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ALABAMA AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY

HIGHLIGHTS

OF AGRICULTURAL RESEARCH

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An AAES study found azaleas to be a major nursery crop in Alabama. See the related story on page 12.

What do you think?

This is the second issue of the new format of *Highlights*. We would like to know what you think about the changes.

A survey of 1,000 *Highlights* readers was conducted in the fall of 1994. The majority of respodents confirmed our suspicions that *Highlights* made less than optimum use of color, the articles are sometimes too technical, and some of the articles are too short.

The new *Highlights* format allows us to address some of these concerns. Advancements in computer and printing technology allow us to produce the new *Highlights* at about the same cost as the old. The critical unknown is whether you, our audience, like the changes.

A follow-up survey will be done with this issue of *Highlights*. Results of this survey and your comments will help us plan future fine-tuning of *Highlights* to make it an even better magazine. If you have comments, please write us in care of: *Highlights*, 110 Comer Hall, Auburn University, AL 36849, fax us at 334-844-5892, or e-mail us at eturner@ag.auburn.edu.

Lowell T. Frobish, Director
Alabama Agricultural Experiment Station

S p r i n g 1 9 9 5 V o l u m e 4 2 N u m b e r 1

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

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Russell County Bermudagrass Accepted as New Variety

Donald M. Ball, Robert A. Burdett, Dane R. Williamson, Steven P. Nightengale, and Charles B. Elkins

Livestock and hay producers are always interested in promising new forage varieties, especially if they are high yielding, widely adapted, relatively easy to propagate, and have a favorable growth distribution. Most new varieties are developed in intensive plant breeding programs. However, one new bermudagrass variety was first discovered growing on an Alabama farm in the late 1970s and was subsequently shown to be highly productive in AAES variety trials.

Russell County Extension Agent Donald Bice found the grass while inspecting a field near Seale that had been planted originally with a Mississippi State University-released bermudagrass variety named Callie. Because Callie is highly susceptible to winter kill and this grass had persisted, he realized that the grass that dominated the field was not Callie. After years of AAES testing, this mystery grass has been recognized as a new variety — Russell.

After Bice's discovery, word spread of the performance of the new grass. Its acreage increased as farmers shared planting material. More than 2,000 acres of it are being grown today, mostly in the vicinity of Russell County.

After producers had several years of success with this grass, it was entered in AAES bermudagrass variety trials established at the Plant Breeding Unit in Tallassee in 1986 (Table 1) and at the E.V. Smith Research Center Crops Unit in Shorter in 1991 (Table 2). It also was evaluated in a trial established in 1988 at the Hill Farm Research Station at Homer, La. In each of these tests, the dry matter yield of Russell was equal to, or better than, several widely-grown hybrid bermudagrass varieties.

A unique characteristic of this bermudagrass is its superior early-season growth. If a field is to be used for pasture, early growth allows earlier grazing. High growth potential in early spring when rainfall is most dependable also gets hay production off to a good start and reduces the risk of a poor hay yield.

Russell bermudagrass apparently developed either as a result of mutation or natural hybridization. Like other hybrid bermudagrasses, it requires vegetative propagation from sprigs or clippings, but producers report that it is hardy and relatively easy to establish. This claim was supported in a greenhouse test in which Russell had a higher rate of establishment from stem cuttings than Coastal bermudagrass, the most commonly used variety in the Southeast (Table 3).

Russell bermudagrass forage is light green, and its stem size at recommended cutting intervals is slightly smaller than

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Coastal. Leaves tend to be shorter than Coastal, and its rate of spread is slightly faster. Forage quality, as reflected by crude protein content, crude fiber, neutral detergent fiber (NDF), and acid detergent fiber (ADF) concentrations, has been similar to Coastal. NDF is an indicator of palatability, and ADF is an indicator of digestibility. Ratings made in Louisiana indicate it is slightly more winter hardy than Coastal. No unusual disease or insect problems have been noted with the grass.

Russell exhibits physical characteristics similar to robust common bermudagrasses. At cutting intervals of 30-35 days, its forage height is typically lower than for other common bermudagrass hybrids. However, the forage is dense, thus allowing for high yields. Producers have noted the thick sod-forming ability of the grass and have reported that it holds up well under grazing. This also may have implications for erosion control.

Russell is being released as a variety under the auspices of Auburn University and Louisiana State University. Foundation planting material will be available through the Alabama Crop Improvement Association in spring 1995. Unlike the usual situation with newly released varieties, Russell bermudagrass has already stood the test of time. There is much evidence that it can make a contribution on many farms, especially in Central and North Alabama and other areas with similar growing conditions.

Table 1. Season-long Dry Matter Yields of Entries in Bermudagrass Variety Trial, Plant Breeding Unit, Tallassee, 1988-90

Bermudagrass	1988	1989	1990	Average
	Ton/a.	*Ton/a.*	*Ton/a.*	*Ton/a.*
Russell	4.2	5.9	3.6	4.5
Grazer	3.2	4.9	2.5	3.5
Tifton 78	3.6	5.1	2.7	3.8
Lancaster	3.0	3.7	2.4	3.1
Pasto Rico	3.1	4.3	2.8	3.4
Campo Verde	3.1	4.4	2.6	3.4

Table 2. First-cut and Season-long Dry Matter Yields of Entries in Bermudagrass Variety Trial, E. V. Smith Crops Unit, Shorter, 1992-93

Bermudagrass	1992		1993	
	First-cut	Season-long	First-cut	Season-long
	Ton/a.	*Ton/a.*	*Ton/a.*	*Ton/a.*
Russell	3.4	11.9	3.8	9.0
Tifton 85	2.5	11.7	3.4	9.5
Coastal	2.5	10.9	3.6	8.5
Tifton 44	2.8	11.2	3.1	7.3
Tifton 78	1.9	9.7	2.8	7.2

Table 3. Percentage of Coastal and Russell Bermudagrass Stems Rooting at Three Moisture Levels in a Greenhouse Environment

	Low	Medium	High
Coastal	24.6	27.1	44.3
Russell	32.5	73.6	80.7

Ball and Burdett are Professors in Agronomy and Soils. Williamson, Nightengale, and Elkins are Superintendents of the E.V. Smith Crops Unit, Plant Breeding Unit, and Auburn University Plant Science Research Center, respectively.

Dairy Producers Must Take Steps to Avoid Carryover Effects of bST

Bovine somatotropin (bST), the growth hormone approved for use in dairy cattle in February 1994, has been shown to increase milk production 10-15%. While the effects of bST on milk production are well known, much remains to be learned about how routine use of the hormone will affect dairy cow management. An AAES study found that bST treatments have carryover effects that, if not properly managed, can hamper a cow's effort to recover from one lactation period and prepare for the next.

Keith A. Cummins, Patricia J. Tyler, and Robert C. Smith

A study at the E.V. Smith Research Center Dairy Research Unit in Shorter focused on the effects of bST on cows' dry periods, a time when the animals stop producing milk and attempt to recover body condition. The project also examined how carryover effects of the growth hormone affect feed intake and interact with other environmental factors during the dry period.

Cows treated with bST have the potential to be in poor body condition when they cease lactating due to the demands of increased milk production. In the Southeast there is considerable heat stress during the summer, when most dairy cows are dry. Heat stress can decrease feed intake, further hampering the cows' efforts to gain weight during the dry period.

Beginning at the 75th day of lactation, researchers administered low, medium, or high doses of bST to Holstein cows as weekly sustained-release injections. Cows in the control group were not injected with bST. Injections were given until 300 days of lactation, when the cows stopped lactating. During the dry period, all cows were fed a diet based on corn silage and ground Coastal bermudagrass hay that met published requirements for dry cows. Feed intake and high and low air temperatures were measured daily, and weights and body condition were evaluated weekly (see table).

Body weights did not vary significantly among the bST treatments. Initial body condition scores at drying-off were lower in cows treated with bST. In addition, final body condition scores — a predictor of body fat reserves useful for the next lactation — were lower in cows treated with the medium and high levels of bST. Medium- and high-bST cows also had lower body condition scores at calving than are currently considered as optimum to maximize milk production.

Little data has been reported on dry matter intake for bST-treated cows during the dry period. Most published studies estimate that dry matter intake is generally 2% of body weight. However, this study found that average daily dry matter intake in bST-treated cows ranged from 2.3-2.6% of body weight, with some cows having daily intakes of 3.5 % or more.

Cows treated with bST also had a larger decrease in dry matter intake with increases in environmental temperatures. Researchers found that dry matter intake decreased 0.46, 0.28, 0.63, and 0.72 pound per each degree of increase in high temperature for the control, low, medium, and high bST treatments, respectively. The 44 cows in this study were dry between May and Sep-

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Broiler Litter Can Enhance Potte

Potted plant production in Alabama has steadily increased in recent years, resulting in a multi-million dollar industry for the state. Suitable substitutes for common components of soilless growing media are needed as costs rise and availability is reduced. This need could be fulfilled by Alabama's burgeoning poultry industry, which is faced with environmental concerns over disposal of broiler litter (wastes, feed, feathers, and bedding material).

