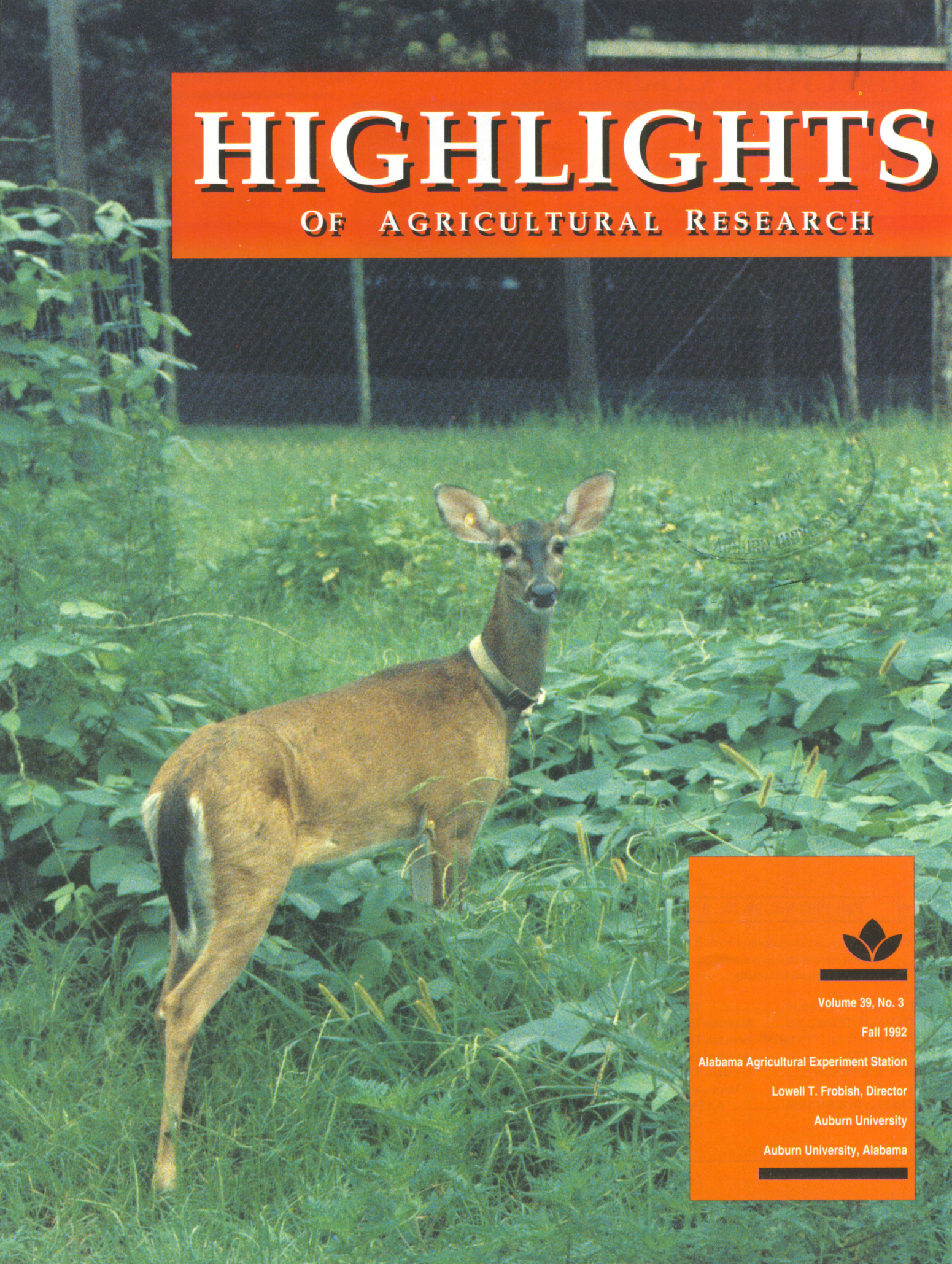
# HIGHLIGHTS

## OF AGRICULTURAL RESEARCH



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Alabama Agricultural Experiment Station

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# Director's Comments

LOWELL T. FROBISH

Variety selection is one of the few decisions farmers can make that will increase yield, decrease pest problems, and improve utilization of water and nutrients; yet not cost more money. When combined with soil fertility testing and other research-proven production information, choosing the optimum variety can make a big difference in the bottom line.

