, 194 from pediatricians, and 38 from family or general practice physicians). From the total, 214 were returned from four counties with major urban center communities (Jefferson, Madison, Mobile, and Montgomery counties) and the remainder (213) came from the nonurban and rural counties.

Eighty-one of the respondents (19%) were not currently providing direct service to patients, either because they were already retired (52) or because they were employed in laboratory research positions for State or private agencies (29). Fifty-eight additional respondents (25 obstetricians, 25 pediatricians, and 8 family/general practitioners) indicated that, for a variety of reasons including plans to retire, they intended to close their practices within the next 5 years.

Data in the graph indicate that a greater percentage of family/general practice respondents had plans to stop practicing during the next 5 years than did obstetricians and pediatricians. Although the actual number of family/general practice physicians who reported plans to stop practicing was small, the fact that each of these physicians comes from a nonurban county in which there is not now a practicing obstetrician and/or pediatrician suggests future health care problems of nonurban residents.

Even more ominous is the response to a hypothetical question concerning physicians' estimates of the likelihood that the quality of care they are now providing would be available to their own patients should the physician decide to close his or her practice. Only about 46% of physicians responded positively.

The potential reduction in the availability of obstetric and pediatric services for women and infants in nonurban counties becomes even more important when the association between infant mortality and frequency of prenatal visits for women in Alabama is considered. Statistics gathered by the Alabama Department of Public Health for 1988 indicated that infant mortality declined from 28.3 per 1,000 live births to 9.7 per 1,000 as the number of prenatal checkups increased from 6-7 to 8-10. Furthermore, when pregnant women received fewer than six prenatal checkups, the rate of infant mortality increased dramatically, up to 65.1 per 1,000 live births for women who had no prenatal care prior to delivery. Furthermore, infant



Percentages of physicians in three specialties indicating that they plan to close and/or leave their practices within 5 years.

morbidity, including growth retardation and developmental delays, is associated with inadequate prenatal care.

The anticipated changes reported by practicing physicians to the AAES survey suggest that prenatal and postnatal care for pregnant women and their babies in Alabama is likely to be further compromised, especially in rural and nonurban counties, which could increase the infant mortality and morbidity rates. For the eight rural counties in Alabama with infant mortality rates that are currently above 20 per 1,000 live births, further reductions in services could result in tragic consequences for infants.

Although the results of this survey are somewhat pessimistic regarding the quality of care for State citizens in the coming decades, there was one glimmer of optimism. According to the survey results, 103 physicians providing obstetric or pediatric services opened a practice or joined an existing practice within the past 5 years, whereas only 70 were planning to retire from a joint practice or to close a single practice during the next 5 years.

Vaughn is Professor, Bost is Graduate Research Assistant, and Duncan is Specialist of Family and Child Development.

# INGESTED LEAD SHOT MAY AFFECT SURVIVAL OF WILD MOURNING DOVES

**M**OURNING DOVE hunting is a popular pastime for many Alabamians. Each year hunters in this State harvest approximately 3.5 million doves, primarily by hunting them over fields in which they feed. Up to one lead shot per square foot can accumulate in the soil of such fields, and doves can suffer lead poisoning when they accidentally ingest them as food items, or as grit to aid in digestion. From 1 to 6.5% of the dove population ingests lead shot in this way.

Lead poisoning causes high mortality in captive mourning doves. Previous research by the Alabama Agricultural Experiment Station (AAES) showed captive doves force-fed one and two lead shot had mortality rates of 24% and 60%, respectively, and another study indicated diet modified the severity of lead toxicity.

The effects of lead on wild mourning doves and the potential for secondary lead poisoning among predators and scavengers that eat mourning doves containing ingested lead shot are largely unknown. To address these subjects, an AAES study compared mortality and causes of death of wild lead-treated and untreated mourning doves.

From early August to mid-November 1986, 133 male and female doves of various ages were trapped on 5 trapping days about 1 week apart. Each dove was held in captivity overnight and its blood was tested for recent exposure to lead. Sixty-one birds (approximately 13 birds from each trapping) with no recent lead exposure were used in the experiment. Before release the next day, half of the experimental doves were force-

fed one #8 lead shot (treatment) and half were force-fed a millet seed (control). A small radio transmitter was fitted on the back of each dove, and they were banded and released at the trap site along with trapped doves not used in the experiment.