An AAES study evaluated the suitability of composted broiler litter as a container media using lettuce as an indicator crop to determine yield and nutrient uptake. Composting litter with common high-carbon materials, such as pine bark or peanut hulls, may be an alternative management practice that could help solve disposal problems. These composts could serve as an extender for many general-use, all-purpose potting media in use by the horticultural industry and home gardeners.

However, metal accumulation in edible plant tissue is of concern when composted material is used as a potting medium. Composts made from broiler litter typically do not contain appreciable quantities of toxic heavy metals, such as cadmium. But many researchers have observed high concentrations of copper, zinc, and iron that may cause plant growth problems. Other elements—nitrogen, phosphorous, potassium,

Carryover Effects of bST, *continued*

Effects of bST Treatment on Body Weight, Body Condition, and Daily Dry Matter Intake During the Dry Period

bST treatment	Weight		Condition[1]		Intake
	Initial	Final	Initial	Final	
	Lb.	*Lb.*			*Lb.*
Control	1,456	1,607	3.4	3.5	30.4
Low	1,428	1,679	3.3	3.6	35.6
Medium	1,408	1,601	2.5	2.9	38.3
High	1,399	1,592	2.4	2.9	38.7

[1]Body condition scores range from 1 (very thin) to 5 (extremely fat). Final body condition scores at calving should be approximately 3.5 to 3.8.

tember. Daily high temperature averaged 85.4° F, and relative humidity averaged 69%, indicating that the cows were under heat stress conditions.

Much remains to be learned about how bST will fit into dairy management programs, especially in the Southeast. The interaction of bST treatments and heat stress is clearly a factor dairy producers must consider, since the majority of Alabama's cows prepare for their next lactation periods during the hottest months of the year. Nutrient content of diets fed during lactation may have to be increased to allow for more recovery of body condition during late lactation and the dry period. Commonly used measures to alleviate heat stress for lactating cows, such as providing adequate shade, should be considered for use during the dry period.

Cummins is a Professor and Tyler is a Research Technician in Animal and Dairy Sciences; Smith is Superintendent of the E.V. Smith Research Center Dairy Unit.

Robert P. Flynn, C. Wesley Wood, and Elizabeth A. Guertal

Figure 1. Heads of lettuce grown in media containing 0% (left), 25%, 50%, 75%, and 100% peanut hull compost, respectively.

calcium, and magnesium — are necessary for proper plant nutrition. Lettuce is a proven nutrient accumulator, making it a good indicator crop to determine media suitability.

Composted materials included: (1) broiler litter containing wood shavings as bedding material composted with peanut hulls (peanut hull compost 1); (2) broiler litter containing peanut hulls as bedding material composted with additional peanut hulls (peanut hull compost 2); (3) broiler litter containing wood shavings as bedding material composted with shredded pine bark (pine bark compost 1); and (4) broiler litter containing peanut hulls as bedding material composted with shredded pine bark (pine bark compost 2). Each compost was sieved through a 0.2-inch screen and mixed with Promix, a commercially available potting medium. Mixtures included 0% compost (pure Promix), 25% compost, 50% compost, 75% compost, and 100% compost. Leaf lettuce was grown under greenhouse conditions and evaluated for yield and nutrition. All treatments were fertilized equally to emphasize the use of composted broiler litter as a potting medium.

Generally, lettuce yields were greater for mixtures of compost and Promix than for Promix alone (Figure 1). Fresh weights also were reduced with pure composts, probably because of lower water-holding capacity and a tendency for the plants to wilt sooner. Lettuce fresh weight was greatest when the media contained 75% peanut hull compost, producing nearly one-half pound per plant (Figure 2). There was no difference between fresh weights from the two peanut hull composts.

Fresh weight from pine bark compost was less than that from peanut hull compost. Lettuce fresh weight yield from pine bark compost 1 was the lowest of the four composts, maximizing at the 75% mixture with one-third pound per plant. Plant growth was most likely suppressed by the lower pH of this compost. The recommended pH range for lettuce production is 6-6.8. Pine bark compost 1 declined to a pH of five as percentage of compost increased to 100% compost. Composts made from pine bark should be tested for pH and, if necessary, treated with limestone or another acid-neutralizing compound if plants sensitive to acidity are to be grown.

Nutrient analysis of lettuce tissue from compost mixtures was used to screen composted materials for physiologically damaging effects resulting from copper,

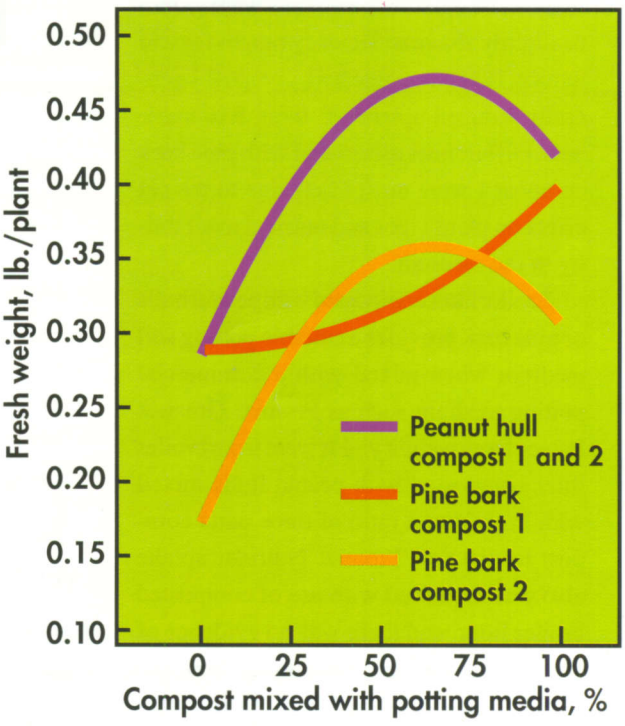

Figure 2. Fresh weight as affected by litter composts.

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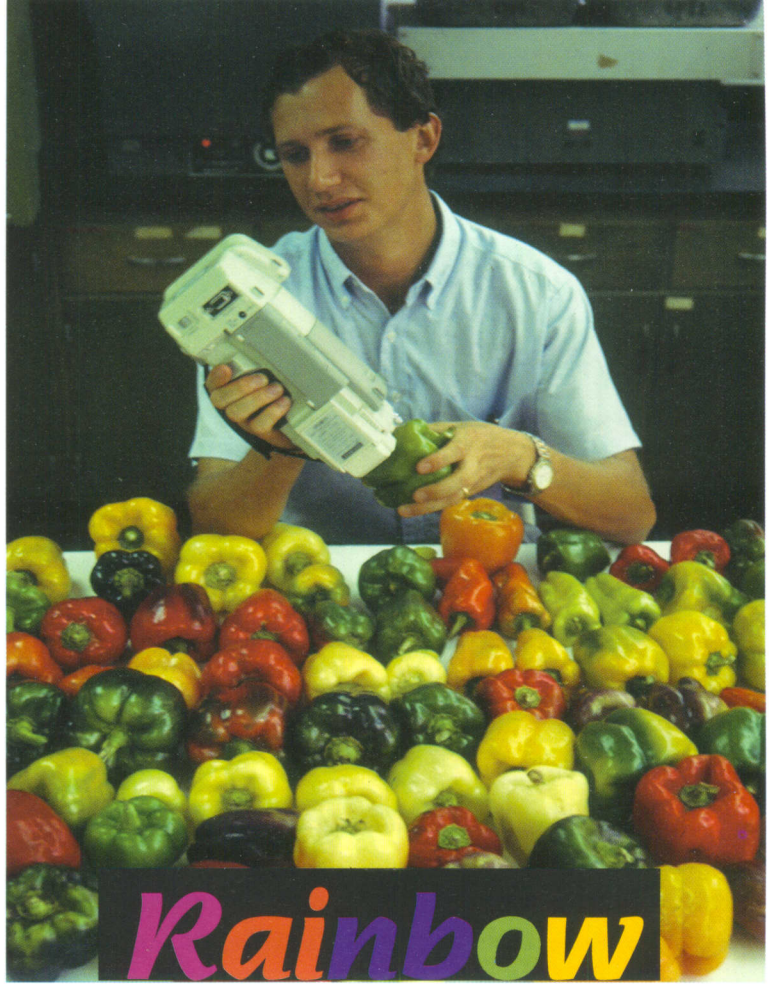
zinc, or manganese. Mixing Promix with composts essentially diluted the concentration of these nutrients. Most micronutrients were within or slightly above sufficiency ranges for lettuce tissue. However, both pine bark composts exhibited an accumulation of manganese, most likely due to effects of media pH. Copper concentration was increased by pine bark compost 1, reaching a maximum of 40 parts per million at 100% compost. Again, this may be related to pH of the material. Zinc concentration of lettuce tissue was within sufficiency ranges for all composted materials.

Nitrogen, phosphorous, potassium, calcium, and magnesium data were collected to aid in assessment of lettuce health. Calcium concentration was slightly less than sufficient, a problem that can be corrected with addition of lime. Tissue concentrations of the other four nutrients were within or slightly above sufficiency ranges for leaf lettuce. However, pine bark compost 1 generally reduced uptake of these five nutrients. Differences associated with pine bark compost 1 were most likely due to the pH effect on plant vigor and nutrient availability in the medium.

