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ALABAMA AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY

HIGHLIGHTS

OF AGRICULTURAL RESEARCH

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ON THE COVER: A Martha Berry holly becomes a childhood memory that can literally last for years. See article on page 3.

from the Director

The Winter issue of *Highlights* brings to close a very productive year for the AAES and it signifies the beginning of a new year.

Throughout the year, a variety of research has been reported. It is our goal to give you a broad perspective of the research conducted to meet the needs of both the producers and consumers. Unfortunately, because of budgetary constraints we must reduce the size and scope of our research program.

Every dark cloud has a silver lining. The reduction in funding provides an opportunity to assess our programs and to make some changes to reflect today's needs. We have the opportunity to ask the question many children ask their parents -- "Why?" Why are we doing this research? Why is the proposed research more important than other areas? "Why" is a difficult but challenging question.

The AAES has developed its "Wish List" for this Christmas Season. We wish

That we could meet all of the needs of the State's producers and consumers.

That the public understood that food does not just come from the grocery store. Somebody has to produce it.

That the next Farm Bill recognizes the importance of agriculture and forestry to Alabama.

That each and everyone has a very Merry Christmas and Happy New Year, and that the closing of 1995 and the birth of 1996 finds you filled with Joy and, most of all, Peace.

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A QUARTERLY REPORT OF RESEARCH PUBLISHED BY THE ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN UNIVERSITY.

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Survey of Preferences for Alternative Christmas Trees

Kenneth M. Tilt, Bridget K. Behe, J. David Williams, Kathryn G. Besong, and J. Heath Potter

A two-year study by AAES researchers indicates that many Alabamians would buy specially pruned holly and cypress trees as alternatives to traditional Virginia pine Christmas trees. The study also indicates a potential niche for magnolias and other plant species for use as alternative Christmas trees.

With growing concern for the environment, there has been an increase in the demand for living trees, those harvested with the roots for future transplanting. To meet this demand, some Christmas tree growers are offering container-grown trees and trees dug from the field that are balled and burlapped. These options allow the grower to sell living trees for Christmas or landscape plants throughout the year. However, the trees often sold are not adapted to high temperatures common in the South. The customer may end up disappointed and resort to buying an artificial tree.

Leyland cypress is an alternative for the traditional Virginia pine Christmas tree. Although leyland cypress is new to Alabama, South Carolina has had tremendous success with this tree as a Christmas tree. It has a good shape, color, and branch strength, and it does not shed needles like other Christmas tree species.

Containerized hollies are another possibility. While visiting a nursery in South Alabama, researchers observed that all the hollies, Arizona cypresses, magnolias, and cryptomerias that were sheared in a neat Christmas tree form were tagged by the landscape designers or architects for their projects. In providing the desired uniformity for their customers, nursery producers also inadvertently created some beautiful Christmas tree specimens. Also, when plants are grown in containers, all of the roots are preserved, reducing the problem of needle or leaf drop. Hollies have long been a symbol of Christmas and have a history of use as Christmas trees.

A 1993 survey was conducted at the Alabama State Fair and the Southern Homes and Gardens Garden Center in Montgomery. Three different trees were displayed: a cut live Virginia pine, a containerized

Arizona Cypress, top, Leyland Cypress, middle, and Brilliant Holly, bottom, were among the container-grown trees used in the study.

Christmas Trees, continued on page 4

Christmas Trees, continued from page 3

Table 1. 1993 Survey Ratings of Christmas Trees

Tree	Avg. rating[1]	Pct. rating 4 or 5
Virginia pine (cut)	3.8	61
Leyland cypress (cut)	3.6	56
Holly (container)	3.3	50

[1] Rating: 1 = would not buy the tree; 5 = would definitely buy the tree.

Table 2. 1994 Survey Ratings of Christmas Trees

Tree[1]	Avg. rating[2]	Pct. rating 4 or 5
Leyland cypress	3.8	64
Martha Berry holly	3.5	54
Nellie R. Stevens holly	3.3	50
Little Gem magnolia	2.7	31
Carolina Sapphire Arizona cypress	2.7	30
Springhill magnolia	2.5	26
Fairhope magnolia	2.4	24

[1] All trees were in containers.
[2] Rating: 1 = would not buy the tree; 5 = would definitely buy the tree.

Nellie R. Stevens holly, and a cut live leyland cypress. All were similar in size and quality. Two trees of each type were used, one of which was decorated. Identical ornaments and decorations were used to prevent judgement by decoration.

Respondents from both locations were compared on the basis of age, income, gender, and education. There were no statistically significant differences between the sites, thus the two sub-samples were combined for further analysis. Respondents in the combined sample had an average age of 47 years and an average household income of $42,500. Twenty-six percent of the respondents were male, and 74% were female. Participants had an average high school education plus three years formal education beyond the high school level.

Of 119 consumers, 55% indicated that they had purchased a tree for the 1992 season. Forty-one percent of the respondents used an artificial Christmas tree in 1992, 54% purchased a cut live tree, and 3% purchased a living tree in a container. No participants purchased a ball-and-burlapped Christmas tree, and 2% chose not to respond to the question.

Survey participants were then asked to evaluate each tree. A scale from one to five was used in the evaluation. A rating of one suggested that the consumer definitely would not purchase this tree for use in his or her home, while a rating of five suggested that the consumer definitely would purchase the tree for home use (Table 1). Results of this survey showed an equal preference for Virginia pine and leyland cypress. However, holly was not far behind.

A 1994 survey was conducted at the Birmingham Botanical Gardens and again at the Southern Homes and Gardens Garden Center. Seven different containerized trees were decorated and displayed, including: Carolina Sapphire Arizona cypress, leyland cypress, Martha Berry holly, Nellie R. Stevens holly, Fairhope magnolia, Little Gem magnolia, and Springhill magnolia. Best trees in each species were selected using taper, density and color of foliage, uniformity, and distribution of branches as selection criteria.

There were no statistically significant differences between the sites, thus the two sub-samples were combined for further analysis. Respondents in the combined sample had an average age of 46 years. Respondents varied widely in their household incomes. Sixteen percent had incomes less than $24,999; 25% had incomes between $25,000 and $49,000; 15% had incomes between $50,000 and $64,999; and 31% had incomes of $65,000 or more. Twenty-nine percent of the respondents were male, and 71% were female. Participants had an average high school education plus three years formal education beyond the high school level.

Of the 171 consumers surveyed, 66% indicated that they had purchased a tree for the 1993 season, an increase of 11% from 1992. Thirty-four percent of the respondents used an artificial Christmas tree in 1993, a decline of 7% from 1992. Fifty-four percent of the respondents purchased a cut live tree, 3% purchased a living tree in a container, and 2% purchased a ball-and-burlapped Christmas tree. Sixty-two percent of the respondents said they would buy a live tree in a container that could be planted outside after Christmas, even though they cost more than live, cut trees. However, 38% still preferred the live, cut trees.

Finally, survey participants were asked to evaluate each tree, using a scale from one to five (Table 2). Results of this survey show that there is a strong interest in containerized Christmas trees, especially leyland cypress and holly. Although magnolias and Arizona cypress were ranked low, 24-30% of the participants indicated a strong preference for these trees. More refined pruning techniques developing trees targeted at this market could improve interests in other alternative Christmas trees.

Data indicate an opportunity for Alabama Christmas tree and nursery industries to develop and explore this new market niche opportunity. It seems that the people of Alabama are receptive to change from our traditional Virginia pine.