Though we are entering into exciting and challenging new areas of research, such as genetic engineering, the nuts-and-bolts research conducted on varieties and soil fertility remains an important aspect of the overall Alabama Agricultural Experiment Station research effort.

Each year the results of variety trials on corn, cotton, soybeans, small grains, grain sorghum, and ryegrass are published by the Experiment Station. And, every year these publications are in demand by farmers. Data for these publications are generated by variety tests at Experiment Station research sites across the State, providing localized information for the State's farmers.

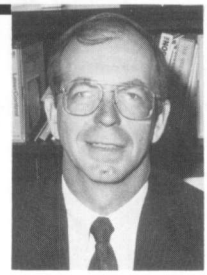
Soil fertility studies provide nearly 60 years of continuous fertility information for the five major soil regions of the State. This soil fertility information is critical to any crop research, and Alabama has the longest continuous soil fertility tests in the Nation.

Variety tests and fertilizer trials are among the most traditional of applied research techniques, meaning results of these tests can be "applied" directly by farmers and agribusiness. While Auburn and other research institutions are increasing emphasis on "basic" research, which is critical in a building a base of scientific knowledge, the importance of variety trials, fertility tests, and other applied research should not be overlooked.

Recently the Experiment Station's variety testing and soil fertility research programs were spearheaded by Clyde Evans, a soil scientist, and Don Thurlow and Wiley Johnson, both agronomists. Each of these scientists retired in 1992, leaving a legacy of valuable information that has provided much of the varietal and fertility information used by Alabama farmers for the past 30 years.

Without question, farmers and the agricultural industry in the State owe a great deal to the variety testing and soil fertility programs and to the scientists who made results of these tests more meaningful.

## May We Introduce



Pat Green, Assistant Director of the AAES. Green, a native of Alabama, joined the staff in June and will be handling the financial operations of the AAES.

Green brings to Auburn an extensive background in university administration that has included work with grants and contract development, copyrights and patent administration, government relations, and industrial contracting. He came to Auburn from the College of Charleston in Charleston, S.C., where he has served as Director of Research since 1987. A graduate of Auburn University with a bachelor's degree in business administration, Green has previously worked in administrative roles at the University of Georgia, University of South Alabama, University of Alabama in Birmingham, and NASA's Marshall Space Flight Center in Huntsville. He also has worked with the National Institutes of Health National Heart, Lung, and Blood Institute.

**ON THE COVER. Deer browsing forage plots, see story on page 4.**

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D.L. RANKINS, JR., J.T. EASON, T.A. MCCASKEY, AND A.H. STEPHENSON

# On-Farm Processing Preserves the Nutritive Value of Broiler Litter

BROILER litter has been used as an economical feed ingredient for beef cattle for several years, providing an alternative disposal method for this by-product of the poultry industry. However, broiler litter must be managed properly to ensure it is a safe and valuable feedstuff for cattle. Research-developed techniques are providing new information on the best management practices for this resource.

Typical on-farm techniques for handling and processing litter include deep-stacking, which generates heat and eliminates potential pathogens. However, deep-stacking also can result in excessive heat generation within the stack, which binds the nitrogen and limits the nutritive value of the litter as a cattle feed. A recent Alabama Agricultural Experiment Station study at the Sand Mountain Substation, Crossville, evaluated the nutritive value of broiler litter deep-stacked in three different ways.

Approximately 20 tons of broiler litter were placed into each of three open-faced bays and deep-stacked to a height of approximately 6 ft. One stack was left uncovered, another was covered with 6-mil plastic, and the third stack was misted with water to form a 1-in. crust upon drying. After 30 days, the litter was used to formulate six experimental diets representing 25 and 50% litter from each of the three treatments. A control diet using urea and no litter also was formulated. All diets contained 10% cottonseed hulls, 2% limestone, vitamin A, and variable amounts of cracked corn.

Twelve crossbred, medium-framed steers averaging 451 lb. were assigned to each diet (six steers per pen and two pens per diet). Steers were weighed every 28 days throughout the study. Following 84 days on feed, three steers from each treatment were fed in individual pens and manure was collected from each steer so that nutrient digestibilities could be determined.

Within 28 days, four to eight steers being offered litter-containing diets were bloated. Therefore, poloxalene (a bloat preventative) was added to the diets for the remainder of the study. Steers consuming the control diet gained from 0.5 to 1.4 lb. per day faster than those consuming the litter-based diets, see table.