Broiler litter composted with peanut hulls or pine bark provides a suitable potting soil medium when mixed with a commercial potting medium such as Promix. Greatest lettuce fresh weight yields were from broiler litter composted with peanut hulls mixed with Promix at a ratio of three parts compost to one part Promix. Nutrient uptake also was improved with use of composted broiler litter, and there was no evidence of physiologic problems stemming from nutrients in composted materials. Need for pH adjustment in compost mixtures with pine bark was evidenced by lower yields and classical pH effects on nutrient concentrations in lettuce tissue.

Flynn is a Graduate Research Assistant, Wood is an Alumni Associate Professor, and Guertal is an Assistant Professor in Agronomy and Soils.



Rainbow of Colored Peppers Could Lead to Pot of Gold for Alabama Farmers

Colored bell peppers can cost up to five times as much as traditional green bell peppers. However, despite the fact that this valuable crop can be grown in Alabama, most colored bell peppers currently available in the state's grocery stores are imported. An AAES study could pave the way for greater production of this colorful and healthful commodity in Alabama.

The objectives of this preliminary study were to evaluate and compare the yield potential of colored peppers across Alabama and to assess concentrations of vitamin C and and precursors of vitamin A in selected colors. Based on the first-season results, the yield potential of bell peppers of all types was good at all the selected locations. Some varieties were found to have up to 200% of the Recommended Daily Allowance (RDA) of vitamin

Eric H. Simonne, Amarat H. Simonne, Nancy R. Green, Ronald R. Eitenmiller, John T. Eason, John T. Owen, and Jim A. Pitts

Researcher analyzes the color of bell peppers using a hand-held chromameter.

C and up to 11% of the RDA for provitamin A (provitamin A is a substance that the body converts to vitamin A after ingestion).

Growing colored bell peppers is similar to growing green peppers, only requiring a longer growing season. Typically, bell peppers are picked at an unripe green stage and become red as they ripen. However, new peppers may be white, purple, brown, yellow, orange, or black. All these peppers are sweet and may be eaten raw or cooked. Green peppers usually cost between 69-99 cents per pound, while colored peppers cost $1.99 to $4.99 per pound, depending on the season.

In spring 1994, bell peppers were transplanted on single rows at a one-foot spacing at the Chilton Area Horticulture Substation (CAHS) in Clanton, Piedmont Substation (PS) in Camp Hill, and Sand Mountain Substation (SMS) in Crossville. Seed suppliers were Stokes, Petoseed, Ball Seed, Rogers NK, and Abbott and Cobb. Rows were spaced four feet apart, creating a stand of approximately 7,300 plants per acre. Black plastic mulch and drip irrigation were used at CAHS, while the plants were grown on bare ground at PS and SMS. Fertilization and pest control followed current recommendations. Fruits were harvested at the fully-colored stage and graded according to the *Sweet Pepper Grader's Guide* (Circular ANR-783 of the Alabama Cooperative Extension Service). Vitamin C and provitamin A were determined on peppers grown at CAHS and included all the varieties at the unripe (green) and colored stage.

Total yields were higher on black plastic than on bare ground and were significantly influenced by pepper color (Table 1). On black plastic, highest yields of fancy grade corresponded to the red and brown peppers, and to the black and red peppers on bare ground. On both cropping systems, purple, white, and black varieties tended to produce the highest yields of US #2 peppers, the smallest grade.

For all colors, the vitamin C content exceeded 100% of the RDA (Table 2). The RDA for vitamin C is 60 milligrams (mg). Nutritional analyses were based on a 100-gram portion of pepper. Highest vitamin C concentrations corresponded to the orange, brown, red, and yellow peppers. Ivory, purple, and black peppers tended to be the lowest. However, differences among cultivars were significant at the green stage and at the colored stage.

Provitamin A concentrations ranged between 2-11% of the RDA and were significantly affected by color (Table 2). Provitamin A concentrations are measured in "Retinol Equivalents" (RE). The RDA for

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Table 1. Effect of Fruit Color on Yield and Grade Distribution of Bell Peppers[1]

Color	Total	Total marketable	Fancy	US #1	US #2	Cull
	Lb./a.	*Lb./a.*	*Lb./a.*	*Lb./a.*	*Lb./a.*	*Lb./a.*
			Black-plastic mulch			
Red	20,497	17,812	2,373	12,371	3,068	2,685
Brown	20,208	19,248	3,522	13,095	2,631	960
Orange	18,610	13,489	640	10,692	2,156	5,121
Yellow	18,566	15,853	934	11,801	3,118	2,713
Black	15,134	13,523	635	10,236	2,652	1,611
White	14,987	13,302	651	9,265	3,385	1,685
Purple	14,361	12,929	677	7,869	4,383	1,432
			Bare Ground			
Black	18,437	11,209	3,096	4,613	8,840	1,887
Purple	14,793	7,549	1,822	4,982	5,289	2,627
Red	12,835	10,445	3,550	5,207	2,415	2,341
White	12,526	8,624	1,638	5,288	3,926	1,700
Yellow	11,186	9,345	2,346	5,143	2,887	1,949
Orange	8,614	7,202	2,093	3,725	1,203	2,778

[1]Plots were harvested six times between June 23 and Aug. 11 at CAHS; seven times between July 20 and Oct. 24 at SMS; and nine times between Aug. 17 and Sept. 27 at PS. Black-plastic mulch was used at CAHS; bare ground plantings were made at PS and SMS. Total weight is the sum of all the grades including culls. Marketable weight is the sum of the Fancy, US #1, and US #2 grades. Fancy fruits are well shaped and at least 3.5 inches long and three inches in diameter; US #1 fruits are fairly well shaped and at least 2.5 inches long and 2.5 inches in diameter; US #2 fruits do not meet the requirements for US #1 but are not seriously misshapen; other fruits are culls.

Improved Diagnostic Tool Developed fo

Viral tenosynovitis, a common and highly contagious disease, costs poultry and egg producers millions of dollars each year worldwide. VT, which causes lameness, poor health, slow growth, and higher death rates, is difficult to diagnose and control. AAES research has resulted in a new technique to provide quick and accurate diagnosis of the disease.

Viral tenosynovitis (VT) affects tendon-related membranes above and below the hock joint of chickens. A sensitive diagnostic test for the virus is needed because the clinical symptoms of VT are easily confused with those of other leg-deforming diseases. The new AAES technique is not only more sensitive than traditional methods, it provides a diagnosis within 24 hours, compared to three or more days with other diagnostic tools. Earlier detection of the disease allows producers to begin treatment of affected flocks and vaccination of unaffected flocks much sooner, possibly preventing many chickens from becoming infected.

Rainbow of Colored Peppers, continued

Table 2. Effect of Fruit Color on Vitamin C and Provitamin A Concentrations of Bell Peppers

Nutrient	Range	Fruit color
Vitamin C	*Pct. RDA/100g*	*(mg vitamin C per 100g)*
	0-100	—
	100-150	Black (62), Purple (81), White (90)
	150-200	Green (98), Yellow (99), Red (100), Brown (100), Orange (108)
Provitamin A	*Pct. RDA/100g*	*(Retinol Equivalents of provitamin A per 100g)*
	0-5	White (15), Purple (19), Yellow (33), Green (36), Black (41)
	5-10	Orange (73), Red (97)
	10-15	Brown (108)

provitamin A is 1,000 RE. White, purple, and yellow peppers were lower than green peppers in provitamin A concentrations.

Vitamin C and provitamin A concentrations also were different for cultivars of the same color. For green peppers, Orobelle had the highest concentrations — 162 mg of vitamin C and 48 RE of provitamin A. At the colored stage, Cardinal, a red variety, had the highest vitamin C concentration (124 mg). Black Bird, a black variety, had the least vitamin C (62 mg). Provitamin A concentrations ranged between 26-127 RE for Valencia, a yellow variety; and King Arthur, a red one. For most cultivars, vitamin content increased during ripening.

The antioxidant properties of vitamin C and provitamin A are important to human health because they may aid in reducing the risk of coronary heart diseases and certain types of cancer. The success of commercial production of colored bell peppers in Alabama will depend not only on high yields of quality peppers, but also on marketing potential and consumer preference.

Eric Simonne is a Post-doctoral Fellow in Horticulture. Amarat Simonne is a Post-doctoral Fellow and Green is a Professor and Department Head in Nutrition and Food Science. Eitenmiller is a Professor of Food Science and Technology at the University of Georgia. Eason, Owen, and Pitts are superintendents of the Sand Mountain Substation, Piedmont Substation, and Chilton Area Horticulture Substation, respectively.

Major Poultry Disease

Joseph J. Giambrone, Lanqing Li, and Frederic J. Hoerr

Figure 1. Four-week-old broiler chicken (left) showing ruptured tendons characteristic of viral tenosynovitis. Uninfected tendons are on the right.