Tilt and Behe are Associate Professors, Williams is an Assistant Professor, Gaylor is a Research Technician, and Potter is a Research Assistant in Horticulture.

Pasture-Finished Beef Pleasing to the Palate:
Consumers Find Little Difference Between Pasture- and Feedlot-Finished Beef

Amy H. Simonne, Nancy R. Green, David I. Bransby, and James S. Bannon

Ryegrass, which is widely planted as a winter annual in the southeastern United States, provides an excellent forage for finishing beef. Consumer panels found that ryegrass-fed beef tastes just as good as feedlot-fed beef and also is higher in β-carotene, an antioxidant and precursor to vitamin A.

Most beef cattle are finished on grain diets in feedlots. Increasing and fluctuating grain prices, environmental concern associated with feedlots, and consumer demands for lower fat beef have generated interest in using forages as finishing diets for beef cattle.

Previous research had indicated that the quality of pasture-finished beef was inferior to that of feedlot-finished beef. However, many of these studies did not control slaughter weights. Other research suggested that sensory quality of meat from animals finished on forage may depend on forage types, quality of forage, and stocking rate. Early studies evaluated beef subjectively using small trained taste panels. Therefore, it had not previously been established if consumers can detect a flavor difference in pasture-finished beef and grain-finished beef.

Evaluation of meat from cattle finished on ryegrass, which is commonly grown in Alabama and other parts of the southern United States, is limited. Ryegrass may contain up to 4.0-5.2 mg per 100 grams fresh weight of β-carotene. Australian studies show cattle that are predominately pasture-fed tend to accumulate β-carotene in subcutaneous and intramuscular fat. Therefore, beef tissue may have potential as an auxiliary source of β-carotene.

The goals of this AAES study were (1) to determine if consumers can differentiate the quality of beef finished with annual ryegrass (*Lolium multiflorum*), annual ryegrass and "Tifton 78" bermudagrass (*Cynodon hybrid*) hay, and a feedlot diet and (2) to determine analytically the moisture, protein, fat, ash, and β-carotene content of beef tissues from each diet.

Three groups of five Angus or Angus x Hereford steers received finishing diets of annual ryegrass, annual ryegrass and hay, or a feedlot diet until

Pasture-Finished Beef, continued on page 6

Little difference can be seen among steaks cut from cattle on the three treatments. Pictured, from top to bottom, are steaks from the reygrass-hay treatment, ryegrass-only teatment, and feedlot-fed treatment.

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they reached similar slaughter weights. The feedlot diet consisted of grain and cotton seed meal (36% Tend-R-Lean Beef Finisher Pellets™ medicated). The steers receiving forage-based diets grazed ryegrass at a stocking rate of one animal per acre. The feedlot animals reached slaughter weight in 72 days and the forage-finished animals were fed 161 days before reaching slaughter weight. Average daily gain (ADG) for cattle grazing on ryegrass, ryegrass and hay, and cattle receiving a feedlot diet were 3.0, 2.8, and 4.1 lb, respectively.

Average slaughter weights were 1,069, 1,082, and 1,058 pounds for cattle finished on ryegrass, ryegrass and hay, and the feedlot diet, respectively, and were not significantly different. Therefore, weight at slaughter was unlikely to influence the objective and subjective evaluation of the meat.

Eighty male and female volunteers (age 18-60 years) who were regular meat consumers were asked to taste ribeye steaks and ground beef from animals receiving each of the three finishing diets (see the figure). Meat samples were oven-broiled to an internal temperature of 158°F. The panelists were presented first with three ground beef samples followed by the corresponding three steak samples. Samples were coded with random three digit numbers.

The consumer panel rated steaks from pasture-finished animal higher for juiciness, tenderness, and overall preference, but the differences were not statistically different (Table 1). All the scores were in the acceptable range. This study implies that consumers did not detect any differences in the steaks from different treatments.

The ground beef from cattle finished on feedlots received higher scores than that of ground beef from cattle finished on pasture or pasture and hay, but the scores were in the acceptable range. The consumer panel did not perceive any objectionable flavor in any steak or ground beef samples. Since ground beef is normally eaten with condiments or in a casserole, this slight difference would be extremely difficult to detect.

Finishing diets did not influence moisture, fat, or ash content of the ribeye muscle. Protein of steaks from cattle finished on the feedlot diet (23.13%) was higher than that of steaks from the cattle finished on ryegrass pasture (22.05%), but not different from animals finished on pasture and hay (22.39%). This difference in protein content is of little practical consequence as a four-ounce serving of ribeye steak from animals finished in the feedlot or on pasture would be 26 and 25 grams, respectively.

Color of ribeye steaks from the three finishing diets was not different, but subcutaneous fat from feedlot animals was significantly darker in color than that of ryegrass- and ryegrass-and-hay-finished animals. Color of subcutaneous fat is not usually an issue to consumers because cuts are usually trimmed prior to retail marketing.

Cattle finished on ryegrass pasture and pasture plus hay had significantly higher β-carotene than the animals finished in the feedlot (Table 2). Results from this study show that meat and liver from cattle finished on ryegrass pasture would provide approximately 0.1 mg and 2 mg β-carotene per 100 grams (four ounces) raw weight, respectively.

This study demonstrates that it is possible to produce beef of acceptable quality on ryegrass pasture or on ryegrass and hay. Although the time required to reach a specified slaughter weight for animals grazing on ryegrass pasture or pasture and hay was longer than in the feedlot, the general quality and consumer acceptability was not compromised and beef from pasture finished cattle was higher β-carotene content.

Table 1. Sensory Scores (cm*) of Steaks and Ground Beef From Cattle Finished on Different Diets

Finishing diet	Taste/flavor	Juiciness	Tenderness	Overall preference
		Steaks		
Pasture	6.8	7.6	7.1	7.8
Pasture and hay	6.3	6.4	6.7	7.4
Feedlot	7.2	6.9	6.9	7.5
		Ground beef		
Pasture	7.6	6.6	-	7.4
Pasture and hay	6.8	5.7	-	6.7
Feedlot	8.7	7.5	-	8.6

*The maximum full scale of score is 14 cm.

Table 2. β-Carotene and Vitamin A Contents of Ribeye Steaks, Ground Beef, and Liver From Cattle Finished on Pasture, Pasture and Hay, and Feedlot Diets*.

Finishing diets	β-Carotene content			Vitamin A
	Steaks	Ground beef	Liver	Liver
		(μg/100g)		
Pasture	64 ± 11.4	87 ± 13.7	2, 180 ± 748	51,650 ± 28,031
Pasture and hay	63 ± 15.4	80 ± 26.0	1,955 ± 1,161	25,134 ± 9,397
Feedlot	36 ± 17 .3	41 ± 5.0	305 ± 64	9,600 ± 3,967

* Data are average ± standard deviation with duplicates of each sample of each animal.

Simonne and Green are Post-doctoral Fellow and Professor, respectively, of Nutrition and Food Science; Bransby is a Professor of Agronomy and Soils; and Bannon is Director of the E.V. Smith Research Center.

Consumer Preferences for Geranium

Flower Color, Leaf Variegation, and Price

Bridget K. Behe and Robert G. Nelson

A recent AAES survey of consumers indicates flower color and price are the top considerations when purchasing geraniums. Unlike previous studies in which consumers preferred red flowers, the Auburn study indicates lavender is the preferred color, and that these preferences vary according to gender and age.

Geraniums are the third most popular bedding plant in the United States.