The deep-stacking method had no appreciable effect on steer average daily gains. Daily feed intake was not significantly different among cattle fed the experimental diets. Feed efficiency values followed the same pattern as daily gains; best for steers fed the control diet, followed by those fed 25% litter, and then those fed 50% litter. The suppressed weight gains as a result of the addition of broiler litter were directly related to the energy content of the diets. Broiler litter contained less energy than corn. However, the cost per pound of gain was quite similar among the seven treatments, see table.

Inclusion of broiler litter into the ration resulted in decreased digestibility of all nutrients except the fiber component (neutral detergent fiber). The deep-stacking method had no effect on dry matter, organic matter, fiber, or energy digestibilities. However, deep-stacking affected nitrogen digestibility. Nitrogen digestibility of diets containing plastic-covered litter was not different from the urea control diet, but was greater than for treatments containing uncovered or watered litter. Differences in nitrogen digestibility probably occurred because heating formed indigestible nitrogen complexes. The uncovered stack reached an internal temperature of 158°F, the watered stack 154°F, and the covered stack did not exceed 142°F.

Based on these findings, the temperature range between 142°F and 158°F appears to be very important for maintaining adequate availability of broiler litter nitrogen for cattle. The suppression of temperature caused by covering the stack resulted in a diet that contained 20% more digestible nitrogen. Previous research has shown that temperatures of 142°F for several days are adequate for the elimination of most enteric bacteria that might be associated with broiler litter.

In summary, steers fed the urea control diet gained extremely well. Incorporation of 25 and 50% broiler litter into the diets reduced weight gains and resulted in less efficient gains as a result of the decreased amount of dietary energy. However, the cost of each diet ranged from $0.282 to $0.305 per pound of gain. Covering the deep-stacked litter with plastic did not increase average daily gains, but did increase nitrogen digestibility, making it most useful in cattle with higher protein requirements, such as lightweight heifers. In some cases, uncovered stacks might achieve even higher temperatures, further accentuating these differences.

Rankins is Assistant Professor of Animal and Dairy Sciences; Eason is Superintendent, Sand Mountain Substation; McCaskey is Professor and Stephenson is former Research Associate of Animal and Dairy Sciences.

Average Daily Gain, Feed Intake, Feed Efficiency, and Nutrient Digestibilities of Steers Fed Varying Amounts of Deep-Stacked Broiler Litter

| | | 25% litter | | | 50% litter | | |
|---|---|---|---|---|---|---|---|
| | Urea | Unc. | Cov. | Wet | Unc. | Cov. | Wet |
| ADG, lb. | 3.43 | 2.71 | 2.88 | 2.62 | 2.09 | 2.07 | 2.18 |
| Intake/d, lb. | 19.1 | 18.5 | 21.1 | 19.1 | 20.2 | 19.1 | 20.5 |
| Feed/gain | 5.57 | 6.83 | 7.33 | 7.29 | 9.66 | 9.23 | 9.40 |
| $/lb. of gain | .298 | .284 | .305 | .303 | .296 | .282 | .288 |
| **Digestibilities** | | | | | | | |
| DM, % | 69 | 58 | 58 | 54 | 49 | 48 | 52 |
| OM, % | 71 | 64 | 61 | 61 | 56 | 58 | 60 |
| N, % | 55 | 41 | 52 | 37 | 38 | 46 | 49 |
| NDF, % | 39 | 38 | 41 | 38 | 39 | 34 | 36 |
| Energy, % | 69 | 58 | 55 | 51 | 51 | 52 | 52 |

DM = dry matter, OM = organic matter, N = nitrogen, and NDF = neutral detergent fiber.

N.A. WAER, H.L. STRIBLING, AND M.K. CAUSEY

# White-Tailed Deer Preferences For Planted Forage Crops

ALABAMA farmers, and even homeowners in some areas of the State, can attest to the varied culinary tastes of white-tailed deer. A recent Alabama Agricultural Experiment Station study confirms some distinct dining trends by deer on forages, some of which depend on time of year the crop matures, crude protein content, and forage fiber content.

Cool-season (September-May) crops in the study included: oats, rye, ryegrass, wheat, forage turnips, Regal ladino clover, Osceola ladino clover, Imperial Whitetail® ladino clover, Tibbee crimson clover, and Mt. Barker subterranean clover. These same forages were grown in the second year, except Redland II red clover replaced Mt. Barker.