AAES experiments led to the production of monoclonal antibodies (MABs), genetically engineered molecules designed to seek out and mark specific viruses or other microscopic agents, to detect the presence of VT virus in chickens. MABs are very specific reagents that bind only to the VT virus. They were used to modify a commercially available immunoperoxidase test kit, allowing researchers to identify damaged tissue and quickly confirm whether the damage was caused by the VT virus.

Tissues from chickens suspected of carrying the virus are preserved with formaldehyde and imbedded in paraffin. The wax-encased samples are sliced into one-cell-thick sections and mounted on microscope slides, which are treated with a solution containing the MABs. The antibodies then seek out and bind to viral proteins in the cells. This chemical reaction stains infected cells with a yellow-brown color. Auburn's technique will allow for a more definitive diagnosis by confirming the presence of the virus, in addition to detecting VT lesions.

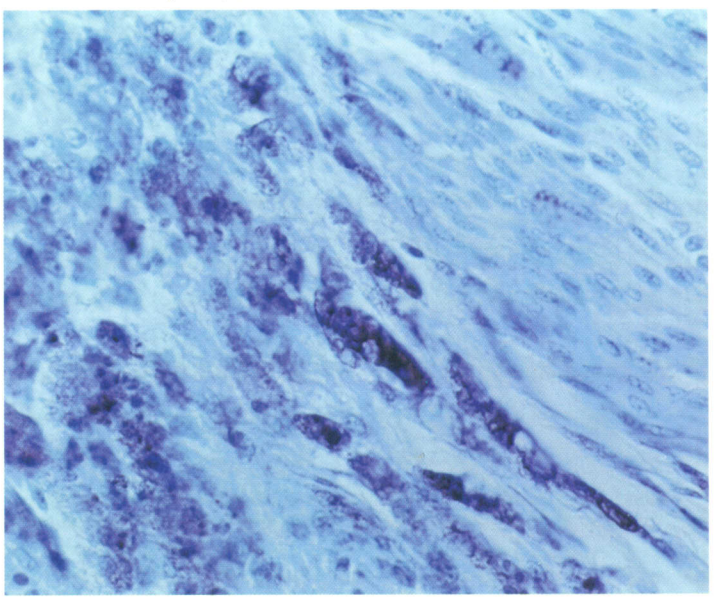
To determine accuracy of the test, researchers injected day-old chickens with a highly pathogenic, disease-causing VT virus and collected tissue samples periodically up to 18 days. Chickens receiving the virulent virus had severe lameness. These birds also exhibited gross lesions, swelling above and below the hock joint (Figure 1), and hemorrhage and edema around the tendons characteristic of the disease. There was a direct association between microscopic lesions and positively stained cells marked in the experimental diagnostic test. Tissues from birds infected with this pathogenic VT virus had dark-stained cells indicating areas of virus replication (Figure 2).

In contrast, birds not injected with VT virus had no clinical disease or gross lesions. Tissues from these birds showed minimal numbers of lightly stained cells, which are characteristic of nonspecific background (negative) reactions.

Results indicate this new diagnostic technique can detect VT virus. This test will be evaluated for use by Alabama State Veterinary Diagnostic Laboratory in Auburn to aid in improved diagnosis of VT. Also, this test will need to be evaluated against other commonly used assays in field cases from commercial flocks, where typically more than one infectious agent may be present in diseased birds, before it can be routinely used.

Giambrone is a Professor and Lanqing is a Graduate Research Assistant in Poultry Science. Hoerr is Director of the Alabama Veterinary Diagnostic Laboratory in Auburn.

Figure 2. Microscopic section of the tendon of a chicken affected by viral tenosynovitis. Section shows positively stained (dark cells) which depict areas of viral replication. They are in close proximity with microscopic lesions (inflammatory cells and edematous fluid).



AAES Study Profiles Alabama's Ornamental Plant Industry

Ornamental plant production is a major agricultural industry in Alabama. The state's 375 nursery operations provide crops for wholesalers, landscape contracting and design firms, garden centers and other retail outlets, and businesses that install and maintain plants in commercial facilities. USDA estimates indicate that Alabama's greenhouse and nursery crops accounted for $131 million in farm-level sales in 1992.

An AAES survey of nursery operations was conducted to provide current information on the operation, promotion, market area, labor force, seasonality of sales, problems encountered, and types of plants produced in Alabama's ornamental plant industry. Researchers contacted the 130 nursery operations that have five or more acres; 31 firms returned questionnaires. Fifty-three percent of these firms were in business before 1980.

Alabama nurseries grow and sell a variety of plants. However, individual firms tend to specialize in a limited number of plant types, thus concentrating their management and labor expertise and allowing them to achieve more efficient production. Seventy-one percent of the firms produced broad-leaved evergreen shrubs, which comprised an average of 45% of sales for these nurseries. Similarly, 68% of the firms produced deciduous shade and flowering trees, which accounted for an average of 26% of sales; 65% produced deciduous shrubs, 19% of sales; 52% produced narrow-leaved evergreen shrubs, 14% of sales; 45% produced evergreen trees, 9% of sales; and 36% produced vines and ground covers, 11% of sales. A few firms concentrated a high proportion of sales in fruit tree and propagating material (liners, cuttings, etc.) production.

Almost half of the firms handled items produced by other growers. A similar percentage of the growers contracted 1-80% of sales before production; contracted sales averaged 22%.

Eighty-one percent of the firms sold plants in containers, with 11 of the firms selling containerized material exclusively. Containerized crops comprised 1-100% of sales for these firms, with an average of 79%. About half the firms used the balling-and-burlapping method of containing plant roots and media for about half their sales. Twenty-nine percent used the bare root alternative, averaging 23% of sales. Field-grow bags and pot-

John L. Adrian, Jerry D. Parrish, and Kenneth M. Tilt

in-pot systems were infrequently used.

Among the surveyed nurseries, the two primary factors cited as limiting expansion were land availability and capital constraints (35% ranked these as first and second in importance). The next most noted expansion-limiting factors were market demand (16%) and environmental regulations (9%).

Nursery sales varied by month with the highest percentage of sales occurring March through May and a smaller sales peak in the fall. This seasonal nature of sales was cited as putting stress on the cash flow and other operations of the business. Seasonality also influenced labor needs with firms averaging 26 year-round employees and six seasonal workers.

Cost of production was the most important factor considered by producers when establishing a selling price. Quality of the plant material, market demand for the product, and competition in the market (the price at which the other growers were selling the same product) were other considerations affecting how the nursery managers established prices.

Catalogs were the most popular advertising media used by the nurseries, claiming 51% of the money spent on promotions. Trade shows were the second most popular advertising method, accounting for 37% of promotional expenditures. Fifty-five percent of the firms attended at least one trade show each year. Average attendance among these firms was four trade shows per year, while some attended as many as 13 shows.

Many ornamental plants produced in the state are shipped out of state. Georgia is the primary destination, but Tennessee also is a major buyer of Alabama's nursery products. Nine percent of the nurseries shipped some of their products out of the country. When asked about limitations on expanding the geographic scope of their businesses, nursery owners cited insufficient personnel as the number-one constraint, followed by transportation, capital, and production issues.

Nearly half reported some type of computerization in their operations. Most frequently identified computer applications were accounting software, which 45% of the firms reported using; word processing, 35%; and inventory management, 35%. Interestingly, use of computers for accounting and word processing has not increased significantly over the past five years, but computerized inventory management increased substantially.

Information gained in the study confirmed the importance and nature of Alabama's nursery industry. Nursery businesses in Alabama were found to be adjusting to production and marketing forces. As markets mature and become more competitive, efficiency and marketing expertise will influence the nature and success of the industry.

Adrian is a Professor and Parrish is a Graduate Research Assistant in Agricultural Economics and Rural Sociology. Tilt is an Associate Professor in Horticulture.

This golf course in Cullman shows possible signs of winter kill.

Potassium No Cure for Golf Course Freezes

Grady L. Miller and Ray Dickens

Extreme cold during the winter of 1993-1994 caused severe injury to warm-season turfgrasses throughout North Alabama and neighboring states. Bermudagrass on golf courses suffered extensive damage and had to be re-established on many fairways and tees.

Claims that application of high rates of potassium (K) can uniquely enhance turfgrass winter hardiness are common in the turfgrass industry. However, an AAES study indicates that high K application rates have no effect on freezing resistance. Cold tolerance was instead influenced by cultivar choice.

A three-year study at Auburn's Turfgrass Research Unit began in 1991 to determine the effects of K application on bermudagrass. While K had no effect on freeze resistance, low to moderate rates of the nutrient did help the turfgrass recover from drought stress more quickly than plants not receiving K. Other findings indicated that the turfgrass cultivar Tifway was more cold hardy than Tifdwarf on most sampling dates.

Six K rates were applied twice monthly to Tifdwarf and Tifway bermudagrass established on a Coastal Plain soil (loamy sand) and on a sand-peat medium. These cultivars were selected since they represent a range in tolerance to winter injury. Also, they are popular sports turfs in the "transition zone," a 200-mile-wide belt from the Atlantic Coast to Oklahoma where the summers are often too severe for cool-season grasses and the winters can be harmful to warm-season species. Tifdwarf was maintained at three-sixteenths of an inch and Tifway at one-half inch. Potassium rates used ranged from 0-4 pounds per 1,000 square feet per growing month on the loamy sand and twice those rates on the sand-peat soil. The wide range in rates was used to determine if there are special benefits to using higher rates on the sand-peat soil.