Consumers shopping at two Montgomery, Alabama, garden centers on two Saturdays in April, 1993, were asked to rate 25 composite photographs of geranium plants and respond to several demographic questions. The rating scale was from 1 (not likely to buy) to 10 (likely to buy). Each participant received a red geranium plant for participating.

Conjoint analysis, a technique developed to identify and quantify consumers preferences and to establish ranking of these preferences, was used to select flower color, leaf variegation, and price combinations. Five flower colors were used: red, pink, white, coral, and lavender. Three leaf variegations were used: plain green leaf (no zone), green leaf with white zone, and green leaf with dark zone. Price points from $1.39 to $2.79 in increments of $0.20 were used. Conjoint analysis selected 25 combinations of these factors. Researchers then developed composite photographs to represent each plant and price combination.

Of the 204 respondents, 79% were female and 21% were male. The average

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age was 48 years and the median household income was $50,000 to $54,999. Thirty percent had completed some high school, 48% had completed college, and 22% had completed college and beyond.

Conjoint analysis was used to determine the highest and lowest rated plants (Table 1). The lavender geranium with a white zone (Danielle) priced at $1.39 was most preferred. The white flower with plain green leaf (Snow White) priced at $2.39 was least preferred. In contrast to previous studies, red geraniums were not most preferred in the AAES study.

Conjoint analysis also yielded the relative importance of each factor when consumers were making purchase decisions (Table 2). For the sample as a whole, flower color was most important (52% of the decision process), followed by price (45% of the decision process). Leaf variegation was relatively unimportant in the purchase decision, comprising only 3% of the decision. For men, flower color and leaf variegation were more important in the purchase decision. For women, retail price was more important. Older consumers (over age 60 years) used flower color and leaf variegation more than the group overall in making their decision.

Despite gender and age differences in consumer preferences for geranium flower color, leaf variegation, and price, flower color was overall the most important factor in deciding which geraniums might be purchased, comprising nearly half of the purchase decision for all gender and age groups. Controlling for price and leaf variegation, the lavender cultivar, Danielle, was the most preferred color followed by a dark red cultivar, Flame. Lower prices were preferred to higher prices, as one might expect. Leaf variegation had little effect on the purchase decision. Thus, plant breeders and marketers should focus more on developing and selling different colors of geraniums rather than different leaf variegation patterns.

Behe is an Associate Professor of Horticulture and Nelson is an Assistant Professor of Agricultural Economics and Rural Sociology.

Table 1. Three Highest and Lowest Rated Geranium Plants Using 25 Composite Photographs

Highest rated				Lowest rated			
Rating	Flower	Leaf	Price	Rating	Flower	Leaf	Price
6.56 [1]	Lavender[2] (Danielle)[5]	Var.[3]	$1 .39[4]	4.66	Pink (Mrs. Parker)	None	$2.39
6.39	Dark Red (Flame)	None	$1.39	4.27	White (Snow White)	None	$2.79
6.36	Lavender (Danielle)	None	$1.59	4.21	White (Snow White)	None	$2.39

[1] Average rating on a scale from 1 (definitely would not buy this plant) to 10 (definitely would buy this plant).
[2] Flower colors were: white, pink, coral, lavender, or red.
[3] Leaf variegation was none (none), green leaf with white zone (var), or green leaf with dark zone (zone).
[4] Prices were: $1.39, $1.59, $1.79, $1.99, $2.39, or $2.79.
[5] Variety name.

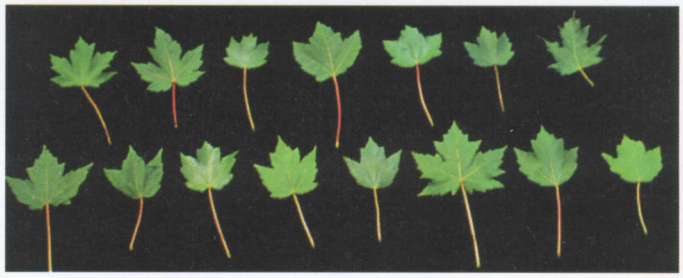
Table 2. Relative Importance of Flower Color, Leaf Variegation, and Price to Consumer Sample Overall, by Gender and by Age

	Relative importance[1]		
	Flower color	Leaf variegation	Retail price
Overall (n=191)	52.05	3.38	44.57
Gender			
Male (n=35)	67.74	10.59	21.67
Female (n=140)	48.70	3.13	48.18
Age			
60 years or less (n=134)	44.84	5.09	50.07
61 years or more (n=37)	61.82	7.51	30.67

[1] The percentage that each attribute was weighted in the purchase decision as calculated by conjoint analysis from consumer ratings made about purchasing.

ERRATA

In the Fall issue of Highlights this photograph was inadvertantly flipped. It is shown printed correctly here.



Foliage of red maple cultivars (top row, left to right): Armstrong, Autumn Blaze, Autumn Flame, Bowhall, Fairview Flame, Gerling, Karpick, (bottom row, left to right) Morgan, Northwood, October Glory, Redskin, Red Sunset, Scarsen, Schlesingeri, and Tilford.

Figure 1 (left.) The white, cottony fungal growth on the surface of the leaves of the flowering dogwood cultivar Pink Beauty. Figure 2 (below.) Typical powdery mildew symptoms on the flowering dogwood cultivar Ozark Spring.

Dogwoods Resist Powdery Mildew

Austin Hagan, Charles Gilliam, Gary Keever, and Dave Williams

WITHIN THE LAST TWO YEARS, powdery mildew has emerged as a common and disfiguring disease of flowering dogwood in landscapes and forested areas across Alabama. Trees growing in heavy shade to full sun have suffered equally from this disease. In AAES tests on 26 flowering dogwood varieties, only Cherokee Brave proved highly resistant to this disease.

This study confirmed that flowering dogwood cultivars are much more likely to be disfigured by powdery mildew than kousa or hybrid dogwoods. Of the 26 cultivars of flowering dogwood screened, colonization of the leaves of five cultivars of flowering dogwood generally was unobtrusive and tree aesthetics were largely unaffected. Several cultivars of the flowering dogwood were, however, so susceptible to powdery mildew that fungicides would be required to maintain tree health and beauty. With the exception of Eddie's White Wonder, the hybrid, kousa, and giant dogwoods displayed a consistently high level of resistance to powdery mildew.

With the increasing emphasis on minimizing the use of pesticides in home and commercial landscapes, disease resistant cultivars offer the most practical and effective means for controlling diseases such as powdery mildew on woody trees and shrubs. However, the reaction of cultivars of the flowering and other dogwood selections to powdery mildew is largely unknown .

The considerable differences in the severity of powdery mildew, which have been observed in several stands of seedling flowering dogwoods in the Auburn area, are a strong indication that some cultivars of the flowering dogwood may be highly resistant to this disease. In an AAES-supported field study, the reaction of cultivars of the flowering, kousa,

Powdery Mildew, continued on page 10

hybrid, and a single selection of the giant dogwood to powdery mildew was determined.

Bare-root dogwoods were planted in March 1993 in a Marvyn loamy sand. The trees were grown in full sun and watered as needed with a trickle irrigation system. Twice a year, each dogwood was topdressed with 0.2 pound of 13-13-13 fertilizer. Directed herbicide applications and mowing were used to control weeds. A visual rating of powdery mildew severity was made on August 4, 1994 and May 24, 1995 using a scale of 0 to 4 (0 = no disease, 4 = 76-100% of leaves damaged or colonized by the powdery mildew fungus).