Warm-season (May-October) crops included: Davis soybean, Quail Haven® soybean, Combine cowpea, catjang pea, velvetbean, and American jointvetch. The perennial ladino clovers were available in minimum quantities during the warm-season.

The test was conducted at the Auburn Deer Research Facility near campus. Six female and four male deer were allowed to graze the forages. Colored collars were placed on each deer to allow identification at a distance. Deer were released onto the forage plots approximately four times per week, usually within 3 hr. of sunrise or sunset, and allowed to feed 15-30 min. These deer are normally fed pelleted feed, but feeding was restricted 12-14 hr. prior to the animals being released onto the forage plots.

Preferences were determined by viewing and recording deer foraging activities from an observation blind during feeding intervals. After deer were dispersed onto the test plots, the location of each feeding deer was recorded by plot number at 3 min. intervals. If a deer did not enter the enclosure, did not forage, or foraged on surrounding volunteer vegetation, this alternate activity was recorded during the 3 min. interval.

Deer preference was determined by calculating the number of observations per minute for each forage. During the study, 16 observational periods of 7-21 feeding intervals each were conducted over three seasons; 15,740 independent observations were made during the 227 feeding intervals. Throughout the study, deer spent about the same amount of time eating planted forages (40.8%) as they did eating volunteer vegetation (40.3%), such as blackberry, evening primrose, and bahiagrass.

During the cool-seasons, small grains were preferred from November through February. Ryegrass was a preferred species along with small grains in January of the first year and in December through March of the second year. Crimson clover also was a preferred species from late January through March of the first year and from February to March of the second year. Deer preferred ladino clovers from April through May, which was during ladino clover's peak production. While the peak in production and use of ladino clovers was high compared to other forages, it occurred during spring green-up when browse was plentiful and succulent. At that time, the deer shifted most of their grazing pressure to volunteer vegetation even though ladino clover forage was available. Red clover was a preferred species in May through September, paralleling its peak production. Use of red clover was strong due to its ability to produce forage during late summer when ladino clovers were stressed and other cool-season forages were dead.

During the warm-season of 1990, soybean was preferred over all other forages from mid-June through August. Velvetbean was the second most preferred forage in mid-June to mid-July. From late-July to late-August, jointvetch and Quail Haven soybean were preferred species. Soybeans and ladino clovers were preferred forages during late-August to early-October. Peas were the least preferred of all forages throughout the summer.

Preference was associated with growth stages of the forage species. Generally, forages were preferred when they were growing rapidly, relatively high in crude protein, and relatively low in fiber. Once forages matured, they became more fibrous and decreased in crude protein content. Subsequently, deer use shifted to other forages containing less fiber and more protein. These changes in fiber and protein content could explain decreased use, possibly due to decreased palatability.

Results from this study may be used to develop planting regimes in accordance with particular management objectives.

Waer is Graduate Research Assistant, Stribling is Assistant Professor, and Causey is Professor of Zoology and Wildlife Science.

**Deer browsing on forage plots at the Auburn Deer Research Facility.**

C.H. GILLIAM, D.J. EAKES, P.R. KNIGHT, AND J.A. REEDER

# BIOBARRIER RESTRICTS ROOT GROWTH

ALABAMA Agricultural Experiment Station research with Biobarrier®, a long-term root control system, indicates it is effective in preventing roots from spreading outside designated landscape areas. This relatively new product, which consists of time release nodules of (trifluralin)[1] herbicide permanently bonded into a fabric, may prove to be environmentally safe and effective in preventing root damage to sidewalks, driveways, underground pipes, and septic tanks.

Red maple, American sycamore, Bradford flowering pear, and willow oak, were planted at the E. V. Smith Research Center, Shorter, in March 1990. Trees were about 2 in. in caliper at the time of planting, and treatments included Typar Biobarrier, Dewitt Pro-5®, and a control with no root barrier. Dewitt Pro-5 is a woven polypropylene product that has provided superior weed control in another study evaluating weed mats.

Planting hole preparation included digging an 8 X 8 ft. area to a depth of 19 in. Each hole was lined along the four vertical walls with one of the two root control products to a depth of 18 in., or left unlined (control). Trees were planted in the center of each hole and backfilled with native soil. Each tree species was evaluated as an individual experiment. Trees were mulched with pinebark to a depth of 2 in., watered, and fertilized annually with 1 lb. of 13-13-13 per caliper inch. Postemergence weed control was maintained around the edge of the hole with Roundup® herbicide.