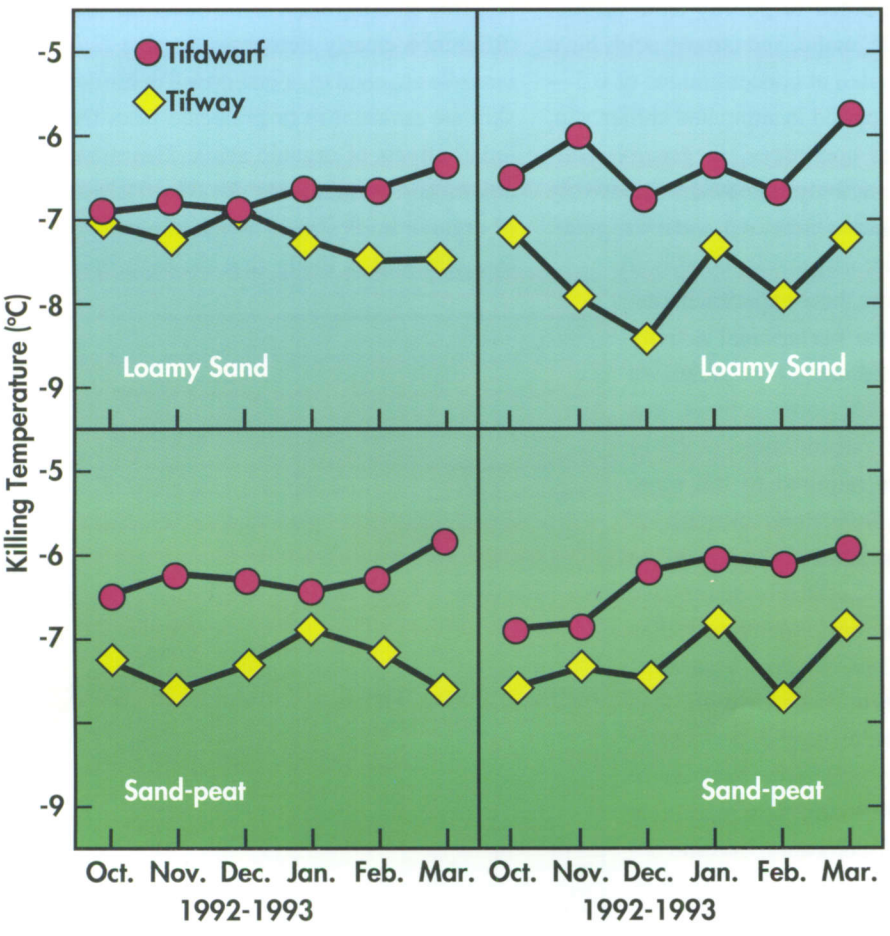
Plant samples were collected in the field and exposed to sub-freezing temperatures in an ethylene glycol bath. The amount of cold damage to the plant cells was estimated by placing the exposed stems in deionized water and measuring the electrical conductivity of the leachate.

In addition to not significantly affecting freeze tolerance, heavy application of K fertilizers could actually reduce the plant's

ability to survive cold weather. High K rates had a tendency to reduce the plant's concentration of stored carbohydrates, which are important energy sources for plants during the winter months and spring transition. On the positive side, bermudagrass that received one or two pounds of K per 1,000 square feet was able to recover from drought stress much more quickly. The ability to recover from drought stress could be important from a freezing tolerance aspect since cell desiccation is a primary cause of winter kill.

Previous studies indicated that K deficiency can reduce stress tolerance, but results of this study indicate there may be no significant benefit from using rates beyond those that provide sufficient K fertilization. In this study, no increase in freezing resistance was observed by increasing K concentration in leaf tissues of Tifdwarf and Tifway greater than 1.2% and 1%, respectively. To provide the most freeze tolerant plant, K rates should be adequate but not excessive throughout the year. The rates needed to maintain a sufficient K concentration in a turfgrass plant will vary according to environmental conditions, soil type, clipping removal, and availability of other nutrients.

Miller is a former Graduate Research Assistant and Dickens is a Professor in Agronomy and Soils.



Lethal temperatures for Tifdwarf and Tifway bermudagrasses predicted using an electrolyte leakage technique expressed as means of potassium (K) rates.

New Test Could Result in Safer Poultry Products

Donald E. Conner and Katherine C. Tamblyn

A food safety regulation proposed Feb. 13 by the USDA Food Safety and Inspection Service (FSIS) calls for a number of mandates for meat and poultry processors, one of which is that all carcasses processed must be given at least one antimicrobial treatment. An AAES research program has developed a new test that can be used to identify effective treatments to meet the industry and USDA goal of reducing pathogens on meat and poultry products.

FSIS officials proposed the *Pathogen Reduction: Hazard Analysis Critical Control Point System*, which has been dubbed the "Mega Reg." The antimicrobial treatments it calls for could include chlorine, trisodium phosphate, hot water, or organic acids. An AAES research effort has confronted the bacterial contamination problem by investigating the attachment of *Salmonella* to poultry skin. These studies led

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to the development of a novel method for providing relatively quick and accurate evaluations of acid-based and other treatments that show potential for use in poultry processing.

Bacterial contamination of poultry during processing is unavoidable. Chickens naturally carry a wide variety of bacteria into the processing plant. Some of these bacteria are transferred to the surface of the chicken during processing. Most of the bacteria do not cause disease but do decrease the shelf-life of poultry. However, bacterial pathogens such as *Salmonella*, *Campylobacter jejuni*, and *Listeria monocytogenes* can be transmitted to humans who eat improperly handled poultry. Certain processing steps — carcass washing and immersion chilling — effectively reduce but do not completely eliminate bacterial contamination of poultry skin. Data collected in AAES studies indicated that 47% of broilers obtained from retail sources were contaminated with *C. jejuni*, and a survey of freshly processed broilers showed that 17% were contaminated with *Salmonella*, albeit at low numbers.

Many novel antimicrobial treatments for broiler carcasses have been tested and reported in the past, but few, if any, have been adopted by the industry. Positive results in the laboratory have seldom been translated into favorable results in the processing plant. This discrepancy is likely due to a lack of standardized testing methods, as well as to the natural process by which bacteria attach to the poultry skin.

Most traditional laboratory tests examine the numbers of bacteria in the water used for poultry processing chill and scald baths. However, bacteria imbedded in follicles of the chicken skin are much better able to survive most disinfectant treatments. The "skin attachment model" (SAM), which resulted from the AAES project, allows for testing of antimicrobial agents against skin-attached bacteria. SAM allows researchers to target specific pathogens without interference from background microbes. It also allows for increased recovery of sublethally injured cells, which helps to avoid "false-negative" test results. Favorable SAM results are more likely to translate into success in subsequent processing plant experiments.

SAM has been used to quantify the effectiveness of generally-recognized-as-safe (GRAS) organic acids against *Salmonella* that are attached to poultry skin. Acetic, citric, lactic, malic, and tartaric acids have been evaluated at concentrations of 0.5—6% when applied in simulated chiller, dip, and scalder conditions. In general, anti-*Salmonella* activity increased progressively as concentration increased, and it was greatest in chiller and scalder conditions.

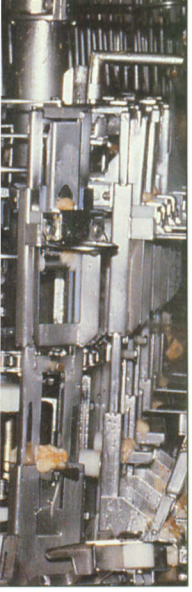
Data from these experiments established the bactericidal activity of the tested acids (see table). At 0.5% and 1% some activity was noted, but concentrations of 2% or more were required to kill more than 100 *Salmonella* bacteria on each skin sample. About 25% of the chickens sold at supermarkets have *Salmonella* but usually less than 100 cells per chicken. Therefore, any treatment that kills more than 100 cells per piece of skin is considered highly effective. However, at concentrations of 2% or more, cost and skin discoloration become obstacles to the commercial applicability of organic acids as sanitizers for ready-to-cook poultry. Therefore, means of enhancing the effectiveness of low levels of organic acids need to be found to circumvent cost and quality problems.