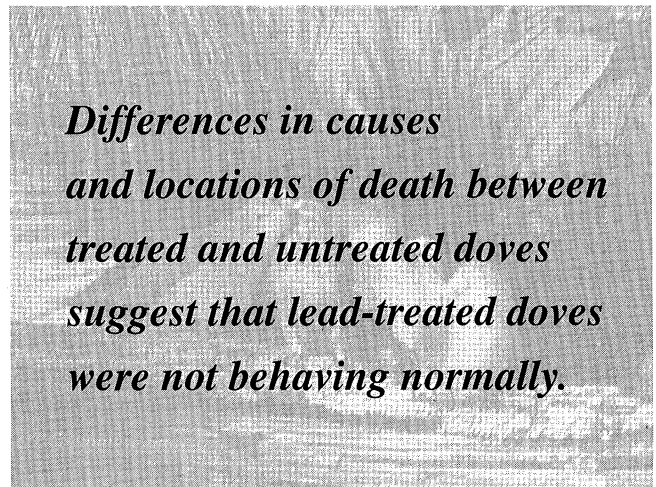
Survival time and cause of death were determined by locating each dove twice daily with a radio receiver and antenna for 21 days, or until they died. Remains of dead doves usually contained only feathers and occasional bones, so "clues" such as arrangement of the feathers and marks on the radiotransmitter were used to determine causes of death.

Sixty-eight percent of the treated doves died during the study, whereas only 52% of the control doves died. This difference was not large enough to prove that the lead treatment caused higher death rates, but the mortality of control doves also was higher than normal annual mortality. Avian predators "keying in" on the radio-outfitted doves may have masked any additional lead effects by killing some treated doves before lead poisoning developed.

Differences in causes and locations of death between treated and untreated doves suggest that lead-treated doves were not behaving normally. Avian predators killed most of the untreated doves, and no mam-

malian predation or scavenging was detected in that group. Conversely, mammals either killed or scavenged most of the treated doves, see table. Additionally, remains of avian-killed doves were usually found in open areas (8 of 10), whereas remains of doves killed or scavenged by mammals were found in denser cover (7 of 7). Lead-poisoned waterfowl seek dense cover, so the use of this type of cover by the treated doves may indicate they were sick and became susceptible to mammals hunting and scavenging there.

Secondary poisoning of mammalian predators by mourning doves containing lead shot seems unlikely because mammals would probably excrete lead shot intact.



*Differences in causes and locations of death between treated and untreated doves suggest that lead-treated doves were not behaving normally.*

Avian predators are likely to retain lead shot longer, but few would probably be poisoned by the small amount of lead shot in the digestive tracts of mourning doves.

The lower survival rates and high incidence of mammals killing or scavenging the lead-treated doves in this study suggest that the adverse effects of lead shot ingestion observed in captive mourning doves may carry over into the wild population. An intensive banding study that includes lead-treated and control doves and an analysis of their survival during a long period is necessary to verify these findings and to determine if lead poisoning has any significant impact on the State's dove population.

Carrington is former Graduate Research Assistant and Mirarchi is Professor of Zoology and Wildlife Science.

Treatment	Cause of death/scavenging				Unknown
	Avian	Mammalian	Other	Total	
Lead-treated .....	4	7	0	11	4
Control .....	6	0	1 <sup>1</sup>	7	6

<sup>1</sup>Eaten by snake.

malian predation or scavenging was detected in that group. Conversely, mammals either killed or scavenged most of the treated doves, see table. Additionally, remains of avian-killed doves were

# GROWTH RETARDANT MAY HELP PRODUCE IDEAL CAMELLIA

**T**HE SHOWY fall and winter blooms, lustrous dark green foliage, and refined growth habit of the *Sasanqua* camellia have made it a favorite landscape plant in the Southeastern United States. When buying camellias, consumers look for large, vigorously growing plants with an abundance of buds or flowers. However, producing such a plant can be difficult because vigorously growing plants tend to set few if any buds, and profuse budding tends to slow vegetative growth. Now the use of a growth retardant shows some potential as a way to produce these ideal characteristics in camellias, thereby increasing their value and making them more marketable as landscape plants and flowering potted plants.