With few exceptions, cultivars of the flowering dogwood proved to be moderately to highly susceptible to powdery mildew (see table). Both years, discoloration and distortion of the young leaves along with some premature leaf shed were seen on many of the flowering dogwood cultivars screened. Of 26 flowering dogwood cultivars established, 19 with disease ratings of 2.0 or more for one or both years were considered highly susceptible to powdery mildew. First Lady, Rubra Pink, Pink Beauty, Pink Flame, and Purple Glory consistently had the highest disease ratings. In both years, light to moderate powdery mildew damage was noted on the cultivars Fragrant Cloud, Springtime, Cherokee Chief, Cherokee Daybreak, Weaver's White, and Barton White. The newly released cultivar, Cherokee Brave, remained free of powdery mildew in 1994 and 1995.

Generally, the selections of kousa and hybrid dogwoods were more resistant to powdery mildew than those of the flowering dogwood (see table). Across all hybrid dogwood selections, only the disease ratings for Eddie's White Wonder were similar in both years to those of the flowering dogwood cultivars considered moderately susceptible to powdery mildew. On the remaining hybrids Aurora, Constellation, Galaxy, Stardust, Stellar Pink and to a lesser extent Ruth Ellen, only a few colonies of the powdery mildew fungus were scattered across the foliage and no leaf discoloration or distortion was observed. In addition, the kousa dogwood cultivars Milky Way, Satomi, National, and Milky Way Select remained almost symptom-free both years.

Powdery mildew was never observed on the giant dogwood Controversy.

Hagan is a Professor of Plant Pathology, Gilliam is a Professor, Keever is a Professor, and Williams is an Assistant Professor of Horticulture.

Reaction of Dogwoods to Powdery Mildew

		Disease rating				Disease rating	
Cultivar	Species[1]	July 94	May 95	Cultivar	Species	July 94	May 95
Dwarf White	CF	N.R.[2]	3.0	Springtime	CF	1.5	0.8
Junior Miss	CF	2.8	1.7	Cherokee Chief	CF	1.5	1.4
First Lady	CF	2.6	2.1	Eddie's White Wonder	H	1.4	1.3
Welch's Bay Beauty	CF	2.6	1.8	Cherokee Daybreak	CF	1.4	0.9
Ozark Spring	CF	2.6	1.8	Weaver's White	CF	1.1	1.1
Rainbow	CF	2.6	1.6	Ruth Ellen	H	1.1	0.1
Rubra Pink	CF	2.5	2.0	Barton White	CF	1.1	1.5
World's Fair	CF	2.4	1.6	Wonderberry	CF	1.0	2.2
Stokes Pink	CF	2.3	1.5	Aurora	H	0.6	0.0
Cloud 9	CF	2.3	1.7	Milky Way	K	0.5	0.3
Cherokee Princess	CF	2.3	1.5	Satomi	K	0.3	0.0
Double White	CF	2.3	1.5	Constellation	H	0.3	0.0
Pink Beauty	CF	2.3	2.6	Galaxy	H	0.2	0.1
Sunset	CF	2.2	1.4	Stardust	H	0.2	0.2
Red Beauty	CF	2.2	2.0	Stellar Pink	H	0.2	0.0
Pink Flame	CF	2.2	2.5	Milky Way Select	K	0.1	0.0
Purple Glory	CF	2.0	2.0	National	K	0.0	0.0
Autumn Gold	CF	1.7	2.9	Cherokee Brave	CF	0.0	0.0
Fragrant Cloud	CF	1.7	1.8	Controversy	G	0.0	0.0

[1] CF=flowering dogwood, K=kousa dogwood, G=giant dogwood, H=hybrid dogwood (*C. florida x kousa* and *Cornus nuttallii x Florida*).
2 N.R.=not recorded.

Plant Growth Regulators Influence Cotton Growth and Yield

Dale Monks and Mike Patterson

Excessive vegetative, often called "rank," growth of cotton reduces sunlight penetration through the canopy, increases relative humidity in the lower canopy, and lowers the efficiency of picking. The result can be an increased incidence of boll rot.

In an AAES study, mepiquat chloride, the standard plant growth regulator for cotton, controlled growth better than sulfonylurea herbicides, but neither reduced boll rot and in some applications both produced lower yields than nontreated cotton plots.

Mepiquat chloride, which is marketed under several trade names, can be applied according to the manufacturer's label at multiple low rates beginning at the pinhead square stage of growth or at higher rates at first bloom. The yield response of cotton to applications of mepiquat chloride has been extremely variable, ranging from no effect to a yield increase or decrease. Cotton yield response can vary ac-cording to location, plant maturity, and environmental conditions. Mepiquat chloride can sometimes increase the earliness of cotton due to increased fruit retention on first position fruit sites.

Sulfonylurea herbicides have traditionally been used for weed control in corn and soybean production; however, herbicides in this chemical family recently have been labeled for use in cotton. These herbicides are safe, effective, and extremely reliable in their activity and, at low doses, might have potential in reducing plant height without killing cotton or reducing its yield. Bensulfuron is a sulfonylurea-type herbicide currently used for controlling broadleaf weeds and sedges in rice. Bensulfuron has a short half-life, is nontoxic to most fish, birds, and other wildlife at low to medium concentrations, and is very reliable in its activity.

To evaluate the effectiveness of bensulfuron as a plant growth regulator in cotton, studies were conducted at the Gulf Coast Substation in Fairhope from 1992 through 1994. Mepiquat chloride and bensulfuron were applied postemergence over-the-top with a conventional-type sprayer at the pinhead square and/or early bloom stage of cotton growth. The varieties planted were Delta and Pineland (DPL) 5690 in 1990 and 1993 and DPL-51 in 1994. Prior to harvest, heights were recorded and boll counts were conducted to determine the effect of growth regulation on boll rot incidence and cotton maturity. The plots were then machine-harvested and yields were recorded.

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Growth Regulators, continued from page 11

The initial cotton response to bensulfuron application was yellow apical meristems, purple coloration of leaf margins and petioles, and slow growth. Initial injury was 10 to 14 days in duration, after which the cotton regained its normal coloration. Most of the mepiquat chloride treatments successfully shortened cotton (Table 1). Higher rates applied sequentially were especially effective at reducing height. Bensulfuron was not as effective as the mepiquat chloride, with little to no additional response as the rate was increased. Although plant height was reduced by some treatments, boll rot was not affected by any treatment.

Percent open bolls indicated that cotton maturity was delayed in 1993 by mepiquat chloride applied sequentially at the higher rates (Table 1). Mepiquat chloride did not delay maturity in 1994. Bensulfuron also delayed boll opening in 1993 for four out of six treatments. The higher rate of bensulfuron applied alone at the pinhead square stage of growth or sequentially delayed boll opening in 1994.

Cotton yield was not affected by treatment in 1992. In 1993, all sequential applications of mepiquat chloride decreased yield from 18 to 26% (Table 2). Mepiquat chloride did not reduce yield in 1994. Bensulfuron reduced cotton yield in three out of six treatments in 1993 and 1994, especially at higher rates. Single application of bensulfuron at low rates did not reduce cotton yield.

In summary, mepiquat chloride, currently considered the industry's standard plant growth regulator, was more effective at controlling cotton height than bensulfuron. Although cotton height was reduced by some treatments, the incidence of boll rot was not affected. Since bensulfuron was not as effective as mepiquat chloride at controlling cotton growth and reduced yield in two out of three years for some treatments, it does not appear to have potential as a plant growth regulator in cotton.

Monks is an Assistant Professor and Patterson is an Associate Professor of Agronomy and Soils.