The organic acids also were tested against *Salmonella* bacteria freely suspended in water. In contrast to SAM results, most acid treatments rapidly killed more than a million free-floating *Salmonella* bacteria. This difference clearly demonstrates that *Salmonella* attached to or embedded in broiler skin are resistant to or protected from the lethal effects of organic acids. Therefore, any means of improving the effectiveness of organic acids should attack this protective effect. It is likely that the high lipid

Percent Reduction in the Number of Live *Salmonella* Bacteria After GRAS Organic Acids Applied in Three Simulations

Acid	Application[1]					
	Chiller		Dip		Scalder	
	Loose	Firm	Loose	Firm	Loose	Firm
Acetic	37	60	0	0	95	98
Citric	75	88	0	0	92	97
Lactic	92	84	37	50	98	99
Malic	98	98	0	0	92	96
Tartaric	60	84	0	0	80	98

[1]In the chiller treatment, samples were submersed in wate at 0°C for 60 minutes; dip, 23°C for 15 seconds; an scalder, 50°C for two minutes. The "Loose" column represents the numbers of cells recovered from rinse wate following acid treatments. The "Firm" columns represent numbers of cells recovered from skin after acid treatmen and rinse. This table shows the average bactericidal activit of the acids across all concentrations.



A new AAES test could aid in development of more effective antimicrobial treatments.

content and topography of chicken skin are the primary protective factors. Thus, the use of "transdermal" agents may increase the number of bacteria killed by enhancing delivery of the acids to attached or embedded pathogens.

Much of the information on transdermal delivery of antimicrobials is found in the pharmaceutical area. However, many pharmaceutical transdermal agents are emulsifiers, which allow for mixing of lipid and water phases. Emulsifiers are widely used in food processing, and many pharmaceutical emulsifiers are GRAS in food applications.

Current AAES efforts are focused on improving the effectiveness of low organic acid concentrations. By determining efficacy and factors that affect bactericidal activity, it is likely that treatments can be further adapted for processing plant and field experiments.

Poultry is Alabama's major agricultural commodity, with broilers contributing more than $1.35 billion in cash receipts — nearly half the state's total agricultural revenues. New methods of improving microbiological safety and quality will help protect public health and maintain the economic soundness of the poultry industry.

Conner is an Associate Professor and Tamblyn is a Graduate Research Assistant in Poultry Science.

Improving the Value of Cull Cows

Donald R. Mulvaney, William B. Mikel, William R. Jones, and Wendell H. McElhenney

Alabama's beef cow herd exceeds 920,000 head, a significant number of which are culled each year because of poor reproductive efficiency or other reasons. Revenues from cull cows account for an estimated 25% of the income for most cow-calf producers. These "spent" cows are a major source of ground beef, which by itself accounts for 45% of the beef consumed in the U.S. Cull cows also are used to produce processed beef products, specialty steaks, and other inexpensive retail cuts. Despite the significance of cull cows, most producers do not consider enhancing the value of this cow-calf production byproduct.

An AAES study demonstrated that treating spent cows with the experimental genetically engineered growth hormone bovine somatotropin (bST) can significantly enhance the quantity and quality of meat products from the culls. While bST has been approved for use in dairy production, the Food and Drug Administration has not yet approved its use in beef cattle.

The study also indicated that feeding spent cows for a brief period after culling — as opposed to sending them directly to market — can increase their value to some extent without the use of bST. The value of a cull cow is based on the yield of boneless meat and the percentage fat or lean in the meat. While many factors should be considered in making the decision to feed cull cows, the primary ones are listed in Table 1.

Table 1. Factors Critical to the Decision to Feed Cull Cows

- ✔availability of cows
- ✔cows should be thin but healthy
- ✔the cost/value margin
- ✔feed for cheap gains
- ✔facilities and labor
- ✔can you take the risk
- ✔market

Studies on enhancing the value of cull cows could be vitally important to the competitiveness of the cattle industry in Alabama and the Southeast. Not only do the findings from the AAES study suggest systematic approaches to increasing revenues from low-value cows, they could help meet the current high demand for lean beef.

Sixty crossbred beef cows received either low or high doses of bST or placebo injections each day of the study. Half the cows were slaughtered after 21 days of feeding

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and the other half after 42 days. Ultrasound imaging was used at the beginning, middle, and end of the trial to obtain backfat and ribeye information. Carcasses were dissected into boneless retail products, and muscle weights were recorded (Table 2).

Cull cows may vary significantly in age, composition, carcass characteristics, and other factors. Economy of weight gains achieved from feeding a culled cow is inversely related to the animal's condition at the start of feeding. Cows typically undergo a cyclic loss in body condition and weight. During periods of undernutrition, cows can be expected to lose 15-20% of their previously normal body weight. Thin cows generally can only be used to produce lean trim for ground beef. Compared to cows in normal condition, thin beef cows will undergo a "compensatory weight gain" (CG) when fed an optimally nutritious diet. Along with CG, these cows will have improved efficiency in feed conversion, thereby reducing the cost of the gain. Short-term feeding of thin cull cows increases their salvage value and presents another marketing alternative to producers. The major problems with feeding culled cows are that the composition of the gain may be mostly fat, and the costs of gain are extremely high. Other AAES studies will soon provide information about the important factors that control the profitability of feeding cull cows.

Table 2. Effects of Daily Somatotropin Injections on Cull Beef Cows

Parameter	Slaughter cows[1]	Treatment			Pct. change[2]
		Zero	Low	High	
Daily gains (lb.)	—	2.0	2.7	2.9	45
Feed:Gain (lb.)	—	17.9	11.5	10.5	40
Carcass backfat (in.)	0.15	0.55	0.42	0.32	42
Ribeye area (in.^{2})	10.9	12.5	14.2	14.8	18
Boneless lean yield (pct.)	52	64.7	68.6	69.9	8
Eye of the round (lb.)	4.2	5.4	6.7	7.6	41

[1]These are the measurements for cows that are sent to slaughter directly after culling.
[2]This column depicts the percent change due to bST applications.

To control for any CG effects in the cattle used in the bST tests, researchers fed the cows a high-quality diet for two weeks before treatments began. However, bST still improved gain and feed conversion compared to the placebo-injected control group. When corrected for variation in initial composition, the bST-treated cows had reduced fat and increased ribeye size. Consistent with these valuable carcass traits, the yield of boneless lean and weight of the eye of the round muscle was increased significantly by bST treatments (Table 2).

One of the greatest factors in the profitability of feeding cull beef cows is efficiency of feed conversion and gain

One of the greatest factors in the profitability of feeding cull beef cows is gain and efficiency of feed conversion . As shown in Table 2, a high dosage of bST increased daily weight gain by 0.9 pounds, compared to non-implanted cows. In a 50-day period of full feed on a high-energy diet, this increase would mean an additional 40 pounds and about $15-20 extra dollars per head. Also of great importance is the reduction in the pounds of feed required for a cow to gain one pound of weight. Cows in the high-dosage group required 7.4 fewer pounds of feed per day. For a 50-day feed period, this would require 400 fewer pounds of feed per cow, a savings of approximately $24, depending on unit feed costs.

Length of feeding time is critical to profitability. As time increases, fatness increases, daily gain decreases, and feed conversion worsens. Cows fed over 50-100 days will be too fat for ground beef manufacture, but could serve as source of selected muscle cuts. As with any cattle feeding venture, death losses may be encountered. Cow feeding needs to be coordinated with the seasonality of the cow market, and a positive buy/sell margin should be in place. In addition to these factors, these data suggest that bST may be a valuable technology for both feeders and processors of cull cows to improve the quantity, leanness, and economics of fed cows.

Mulvaney and Mikel are Associate Professors, Jones is a Professor, and McElhenney is a Research Fellow in Animal and Dairy Sciences. *This research was partially supported by a grant from the Alabama Cattlemen's Association.*

AAES Renews Vegetable Variety Trial Program

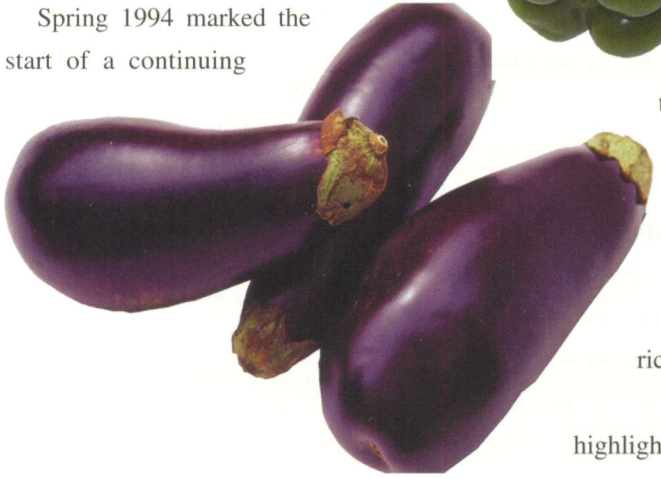
Eric H. Simonne and Joseph M. Kemble

Today's vegetable growers must compete not just nationally, but internationally. New, improved varieties are the lifeline of competitive vegetable production. After a downward trend in the 1980s, commercial vegetable production in Alabama is once again increasing. Presently, the state has approximately 62,000 total acres devoted to vegetable production.

In commercial vegetable production, the choice of a variety is critical since a poorly adapted variety can affect yield, quality, shelf life, and ultimately, farm income. In some cases, varieties of the same crop can perform well in South Alabama but not in the North. Consequently, variety trials are of interest not only to Alabama growers, but also to seed companies, researchers, Extension agents and specialists, and other members of the vegetable industry, such as packers, shippers, and wholesalers.