With all four tree species, Biobarrier effectively suppressed root penetration beyond the root control treatment in both years, as shown in the table. Dewitt Pro-5 landscape mat and the nonrestricted control treatment resulted in numerous roots penetrating the plane beyond the edge of the planting hole. Root growth of red maple and American sycamore was more vigorous, as evidenced by greater root numbers (average of 58 roots) compared to Bradford flowering pear and willow oak (average of 26 roots) in 1991. Roots penetrating the DeWitt Pro-5 tended to branch as they penetrated the barrier and numerous small roots grew along the vertical barrier.

There was no difference in height or caliper measurements during either of the 2 years evaluated for the four tree species. Average height (ft.) and caliper (in.) for the four tree species at the end of 1991 were: red maple, 17 and 3.5; American sycamore, 17.4 and 3.8; Bradford pear, 12.5 and 3.5; and willow oak, 16.4 and 3.1.

On May 1, 1991, soil samples were collected horizontally from a section of the Biobarrier mat to determine trifluralin movement and concentrations. Trifluralin was highest in the 0-1/8 in. distance from the nodule, 24.1 parts per million (p.p.m.) and decreased in concentration as distance from the nodule increased. Trifluralin registered 0.1 p.p.m. 2 in. from the nodule. Furthermore, trifluralin concentrations in the nodules were similar to the initial nodule trifluralin concentrations. These data show that trifluralin concentrations were still present in significant amounts to prevent root growth 2 years after installation, but had not moved significantly from the vertical barrier.

Gilliam is Professor, Eakes is Assistant Professor, Knight is Graduate Research Assistant, and Reeder is Research Technician IV of Horticulture.

**Biobarrier (shown here) is effective in managing root growth.**

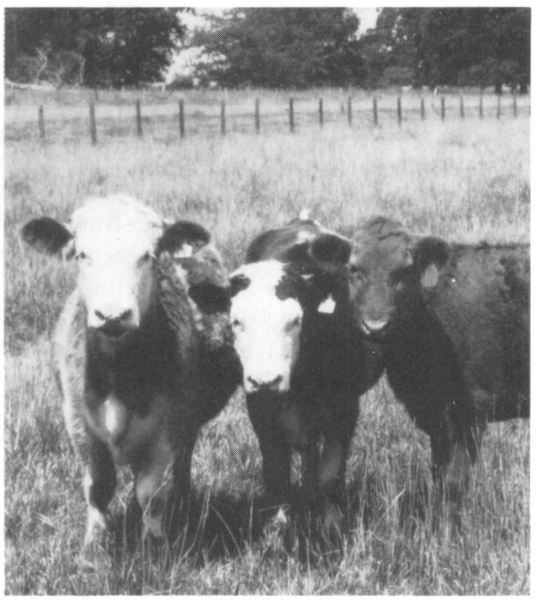
NUMBER OF ROOT PENETRATIONS OF THE PLANTING WALL OUTSIDE ROOT CONTROL TREATMENTS

| | 1990 | | | 1991 | | |
|---|---|---|---|---|---|---|
| | Typar Biobarrier | DeWitt Pro-5 | Control | Typar Biobarrier | DeWitt Pro-5 | Control |
| Red maple | 0.0 | 11.7 | 17.0 | .0 | 58.7 | 28.3 |
| American sycamore | 0 | 16.3 | 11.0 | 1.0 | 58.0 | 53.7 |
| Bradford flowering pear | .0 | 27.7 | 24.7 | .3 | 29.5 | 15.7 |
| Willow oak | .0 | 7.7 | 11.7 | .0 | 23.3 | 17.7 |

[1] Trifluralin is sold under the tradename Treflan, but is also available in generic formulations.

D.I. BRANSBY, D.E. SNYDER, AND W.B. WEBSTER

# MEDICATED SUPPLEMENT BLOCKS EFFECTIVE FOR DEWORMING BEEF CATTLE



DEWORMING is often one of the most neglected aspects of animal husbandry among beef producers. This is probably a result of many producers in the Southeast having small herds and part-time operations with limited labor, facilities (such as a chute), and incentives for deworming cattle. However, an Alabama Agricultural Experiment Station study has shown that medicated supplement blocks can be effective low-input tools for deworming beef cattle.