Table 1. Effect of Bensulfuron and Mepiquat Chloride on Cotton Growth, Bollrot, and Yield, 1992-94

			Cotton plant development[1]			
					Open bolls	
					1993	1994
Treatment[2]	Rate	Timing[3]	Height	Rotten bolls		
	g a.i./ha[4]		*In.*[4]	*Pct*	*Pct.*	
Mepiquat chloride	10	PHS	132	26	18	53
Mepiquat chloride	10	EBL	114	24	27	67
Mepiquat chloride	5 fb 5	SEQ	112	27	22	59
Mepiquat chloride	10 ft 10	SEQ	109	28	14	66
Mepiquat chloride	10 ft 20	SEQ	102	28	13	73
Mepiquat chloride	20 fb 20	SEQ	97	26	16	58
Bensulfuron	0.017	PHS	135	22	17	57
Bensulfuron	0.017	EBL	112	24	19	51
Bensulfuron	0.017	SEQ	119	23	15	49
Bensulfuron	0.034	PHS	125	21	19	44
Bensulfuron	0.034	EBL	122	26	16	57
Bensulfuron	0.034	SEQ	125	26	15	44
Nontreated control	-	-	135	24	25	60
LSD (0.05)			10	NS	8	12

[1] Height and rotten boll data were pooled over years due to lack of interaction.
[2] Bensulfuron treatments included a nonionic surfactant at 0.25% v/v.
[3] Abbreviations are as follows: PHS = pinhead square stage; EBL = early bloom stage; SEQ = sequential treatment at PHS and EBL.
[4] One ounce = 29 grams; one hectare = 2.2 acres, one inch = 2.6 centimeters.

Table 2. Effect of Bensulfuron and Mepiquat Chloride on Cotton Yield, 1992-94

			Seed cotton yield		
Treatment[1]	Rate	Timing[2]	1992	1993	1994
	g a.i./ha[3]			*kg/ha*[3]	
Mepiquat chloride	10	PHS	4,450	2,410	2,950
Mepiquat chloride	10	EBL	4,180	2,450	3,300
Mepiquat chloride	5 fb 5	SEQ	4,510	2,210	3,000
Mepiquat chloride	10 fb 10	SEQ	4,740	2,140	2,850
Mepiquat chloride	10 fb 20	SEQ	4,190	2,020	3,050
Mepiquat chloride	20 fb 20	SEQ	4,600	2,310	3,000
Bensulfuron	0.017	PHS	4,610	2,380	2,800
Bensulfuron	0.017	EBL	3,510	2,460	2,800
Bensulfuron	0.017	SEQ	3,730	2,440	2,250
Bensulfuron	0.034	PHS	4,380	2,310	2,700
Bensulfuron	0.034	EBL	4,470	2,310	2,850
Bensulfuron	0.034	SEQ	4,260	2,190	2,100
Nontreated control	-	-	4,500	2,820	3,100
LSD (0.05)			NS	450	340

[1] Bensulfuron treatments included a nonionic surfactant at 0.25% v/v.
[2] Abbreviations are as follows: PHS = pinhead square stage; EBL = early bloom stage; SEQ = sequential treatment at PHS and EBL.
[3] One ounce = 29 grams; one hectare = 2.2 acres, one kilogram = 2.2 pounds.

Keeping Milk Fever at Bay

Adding Hay to Broiler Litter Ration Helps Protect Cows

Brian J. Rude, Darrell L. Rankins, Jr., S. Eddy Peacock, and John T. Eason

Feeding broiler litter to brood cows as a winter feedstuff has been practiced for several years because of its economic advantages. However, some cows consuming broiler litter during pregnancy have exhibited signs of milk fever following calving. Milk fever is a calcium deficiency in the cow as a result of the increased demands of milk production. A recent AAES study showed that a small amount of hay each day was beneficial for partially alleviating the suppressed serum calcium observed in cows fed broiler litter.

The first trial was conducted at the Sand Mountain Substation in Crossville in 1993. In late October, 45 pregnant cows were divided into three equal groups and fed hay or a diet containing 80% broiler litter and 20% corn or the broiler litter and corn diet with 2% ammonium chloride. Ammonium chloride has been used in the dairy industry to prevent milk fever. Diets were fed through early April.

Two digestibility trials were conducted with the first being at the initiation of the study and the second immediately following calving. Although clinical milk fever was not observed in any of the cows fed broiler litter, blood calcium concentrations were suppressed. Cows fed broiler litter absorbed more calcium, without increasing urinary or milk output of calcium, yet serum calcium concentrations were decreased, thus predisposing the cows to milk fever. Cows fed hay exhibited normal concentrations of serum calcium.

In this study, cows consuming broiler litter were depositing calcium into the bone when they should have been resorbing calcium from the bone. Addition of ammonium chloride was not effective in minimizing the effect broiler litter had on calcium status in these cows.

A second trial was conducted at the Sand Mountain Substation in 1994 to determine if supplemental hay would offset the negative effect that broiler litter was having on calcium status in cows after calving. In late October, 48 pregnant cows were divided into three equal groups and fed hay, broiler litter and corn, or broiler litter and corn with five pounds of hay per cow per day.

As in the previous trial, broiler litter decreased serum calcium concentrations; however, addition of hay to

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the broiler litter diet tended to offset these changes. Measuring serum hydroxyproline, an indicator of bone breakdown, indicated that cows fed broiler litter were depositing calcium into the bone instead of using it for milk production. Addition of hay to the broiler litter diet allowed less calcium to be deposited, and apparently maintained serum calcium within acceptable limits.

A third trial was conducted on the AU campus in 1995 to further assess the effects of supplemental hay on calcium status in animals fed broiler litter. To accomplish this objective, pregnant goats were used as a model for brood cows. Beginning in October, these goats were fed three diets similar to those in the second trial. Goats were subjected to metabolism trials immediately before and after kidding.

As observed in cows, broiler litter consumption suppressed serum calcium, even though more calcium was retained in the body of goats fed broiler litter. Again, it was determined that bone deposition of calcium was occurring in goats that had been consuming broiler litter during pregnancy. Similar to the second trial, serum calcium was increased and bone deposition was decreased in goats consuming broiler litter and supplemented with hay.

Results of these studies indicate that the milk fever problems frequently observed in cows consuming broiler litter during pregnancy is a result of abnormal calcium metabolism. The decreased serum calcium is a result of calcium metabolism being directed towards bone deposition at calving. These cows need to maintain serum calcium at this time due to the demands of milk production. The primary mechanism to accomplish this is through bone resorption of calcium. It was also shown that the potential for this problem can be minimized with addition of hay to broiler litter diets.

Although serum calcium was suppressed in each of these trials, it should also be pointed out that clinical milk fever was only observed in two cows consuming broiler litter. In general, the cows that exhibit milk fever, and thus require treatment, are the older cows (greater than eight years of age) and the best milk producers (i.e., wean the heaviest calves).

Serum Calcium Concentration in Cows and Goats near Parturition

	Serum calcium (mg/dL)
Cows	
Hay	8.9
Broiler litter + corn	7.5
Broiler litter + corn + hay	8.4
Goats	
Hay	11.0
Broiler litter + corn	6.0
Broiler litter + corn + hay	7.2

Rude is a Graduate Student and Rankins is an Associate Professor of Animal and Dairy Sciences; Peacock is a Herdsman and Eason is Superintendent (retired) of the Sand Mountain Substation.

GREEN

AN ENVIRONMENTALL

Many vegetable crops produced in Alabama are susceptible to various soilborne pests, such as root-knot nematodes. Methyl bromide has traditionally been used to control nematodes, but will be banned by the year 2001 for environmental reasons. AAES research has found that certain "green manure" crops may provide growers and researchers an environmentally friendly way to control these pests.