Spring 1994 marked the start of a continuing project aimed at evaluating many common vegetable varieties under the wide range of growing conditions found in Alabama. AAES horticulturists conducted replicated trials with bell pepper, cantaloupe, cucumber, eggplant, southernpea, summer squash, sweet corn, tomato, and watermelon. These tests were conducted at seven AAES substations (see figure).

Production systems used in these trials ranged from bare ground to plastic-mulched beds combined with drip irrigation. Fertility practices were based on recommendations from the Auburn University Soil Testing Laboratory. Pest and weed control followed commercial practices recommended by the Alabama Cooperative Extension Service. Produce was graded according to United States Department of Agriculture standards.



The following results are highlights from the spring 1994 trials. Complete yield and grade information can be found in the *1994 Spring Commercial Vegetable Variety Trials*, available from the AAES Office of Research Information.

Camelot, a standard green bell pepper, performed inconsistently with its lowest yields at the Sand Mountain Substation (SMS). Zerto showed good yield potential. Cubanelle-types (banana-shaped) such as Key Largo, Biscayne, and Greenhorn were early- and high-yielding. Specialty bell peppers that are white, yellow, orange, red, purple, brown, or black have potential for Alabama growers, but marketing opportunities, packaging, and consumer acceptance must be considered before producing these colored bell peppers. Yield of these specialty peppers was strongly dependent on cropping system, variety, and color.

Eggplant varieties were diverse in shape (traditional, oblong, elongated, or round) and color (dark purple, light purple, or white). Classic, the standard variety, performed well under intensive management

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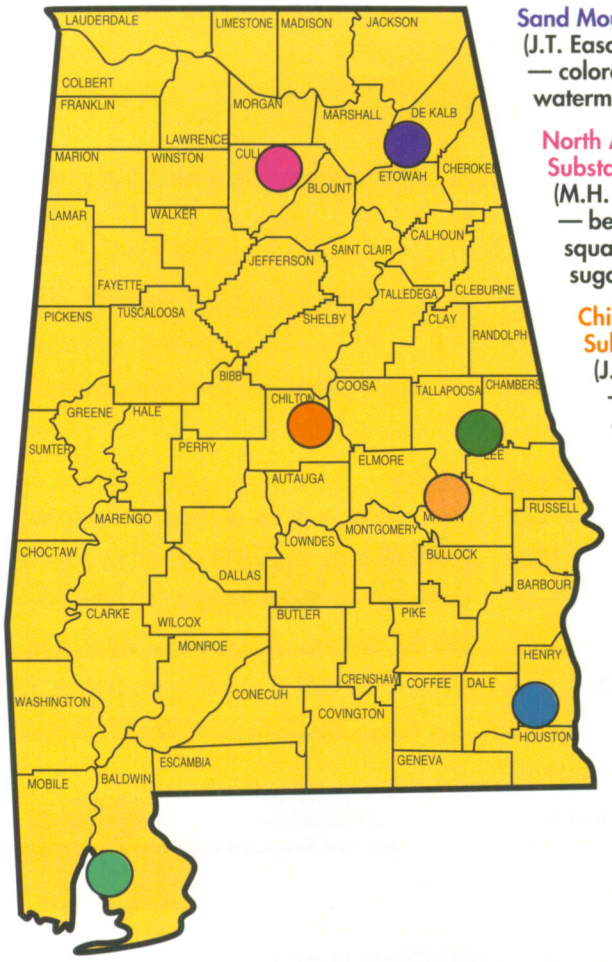

Sand Mountain Substation, Crossville
(J.T. Eason, Superintendent)
— colored bell pepper, bell pepper, tomato, watermelon

North Alabama Horticulture Substation, Cullman
(M.H. Hollingsworth, Superintendent)
— bell pepper, cucumber, eggplant, summer squash, tomato, watermelon, southernpea, sugar-enhanced and supersweet sweet corn

Chilton Area Horticulture Substation, Clanton
(J.A. Pitts, Superintendent)
— colored bell pepper, summer squash, cantaloupe, sugar-enhanced and supersweet sweet corn

Piedmont Substation, Camp Hill
(J.T. Owen, Superintendent)
— colored bell pepper

Horticulture Unit of the E.V. Smith Research Center, Shorter
(J.S. Bannon, Director; and J.B. Witt, Superintendent)
— bell pepper, eggplant, southernpea

Wiregrass Substation, Headland
(H.W. Ivey, Superintendent)
— summer squash, southernpea, watermelon

Gulf Coast Substation, Fairhope
(E.L. Carden, Superintendent)
— sugar-enhanced sweet corn, watermelon

LOCATION OF SPRING 1994 AAES VEGETABLE VARIETY TRIALS

at the North Alabama Horticultural Substation (NAHS). Yields of Vittoria (elongated fruit) and Bambino (small, round fruit) tended to be the lowest. Although small (averaging 0.1 pound per fruit), Bambino fruits were flavorful. Yields of Bride (white, elongated) tended to be lower than those of Classic, but there is increasing demand for white eggplants in specialty markets.

Color (white, yellow, or bi-color) and sweetness are important characteristics of sweet corn. Varieties included sugar-enhanced and supersweet types, which are sweeter than normal sweet corn. SS 7210, a standard for the yellow, supersweet types, was outperformed by Springsweet and Challenger at NAHS, and by Krispy King, Sweet Belle, and SS 7630 at the Chilton Area Horticultural Substation. White, sugar-enhanced varieties, such as Silverado, outperformed the traditional Silver Queen.

Southernpea varieties were classified as blackeye, pinkeye, cream, or crowder. Blackeye and pinkeye are the main commercial types. Combined results over three years indicated that the blackeyes Bettergo Blackeye, Giant Blackeye, and AU-M-90-84-GC67; pinkeyes Mississippi Pinkeye and Coronet; creams Zipper Cream and Mississippi Cream; and crowders Clemson Purple and Colossus 80 produced high yields of good quality.

Most yellow squash grown in Alabama are crooknecks. Several varieties such as Supersett, Goldie, and Pavo outperformed Dixie, which is considered the industry standard for crooknecks. Supersett has the "precocious yellow gene," which produces a deep yellow fruit color that can mask symptoms of watermelon mosaic virus — green blotches or strips on fruit. Infected fruits are unmarketable because of this discoloration. However, unlike other yellow squash, the peduncle (the part of the fruit that is attached to the plant) of Supersett fruits is also yellow. This characteristic is not always desirable in some markets.

Early planting at the Gulf Coast Substation (GCS) tended to produce higher watermelon yields than the later plantings at NAHS and SMS. Among the large melons, Starbrite produced the most consistent yields. Yields of icebox melons were lower that those of the allsweet, jubilee, and mirage-types. However, the icebox melons Asahi Miyako and Red Honey were among the sweetest at GCS.

Performance of a variety can be affected by factors such as cultural practices, management style, soil type, season of production, and weather. As a result, each variety needs to be evaluated over two to three seasons at different locations before a true picture of the variety's adaptability and performance can be drawn.

Simonne is a Post-doctoral Fellow and Kemble is an Assistant Professor in Horticulture.

New Cultivators Cut Herbicide Use in Conservation Tillage

Michael G. Patterson, C. Dale Monks, Bobby E. Norris, and Larry W. Wells

Cultivation has traditionally been used to control weeds between rows in conventional tillage cotton. Conservation tillage helps reduce soil erosion but is more dependent on herbicide use since cultivation has traditionally not been used in these planting systems.

AAES research was conducted to evaluate the potential of new high-residue (HR) cultivators, which do not invert soil and were developed for use in conservation tillage cropping. Three years of research demonstrated that HR cultivators can be used in conservation tillage cotton to reduce the total amount of herbicide required per acre, while achieving yields and weed control comparable to conventional tillage. However, several factors, including soil type, moisture condition, and the type of equipment on the HR cultivator, were found to affect yield and weed control.

Brown-Harden Chiselvator showing sweeps with metal rods welded to trailing edges.

A John Deere HR cultivator was evaluated for weed control potential in no-till cotton at the Tennessee Valley Substation in Belle Mina, and a Brown-Harden HR cultivator was evaluated for weed control potential in strip-till cotton at the Wiregrass Substation in Headland. The soil at Belle Mina is a clay loam, while the soil at Headland is a sandy loam. Cotton was planted into desiccated rye at Belle Mina and into desiccated wheat at Headland. A soil-applied herbicide mixture of Cotoran and Zorial at 1.5 pounds of active ingredient per acre each was applied either in a 16-inch band over the row or broadcast after planting. Plots were cultivated twice during the growing season. Prowl at one pound of active ingredient per acre was broadcast-applied

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preemergence to all conservation tillage plots.

These conservation tillage treatments were compared to a conventional tillage treatment that was prepared by chisel plowing, disking twice, planting, application of the Cotoran/Zorial mixture in a band, and cultivation. In addition, researchers treated plots with postdirected sprays of Bladex at 0.75 pound per acre and MSMA at two pounds per acre. Prowl at 0.5 pound per acre was incorporated before planting.