A 2-year grazing study was conducted at the Tennessee Valley Substation using 60 500- to 600-lb. stocker steers grazing Kentucky 31 tall fescue infected at rates between 40 and 75% with the endophyte *Acremonium coenophialum*. All animals were treated with a single oral dose of fenbendazole paste prior to initiation of grazing in April. This was done to reduce differences among treatment groups caused by different initial worm burdens, and to make sure the experiment evaluated only the rate of reinfection with worms from experimental pastures.

The experiment included three treatment groups: a control group that received no deworming treatment throughout the experimental period; a group that had continuous free access to a block containing only an ionophore, a feed additive that increases feed efficiency; and a third group that had free access to an ionophore block that was replaced with a Safeguard® medicated block containing the dewormer fenbendazole, for a few days, 3 and 6 weeks after grazing started. In 1990 the ionophore treatment was administered using a Bovatec® block, and in 1991 a Rumensin® block was used.

Grazing continued for 132 days in 1990 and 140 days in 1991. Cattle were weighed every 28 days and sampled monthly for fecal worm egg counts, which serve as indicators of worm burdens.

Weight gains were typically low for infected fescue grazed by stockers during the summer. Average daily gains were higher and worm egg counts were lower in 1990 than in 1991, see tables. This was probably because rainfall was lower in 1990, resulting in less favorable (dryer) pasture conditions for worm larvae.

Both supplement block treatments provided higher weight gains and lower worm egg counts than the control. Although worm egg counts were lower for the medicated block treatment than for the ionophore block only, weight gains for these two treatments were similar, with only a slight tendency for higher gains from the medicated block in both years.

Relative differences among treatments in worm egg counts decreased with time. This could partially explain why the difference in weight gain between the ionophore-only block and the medicated block treatment was not larger. In addition, it suggests that further administration of the medicated block (beyond 3 and 6 weeks after initiation of grazing) may further improve worm control. Deworming all cattle before grazing started also may have reduced the difference between the two block treatments.

The reduced worm burden associated with the ionophore-only block is somewhat unexpected. However, some ionophores are known to have anticoccidial activity, and it is possible that these also could have an anthelmintic, or deworming, effect.

In summary, this study showed that medicated supplement blocks provided effective, low-input alternatives to traditional methods of treating stocker cattle for worms. Differences in average daily gain among treatments may have been larger if all animals had not been dewormed before grazing started, but this was not a consideration of this study.

TABLE 1. AVERAGE DAILY GAIN FOR CATTLE WITH NO DEWORMING TREATMENT OR IONOPHORE BLOCK, IONOPHORE BLOCK ONLY, AND BOTH IONOPHORE AND MEDICATED BLOCKS

| Treatment | Av. daily gain | |
|---|---|---|
| | 1990 | 1991 |
| | *Lb.* | *Lb.* |
| No supplement | 1.03 | 0.47 |
| Ionophore block only | 1.21 | .96 |
| Ionophore + medicated block | 1.34 | 1.08 |

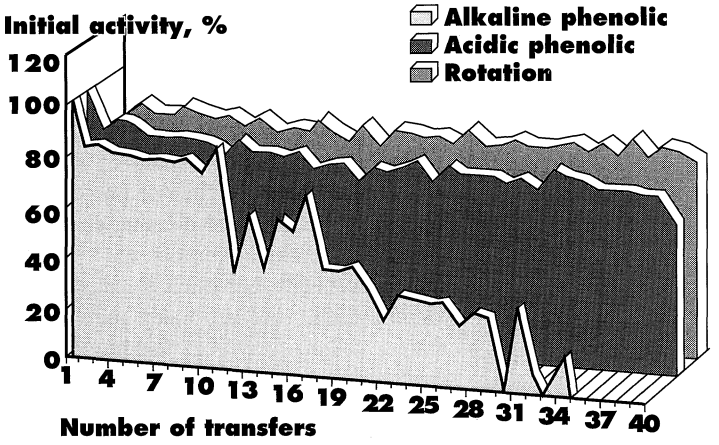
TABLE 2. WORM BURDENS, AS MEASURED BY WORM EGGS PER GRAM OF FECAL MATTER FOR CATTLE

| Treatment | Worm burden, eggs/gram | | | |
|---|---|---|---|---|
| | June | July | August | Avg. |
| **No supplement** | | | | |
| 1990 | 10 | 68 | 84 | 54 |
| 1991 | 83 | 54 | 103 | 80 |
| **Ionophore block only** | | | | |
| 1990 | 8 | 33 | 53 | 31 |
| 1991 | 44 | 21 | 43 | 36 |
| **Ionophore + medicated block** | | | | |
| 1990 | 1 | 14 | 27 | 14 |
| 1991 | 4 | 18 | 32 | 18 |

Bransby is Professor of Agronomy and Soils; Snyder is former USDA Parasitologist; Webster is Superintendent of the Tennessee Valley Substation.