Methyl bromide, a biocide that kills soilborne diseases, weed seeds, and soilborne insects, has been used as a soil fumigant for many years. However, methyl bromide is an ozone depleter and is subject, according to the Clean Air Act, to a complete ban on use and production.

There is no single product or practice that can achieve the effectiveness of this compound against such a wide range of plant pests. Instead of a single component, control of soilborne pests of vegetables must involve an integrated system using both pesticides and cultural practices.

Root-knot nematodes are microscopic roundworms that

MANURES:

FRIENDLY WAY TO CONTROL ROOT-KNOT NEMATODES

William T. Crow, Elizabeth A. Guertal, and Rodrigo Rodriguez-Kabana

Okra roots with root-knot nematode galls.

causes galling and malformation of roots. Infection by root-knot nematodes results in losses of yield and plant vigor and increases plant susceptibility to other pathogens. Root-knot nematodes are especially prevalent in areas with sandy soil and mild winter temperatures, such as the coastal plains of Alabama. Besides vegetables, root-knot nematodes also are major pests of agronomic crops, such as peanuts and cotton.

Because of the impending elimination of methyl bromide, researchers have been exploring other options for nematode control. One alternative cultural practice being explored is the use of green manures—plants that are incorporated into the soil while green and living. This practice is common with legume cover crops, as they add nitrogen (N) to the soil and improve soil physical properties.

Green manures also can have inhibitory effects on root-knot nematodes. These effects may be a result of increases in beneficial organisms due to green manures, or because of toxic substances, such as ammonia or tannins, released from decaying plant material. A series of studies were conducted to discover if green manures might be useful for controlling root-knot nematodes on vegetable crops in Alabama.

Initially, eight green manure crops containing compounds with possible nematicidal effects were selected: lespedeza, common vetch, velvetbean, lupin, castor, rapeseed, giselba mustard, and marigold. Green manures were mixed with root-knot nematode-infested soil at a rate of 1,000 pounds of N per acre. After two weeks, the surviving nematodes were extracted from each treatment and their numbers were compared to a nontreated nematode-infested soil control. All the green manures tested reduced root-knot nematode populations in the soil to near zero.

In a second experiment, the same eight green manures were incorporated at a rate of 500 pounds of N per acre. Green manures were compared to soil amended with urea fertilizer at the same N rate to provide a comparison to a commercial fertilizer nitrogen source. Soil populations of root-knot nematodes were significantly reduced by all treatments.

To determine the effect of green manures on nematode populations and vegetable crop growth, rapeseed and velvetbean green manures were used. Velvetbean is a summer legume crop that is able to fix N, accumulates high biomass, and has been shown to have root-knot nematode inhibitory effects. Rapeseed is a winter cruciferous crop that is being studied as a potential new crop for the

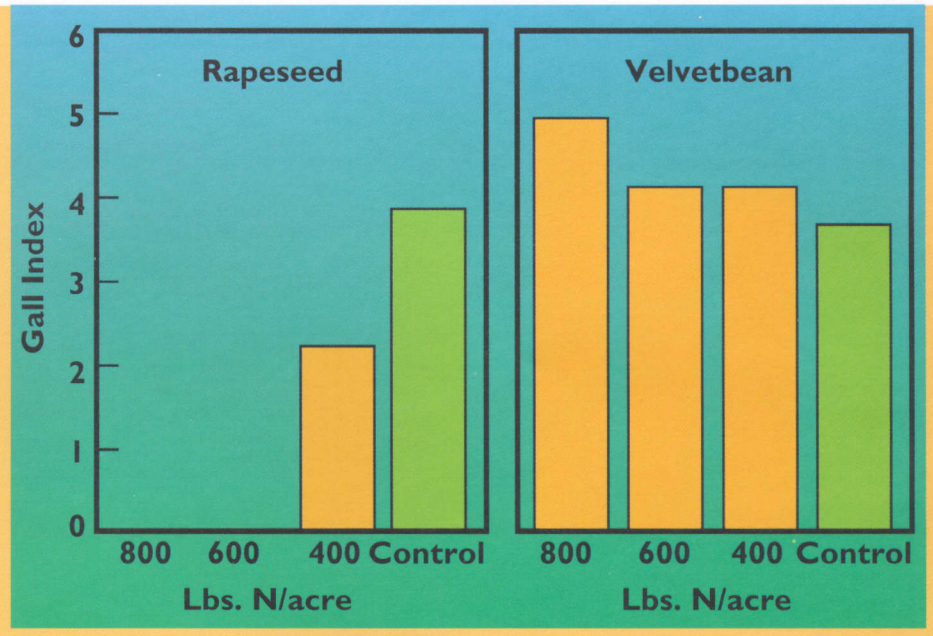
Green Manures, continued on page 16

Green Manures, continued from page 15

Southeast. Green manuring with rapeseed is recommended in the Northwest for control of the potato root-knot nematode.

The green manures were incorporated into root-knot nematode infested soil at three rates — 400, 600, and 800 pounds of N per acre. After incorporation of each green manure, a squash seedling was transplanted into each pot. Two months later, squash roots were evaluated to determine degree of galling and plant dry weight as affected by the green manure. Green manure treatments were compared to a control of squash grown in a bare nematode-infested soil amended with recommended rates of N, phosphorous, and potassium.

There was no difference in severity of galling of squash roots grown in velvetbean-amended soil or the control. Rapeseed treatments were very effective at limiting galling of squash roots (Figure 1). The two highest rates of rapeseed green manure eliminated galling, while galling was significantly reduced using the lowest rate. Unfortunately, rapeseed green manure was also phytotoxic, resulting in significantly reduced wet and dry squash weights in comparison with control and velvetbean treatments.



Effect of N rate and green manure on gall index.

Adult female root-knot nematode.

Nematicidal effects and phytotoxicity may be due to compounds in rapeseed tissue. Glucosinolates are found in rapeseed plants and the variety used in this research was particularly high in this compound. As glucosinolates break down they release methylisothiocyanate. This is an active ingredient in some commercial nematicides. Green manures in this study were incorporated at rates based on nitrogen content rather than glucosinolate content. Therefore it is difficult to determine if treatment differences were directly due to glucosinolates. Phytotoxic effects from rapeseed green manure might be overcome by allowing sufficient time for the material to decompose before planting.

While urea appeared to be equally as effective a nematicide as the green manures, it does not provide the added benefits of green manuring. Green manuring adds organic matter to the soil, which may improve soil physical properties such as tilth and water holding capacity. Green manures also improve the soil's nutrient status by adding N, P, K, and other nutrients to the soil.

Green manures, at high rates, were found to reduce root-knot nematode numbers in the soil. The type of green manure used influenced its effectiveness. Rates used in these experiments were higher than would be practical in a cropping situation. Future research will seek to determine if lower rates of green manure also have nematode-inhibitory effects. If so, then green manuring could prove to be one component in integrated pest control for Alabama vegetable crop production.

Crow is a Research Assistant and Guertal is an Assistant Professor of Agronomy and Soils. Rodriguez-Kabana is a Professor of Plant Pathology.

Michael Davis and Roland Dute

Asian Ambrosia Beetles
THREATEN SOUTHERN ORCHARDS AND TREE NURSERIES

A DAMAGING BUT INTERESTING INSECT–the Asian ambrosia beetle–has been introduced in recent years to orchards and field nurseries in the Southeast. AAES studies are helping provide information about this potentially devastating insect and may eventually lead to new control measures.