Growth retardants are routinely applied to potted crops to produce compact plants. A secondary benefit with some crops is early or enhanced flowering. Growth retardants also are used to promote flowering of woody nursery crops for landscape use or for temporary use as indoor flowering potted plants.

In a study conducted by the Alabama Agricultural Experiment Station, liners of *Shishi-Gashira* camellias were potted on March 21, 1989, into #1 containers of pine bark and sand (7:1, by volume) growth medium amended per cubic yard with 5 lb. of dolomitic limestone, 14 lb. of Osmocote 17-7-12, and 1.5 lb. of Micromax. Plants were grown outdoors under 47% shade and overhead irrigation.

The treatments included single Sumagic sprays of 0, 5, 10, 15, 20, 40, or 60 parts per million (p.p.m.) applied on May 26 in a volume of 2 qt. per 100 sq. ft. Growth index [(height + width at the widest point + width at 90° to the widest point) ÷ 3] was measured approximately every 4 weeks during the 1989 growing season and again on May 30, 1990, following the spring flush of growth. Time until flowering was determined from the time plants were treated until the first flower was fully opened. At this time, flower number, including open flowers and

flower buds, and flower diameters were measured.

Plants treated with Sumagic exhibited darker green, smaller leaves and shorter internodes than control plants. Beginning 4 weeks after treatment (June 23) and continuing through May 30 of the following year, plant growth, as indicated by growth indices, lessened as the concentration of Sumagic increased. This growth suppression reached a maximum of 28% on November 30 in plants treated with 60 p.p.m. of Sumagic. By May 30, 1990, growth was reduced 20% on the plants treated with 60 p.p.m. Sumagic relative to the control; the growth reduction was 12% or less with the application of 20 p.p.m. or less.

Flowering, as indicated by the number of open flowers and buds, increased from 3.8 per plant for the control to a high of 8.1 per plant with the 20 p.p.m. treatment. This change represented a 113% increase in flowering. Even the plants treated with the lowest concentration of Sumagic (5 p.p.m.) exhibited 52% more flowers than the control plants. Flower diameter was not affected by Sumagic concentration.

The 20 p.p.m. treatment resulted in the greatest increase in flower and flower bud number (113%) and reduced growth by 12% compared to untreated plants. Greater compaction and enhanced flowering of plants treated with 20 p.p.m. of Sumagic suggest

this treatment may be useful in the commercial production of camellias for temporary use as interior flowering plants before later planting into the landscape.

Plants treated with 5 p.p.m. of Sumagic produced 52% more flowers than control plants, but were similar in size to the control plants. Increased flowering with low rates of Sumagic, coupled with darker foliage and little or no reduction in growth compared to the control plants, suggests that this treatment may produce a higher value, more marketable plant for retail and wholesale nurseries.

Keever is Associate Professor of Horticulture; McGuire is Professor and Head of Research Data Analysis.

INFLUENCE OF SUMAGIC ON GROWTH AND FLOWERING OF SHISHI-GASHIRA CAMELLIA

Sumagic rate, p.p.m.	Growth indices <sup>1</sup>	Flower number <sup>2</sup>	Days to first flower <sup>3</sup>
0	37.9	3.8	167
5	39.2	5.8	164
10	35.7	5.1	165
15	33.9	5.9	168
20	33.1	8.1	168
40	30.5	6.9	171
60	30.0	7.6	176

<sup>1</sup>Growth indices = (height + width at the widest point + width 90° to the widest point) ÷ 3, in cm; treatments were applied on May 26, 1989, and growth indices were taken May 30, 1990.

<sup>2</sup>Number of open flowers and flower buds determined when first flower fully opened.

<sup>3</sup>Days to first flower after treatment application.

ALABAMA AGRICULTURAL EXPERIMENT STATION  
AUBURN UNIVERSITY  
AUBURN UNIVERSITY, ALABAMA 36849-5403

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