D.E. CONNER AND M.K. ECKMAN

# ROTATIONAL APPLICATION OF CHEMICAL DISINFECTANTS ENHANCES SANITATION OF POULTRY HATCHERIES




**Development of resistance to disinfectants when applied on a repeated basis.**

THE EVOLUTION of modern broiler hatcheries has resulted in a substantial increase in the size of facilities, number of breeder flocks serviced, and hatching egg sources. Currently there are 35 hatcheries operating in Alabama, hatching more than 18 million chicks each week. This intensive industry demands a high degree of sanitation to control diseases and to maintain chick quality and production levels. This means a hatchery's sanitation program must be effective, but also carefully administered to ensure microbial populations are reduced without creating resistant or adapted strains of microorganisms.

Historically, it has been recommended that chemical disinfecting programs for hatcheries rotate chemicals periodically to avoid the development of resistant strains. Although this recommendation seems sound, little or no scientific research has been conducted to support or contradict this premise. An Alabama Agricultural Experiment Station study was undertaken to test this supposition under defined laboratory conditions.

The study compared the efficacies of two commonly used hatchery phenolic detergents when used either individually on a repeated basis or used in rotation with one another over extended periods of time. Experimentation was performed with *Pseudomonas aeruginosa*, a bacterium that has shown some intrinsic resistance to phenolic compounds.

The two germicidal detergents used were an alkaline phenolic compound (pH 10.4 at use dilution) and an acidic compound (pH 2.6 at use dilution). The active ingredients of each are shown in the table. Treatments included no germicide (water control), the alkaline phenolic compound applied on a repeated basis, the acidic compound applied on a repeated basis, and the two compounds applied on an alternating basis (rotational application).

To evaluate these treatments, the test bacteria were cultured in laboratory plates and the various treatments were applied. These samples were incubated for 48 hr. and zones of inhibition were measured around the treated areas to determine the degree of control. Various specimens were then transferred to new plates and further tested over an extended period of time.

Data show that the test bacteria eventually became resistant to the disinfectants when applied on a repeated basis. This resistance led to an apparent loss of initial activity of the disinfectants, as illustrated in the figure. No loss of activity occurred with either disinfectant when applied in rotation, indicating that very little resistance developed.

This suggests that the repeated use of a single disinfectant treatment resulted in the development of a bacterial population with increased resistance, but rotationally applying these detergent disinfectants prevented the development of resistance. This study illustrates that bacteria cannot adapt to disinfectants as rapidly when treatment is applied on a rotational basis as compared to a repeated basis. These results provide evidence to support the efficacy of rotating antimicrobial agents to prevent the development of resistant microorganisms and ensure the success of a sanitation program.

It should be noted that the two disinfectants used in this study are chemically compatible (varying primarily in pH) and lend themselves to a rotational system. Compatibility of agents should be a major consideration in any rotational program because incompatible chemicals might render the two compounds ineffective as antimicrobial agents.

GERMICIDES USED IN ROTATIONAL APPLICATIONS IN BROILER HATCHERIES

| Germicide[1] | Use dilution | pH at use dilution | Active ingredients | Active ingredient concentration at use dilution |
|---|---|---|---|---|
| | *Pct.* | | | *Pct.* |
| Alkaline phenolic detergent | 0.4 (1:256) | 10.4 | Na o-phenylphenate | 0.04 |
| | | | Na o-benzyl-p-chlorophenate | .04 |
| | | | Na p-tertiary-amylphenate | .01 |
| | | | Total | .09 |
| Acidic phenolic detergent | .4 (1:256) | 2.6 | o-phenylphenol | .03 |
| | | | p-tertiary-amylphenol | .03 |
| | | | Total | .06 |

[1]Calgon Vestal Laboratories, St. Louis, Mo. Distributed by Sanofi Animal Health Inc., Overland Park, Kan.