Figure 1. Female ambrosia beetle in her gallery in a Yoshino cherry trunk (magnified 16x).

The Asian ambrosia beetle (*Xylosandrus crassiusculus*) is a tiny insect —females are only 1.5 millimeters long (Figure 1), and the males are even smaller. The beetle was first reported in the United States in a peach orchard in South Carolina in 1974. However, it did not become a serious problem until the last five to seven years. Nurseries from Texas to Maryland to Florida have reported moderate to heavy losses as a result of beetle attacks, and the number of attacks has been growing. The list of hosts includes pecan, peach, maple, oak, and several ornamental trees.

Figure 2. Redbud trunk with frass protruding from beetle entry holes.

An AAES study was initiated in 1994 to learn more about this insect and the damage that it causes and to provide information that might help control this damage in the future.

Careful examination of ornamental cherry, one of the beetle's many hosts, has shown that the insects do not attack a tree randomly. More than 80% of the bore holes were made at the sites of lenticels, areas on the tree's surface where the cells are loosely packed and presumably easier to penetrate.

Trees that are attacked do not initially show many symptoms. Since the insects are so tiny, their entry holes into a host's trunk are inconspicuous. One interesting sign of attack is toothpick-like cylinders of sawdust pushed out of the holes as the insects bore into the tree (Figure 2).

Internally, the sapwood of attacked trees becomes discolored around the tunnels excavated by the beetles (Figure 3). Within a month of attack, the trees wilt rapidly from the tops, and often the plants die. The amount of dieback depends on the age and health of the attacked tree.

How can an insect so small do so much damage? Though the insects attack in large numbers, their tunnels should only cause a general decline in health rather than rapid death. The answer lies with the beetles' life cycles. Various investigators have shown that these insects bore into the sapwood of young trees in early spring and carry with them a fungus. The fungus grows inside the tree and lines the interior of the tunnels. The females then lay their eggs in these locations and the larvae feed on this fungus, or "ambrosia," as they develop (Figure 3). At maturity, the beetles mate inside the tunnels, after which the females fly away in search of a new host.

The ambrosia fungus is a member of the genus *Ambrosiella*, which is often not pathogenic. However, ambrosia beetles have been known to introduce other fungi that are pathogenic along with the ambrosia fungus. The pathogenic fungi include

Asian Ambrosia Beetle, continued on page 18

Asian Ambrosia Beetle, continued from page 17

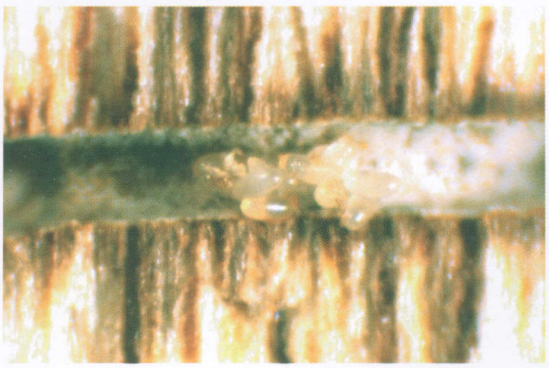


Figure 3. Larvae and eggs in beetle gallery inside cherry wood. Note the white fungal hyphae (ambrosia fungus) lining the tunnel (magnified 130x).

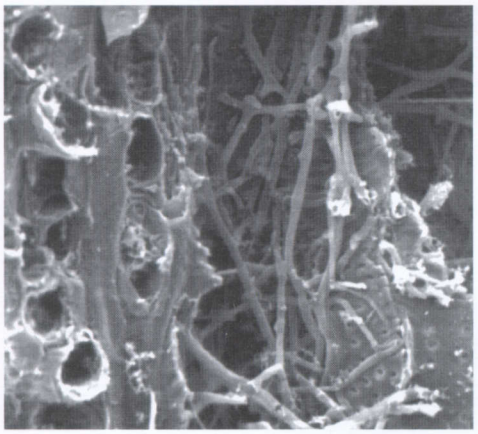


Figure 4. Fungal hyphae occluding cherry vessel members and ray cells (magnified 520x).

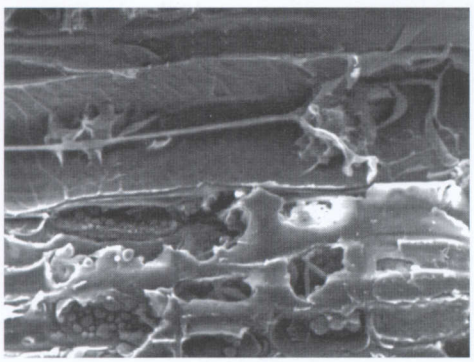


Figure 5. Cherry vessel member with a fungal hypha and gum (magnified 410x).

Fusarium and *Ceratocystis* species.

AAES studies of the interaction between pathogenic fungi and wood were done on eastern redbud and Japanese cherry. These studies indicated that the damage done to trees occurs because of blockage in the wood's vessel elements. That blockage occurs through several means. The galleries of the beetles can cause some blockage. Another means is by production of threadlike strands called hyphae by the pathogenic fungi. These hyphae can grow into the vessel elements and can appear in large enough numbers to impede almost completely the flow of water (Figure 4). The energy needed for hyphal growth is provided by a tree's own food storage cells. Also trees can inadvertently plug their own vessels by producing gums. Both cherries and redbuds produce gums as a defense mechanism when wounded or attacked by a pathogen (Figure 5). These gums inhibit the spread of the pathogen but can also block vessels. So in trying to protect itself the tree can actually compound the problem.

Unfortunately, this insect/disease complex is relatively new in the Southeast and an effective control has not been devised. Since the fungus establishes itself in the sapwood, traditional fungicides are not effective. Current control recommendations are aimed at the beetles. Traditional borer sprays, such as lindane or chlorpyrifos products, are recommended but have proven inconsistent.

Researchers elsewhere are experimenting with traps. The use of traps shows some promise, but results are still preliminary. If the traps prove to be effective, they can be used to monitor populations so growers can make more timely spray applications. Even if the traps prove useful, removal and immediate destruction of infected trees are crucial to prevent further spread of the insect and its fungal inoculum.