Banding a preemergence-applied herbicide mixture over the row in no-till or strip-till cotton and using a HR cultivator between rows provided weed control and seed cotton yields comparable to conventionally tilled cotton in most cases (see tables). Banding herbicides over the row saves money for the grower and reduces the total amount of herbicide applied per acre.

However, yield loss occurred after using a HR cultivator equipped with wide, flat-running sweeps to control annual grass in a clay-based soil containing good soil moisture. The fibrous roots systems of grasses regrew after cultivation, resulting in poor control and consequent yield loss. This yield loss did not occur in experiments conducted on a sandy soil when using a HR cultivator equipped with metal rods welded to the trailing edges of the sweeps. These rods helped separate the soil from grass roots, thereby reducing regrowth.

The John Deere HR cultivator provided cotton yields equal to broadcast herbicide treatment in no-till cotton and to conventional tillage at Belle Mina in 1989 and 1992 (Table 1). Yield loss occurred in 1990 when rains followed the last cultivation, causing annual grass to regrow in the clay loam soil. Adding two postdirected sprays to this treatment provided adequate grass control and yields equal to no-till with broadcast herbicide (data not shown).

Table 1. John Deere High-Residue Cultivator Evaluation, Belle Mina

Treatment[1]	Weed control[2]		Seed cotton yield		
	Crabgrass	Spotted spurge	1989	1990	1992
	Pct.	*Pct.*	*Lb.*	*Lb.*	*Lb.*
No-till / herbicide banded	18	46	1,905	0	2,402
No-till / herbicide banded / cultivated	68	81	2,485	0	3,738
No-till / herbicide broadcast	95	93	2,365	2,025	3,983
Conventional till / herbicide banded / cultivated	86	88	2,644	2,284	3,493

[1]No-till was accomplished using John Deere Maxemerge planters equipped with ripple coulters, heavy downpressure springs, and metal furrow closing wheels. Herbicide was Cotoran + Zorial applied in a 16-inch band over the row or broadcast. Row spacing was 40 inches.
[2]Three-year average.

Table 2. Brown-Harden High-Residue Cultivator Evaluation, Headland

Treatment[1]	Weed control[2]		Seed cotton yield		
	Crabgrass	Sicklepod	1991	1992	1993
	Pct.	*Pct.*	*Lb.*	*Lb.*	*Lb.*
Strip-till / herbicide banded	41	59	1,815	1,113	1,839
Strip-till / herbicide banded / cultivated	81	88	3,545	2,106	1,984
Strip-till / herbicide broadcast	80	86	4,030	2,232	2,529
Conventional till / herbicide banded / cultivated	79	88	2,904	1,803	2,565

[1]Strip-till accomplished using a RoTill machine equipped with IH planting units. Herbicide was Cotoran + Zorial applied in a 16-inch band over the row or broadcast. Row spacing was 36 inches.
[2]Three-year average.

The Brown-Harden HR cultivator Chiselvator provided weed control and cotton yields equal to both strip till with broadcast herbicide and conventional till (Table 2). Metal rods welded onto the trailing edges of the sweeps helped separate soil particles from the grass roots, resulting in good control and optimum cotton yields.

These results show that HR cultivators can be employed to reduce the amount of herbicide used in conservation tillage cotton if soil type and moisture conditions are favorable.

Patterson is an Associate Professor and Monks is an Assistant Professor in Agronomy and Soils. Norris and Wells are Assistant Superintendents of the Tennessee Valley Substation and Wiregrass Substation, respectively.

Broiler Litter Shown to be Effective Cotton Fertilizer

Charles C. Mitchell, Charles H. Burmester, C. Wesley Wood, and Jeffory A. Hattey

Large-scale cotton producers have traditionally avoided using manures and other organic nutrients as a nitrogen (N) source for their crops. Possible reasons include inconvenience, unpredictable nutrient availability, fear of spreading weeds, excessive vegetative cotton growth, cost, and difficulty of hauling and spreading bulky materials. However, AAES experiments have demonstrated that broiler litter can be used effectively as a source of N for cotton.

Unlike other poultry-producing cotton belt states, Alabama has extensive cotton acreage relatively close to its major broiler production areas. Using this litter on Tennessee Valley cotton may also help alleviate some of the environmental concerns of excessive litter application on soils of the Sandstone Plateau region.

A three-year experiment at the Tennessee Valley Substation (TVS) in North Alabama and a four-year experiment at E.V. Smith Research Center (EVSRC) in Central Alabama were conducted to determine some of the problems and opportunities of using poultry broiler litter on cotton. The study was partially funded by check-off funds from Alabama cotton producers. Specific objectives were to (1) determine if poultry litter can be used as the only source of N for cotton; (2) determine if total N in broiler litter can be used to predict the optimum application rate; (3) determine if Pix (mepiquat chloride), a chemical growth regulator approved for use on cotton, should be used to reduce potentially excessive vegetative growth from high litter applications; and (4) determine the effect of broiler litter on residual nutrients in the soil.

Nitrogen rates of 0, 60, and 120 pounds N per acre as ammonium nitrate and broiler litter rates of 120, 180, and 240 pounds total N per acre were applied each year. Duplicate treatments received Pix applications. All broiler litter treatments were applied and incorporated just before spring plant-

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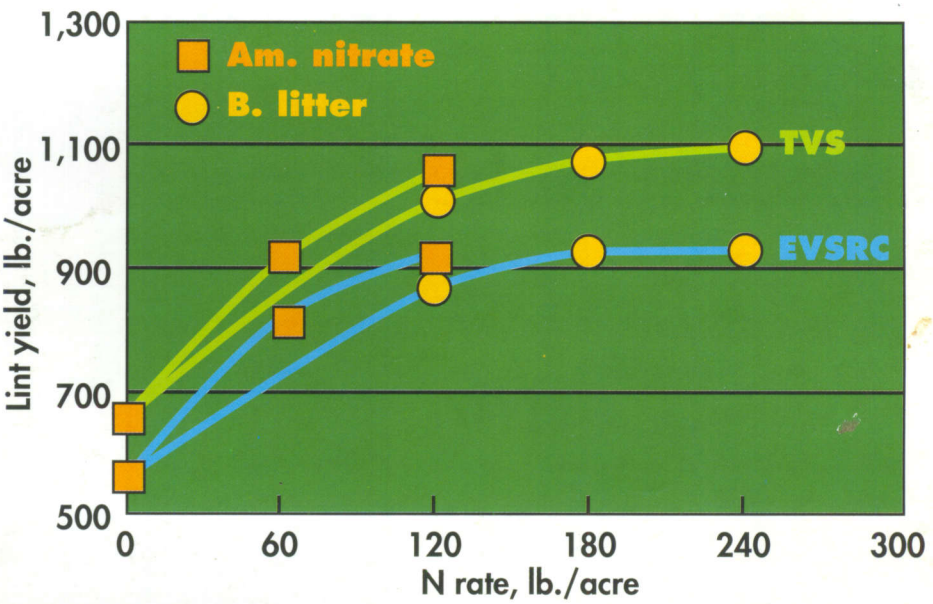
Broiler Litter Effective Cotton Fertilizer, continued

ing. Fertilizer N was applied half preplant and half at early squaring.

Total N, whether from ammonium nitrate or broiler litter, gave the same cotton yield response in five of the seven site-years (a site-year is one test at one site during one year). Average yields were similar whether the N source was ammonium nitrate or broiler litter at both TVS and EVSRC (see figure). After three or four years of annual applications of broiler litter, one would expect very rank cotton on treatments receiving as much as four tons litter per acre per year (240 pounds total N per acre per year). This did not occur. Excessive growth was a problem only in 1992 at TVS, a relatively moist year with high yields. These conditions provided the only circumstances in which Pix was successful in increasing yields, whether the N source was ammonium nitrate or broiler litter.

Although both fertilizer and broiler litter increased nitrate concentrations in the soil after three years of fertilization and cropping, soil nitrate-N did not exceed 5.3 parts per million to a depth of 40 inches at either location. However, high broiler litter rates (four tons per acre each year) dramatically increased extractable, plow-layer phosphorous (P) and potassium (K) compared to the conventionally fertilized treatments. Both sites initially tested high in these nutrients and did not require additional P and K fertilization.



Average cotton lint yields for three years at TVS and for four years a EVSRC indicate that total N in broiler litter is almost as effective as ammonium nitrate N in increasing yields.

Yield results indicate that broiler litter can be used as an alternative source of fertilizer N on cotton. All can be applied at or just prior to planting based on the total N in the broiler litter. A ton of broiler litter generally contains about 60 pounds of N, of which about 67% (40 pounds per ton) will be available the year it is applied. Therefore, a cotton crop requiring 120 pounds of fertilizer N per acre on sandy soils, such as those at EVSRC, would need three tons of broiler litter per acre (180 pounds total N). This rate appeared to be near the optimum rate at both TVS and EVSRC over the three-year study.

Mitchell is an Associate Professor, Burmester is a Research Associate, and Wood is an Alumni Associate Professor of Agronomy and Soils. Hattey is a former Postdoctoral Fellow in Agronomy and Soils and is currently an Assistant Professor at Oklahoma State University.

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

Lowell T. Frobish, Director
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