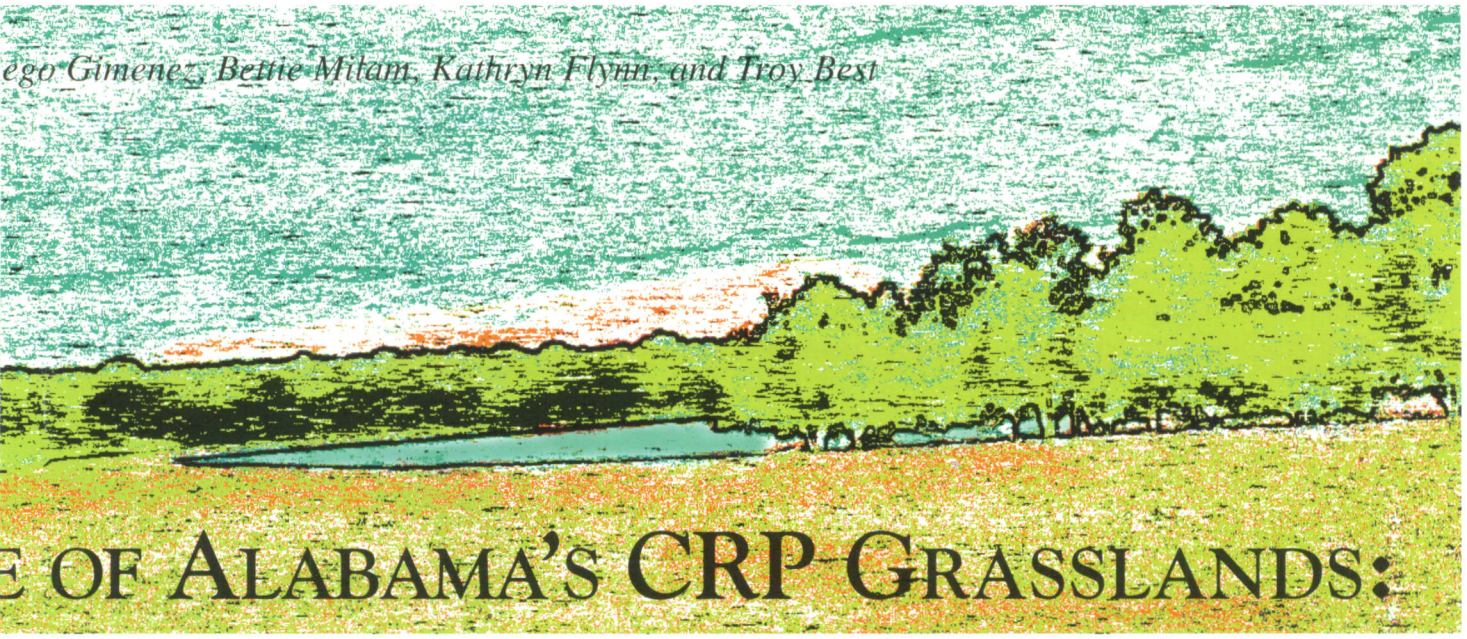
Davis is a Graduate Student and Dute is a Professor of Botany and Microbiology.

AAES

During the past decade, landowners idled more than 36 million acres of cropland nationwide through the Conservation Reserve Program (CRP) with the goal of removing highly erodible cropland from production. The first CRP contracts on this land expired in 1995 and, although most accepted a one-year extension, landowners must now decide what to do with that land. An AAES study explored the options being considered by landowners in Alabama's Black Belt region.

The CRP was enacted by the 1985 Farm Bill and allowed

ego Gimenez, Bettie Milam, Kathryn Flynn, and Troy Best



E OF ALABAMA'S CRP GRASSLANDS:

TUDY EXAMINES PROSPECTIVE USES OF CRP GRASSLANDS IN THE BLACK BELT

landowners to receive annual payments for 10-year contracts to remove land from crop production and convert it to a conserving use. Nationwide surveys have indicated that landowners plan to return more than one-half of the CRP land to row-crop production. Only about 40% of the acreage would remain in grass or trees.

Pine trees were planted on a much larger percentage of the CRP cropland in Alabama than nationally. Upon expiration of CRP contracts, virtually all this land will remain in timber production into the foreseeable future. However, about one-half, or 271,000 acres of Alabama's CRP land entered the program in permanent grass cover, and more than one-half of these grass acres are located in the Black Belt region.

Researchers from the AAES teamed with extension specialists and personnel of the Natural Resource Conservation Service to initiate a project designed to develop recommendations for environmentally sound multiple-use options for returning CRP grass acres in the Black Belt.

The project began in the summer of 1995 with a survey to determine current inclinations and intentions of CRP contract holders for use of their program grasslands, to outline their conceptions of the land's economic potential for the near future, and to estimate their capacity to implement these plans within a reasonable range of their cost estimates. Simultaneously, a preliminary survey of the present condition of herbaceous vegetation on land with CRP grass contracts was conducted to provide some indication of the land's potential for alternative uses and preliminary estimates for conversion costs.

Five CRP contract holders in each of five Black Belt counties were interviewed between July and October 1995. During the interviews, a short production history of the contract was established. Landowners were then asked several questions about their plans for CRP grassland, including their opinions regarding plans for similar land in the area and local rent estimates for various classes of cropland.

Preliminary analysis of interviews with landowners in the Alabama Black Belt indicated that a large proportion of current CRP contracts will remain in permanent vegetative cover well into the future (see the table). Most landowners planned to lease hunting rights at rates of $4-8 per acre. Several indicated interest in renting land for beef production and knew local farmers who would be interested in renting their land for this purpose. Others were interested in establishment of marketable pasture or hay land, but did not know of interested farmers in the area.

Only one farmer-landowner indicated the possibility that CRP grassland might return to row-crop production. Many landowners commented that the land had already been out of row-crop production for one or two years prior to initiation of the CRP program and that they did not plan crop production on their land in the future. Reasons for this were centered on conservation of the land, with row cropping seen as damaging to the fragile prairie soils of the area.

During the preliminary survey of CRP landowners, a wide range of existing vegetative status was discovered. Existing vegetation appeared adequate for erosion control on all CRP acreage surveyed. Much of the acreage showed the production potential of highly erodible land under well-

CPR Grasslands, continued on page 20

CPR Grasslands, continued from page 19

managed beef cattle grazing systems. Production potential was greatest on CRP contracts held by farmer-landowners. On farmer-held CRP contracts, not only was the amount of forage more satisfactory, but fences, holding pens, and other necessary cattle-handling facilities had been maintained in working condition.

Fifty percent of the landowners had planted food plots primarily for deer or quail. Amount spent on food plots was $35-100 per acre. Almost all of the landowners reported an increase in the number of deer and coyotes, and a decrease in quail. These findings are in keeping with general trends in the Southeast and are not considered an aspect of the CRP land-management practices.

Fifty percent of the landowners had considered establishing a hunting club or leasing land for hunting, including one owner who currently leases land to a hunting club. Whether interested in hunting leases or not, 44% of the landowners had no opinion of the management cost or income expected from hunting leases. All the owners who had considered a hunting lease had planned primarily for quail hunting.

Most landowners expected to spend $100 or less per acre to establish and maintain a hunting club or lease. If land was leased to a hunting club, landowners anticipated the club would assume expenses for land management necessary to maintain the wildlife desired. Amount of expected income from leasing land for quail hunting was $150 to $1,000 per person per day; 44% expected to receive $10 or less per acre. Expenses and income from hunting leases and clubs are dependent on several factors such as facilities provided, condition of land and game, and rates in neighboring areas.

Several outlets for this project are planned. First, a handbook that contains information for use in evaluation and implementation of options is being developed. Second, a more in-depth analysis of the survey, including detailed estimates of option costs and returns, will be available. Finally, county and area meetings are planned to provide a forum for discussion with researchers, extension specialists, and technical assistance agency personnel. Industry representatives will be invited to these meetings to present information related to options discussed.

Characteristics of Conservation Reserve Program (CRP) Landowners in Five Alabama Blackbelt Counties

Characteristics	Average	Range
Age (yrs)	61	43-80
Acres land owned	1900	360-5000
CRP grass acres	574	115-1300
Expected rental rates/acre		
Pasture/hay	$15.25	$10-25
Wildlife	6.50	4-8
	% of total acres	
Plans for CRP grasslands		
Hunting	19	
Pasture/hay	70.5	
Crop production	5.8ä	
Trees	4.7	

Goodman is an Associate Professor of Agricultural Economics and Rural Sociology, Miller is an Assistant Professor of Agronomy and Soils, Gimenez is an Associate Professor of Animal and Dairy Sciences, Flynn is an Assistant Professor of Forestry, Milam is Graduate Student, and Best is an Associate Professor of Zoology and Wildlife Science.

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