Conner is Assistant Professor and Eckman is Professor of Poultry Science.

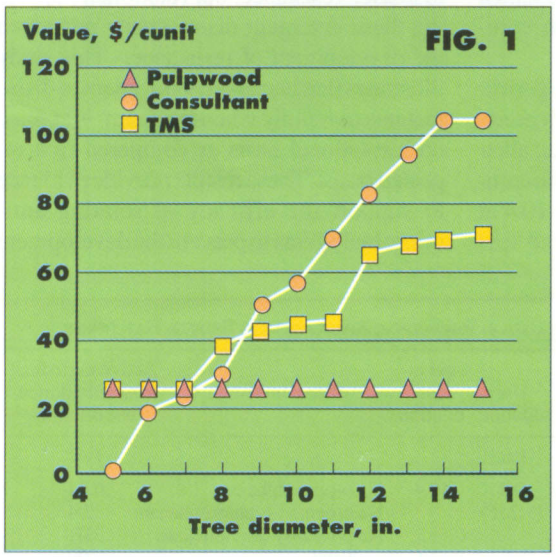
J.P. CAULFIELD, D.B. SOUTH, AND G.L. SOMERS

# TREE SIZE AND VALUE AFFECTS PINE PLANTING DENSITY DECISIONS

PLANTING densities for southern pine tree plantations range from 300 to 1,100 trees per acre (tpa), and average 700 tpa. While the correct planting density for a given situation requires input from individual landowners or managers, recent Alabama Agricultural Experiment Station research indicates lower planting densities than those traditionally used may be more economically sound.

The objectives of this study were to describe and analyze the types of price-size curves that can exist, and the situations to which they apply.

The shape and slope of a price-size curve depends on the value of the intended end-product of the harvested trees. The simplest case is a horizontal line of price per unit product volume over tree diameter, in which per unit volume does not vary with tree size. This relationship reflects a situation where landowners sell a single product, such as pulpwood. In figure 1, for the curve referred to as the Pulpwood price-size curve, price is a constant $25 per cunit of timber sold (1 cunit = 100 cubic feet of wood).



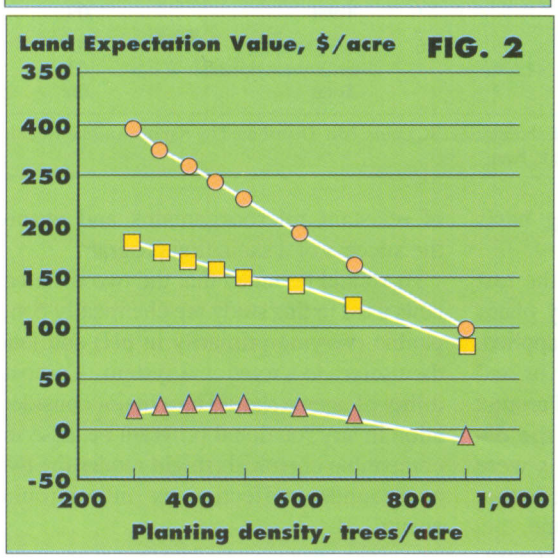




FIG.1. (top) Three different price-size curves.
FIG.2. (bottom) Stand value over density for three price-size curves.

A positively sloped price-size curve means that a market exists for trees to be sold for increasingly higher value products as tree diameter increases. For example, a 14-in. diameter tree contains some volume in large sawtimber, chip-and-saw sawtimber, and pulpwood. Figure 1 shows two positively sloped price-size curves for loblolly pine: one using data from Timber Mart South, a timber price reporting service (the TMS curve); and the other from a forestry consultant (the Consultant curve). Both curves recognize a price premium paid for larger, versus smaller diameter trees. Therefore, when landowners grow products such as sawtimber, the price-size curves can be used to help make planting density decisions.

Prices used to construct the TMS curve came from timber prices in southern Alabama and the Consultant curve came from price data gathered in Georgia. Different product merchantability limits also were used to construct each curve. Each timber seller has a curve that applies to his situation, and this curve will influence planting density decisions.

The economically correct planting density can be determined for each price-size curve by calculating the Land Expectation Value (LEV) for different planting densities. LEV is a financial measure used to compare investments where cash outflows and inflows occur at different points in time. Densities ranging from 300 to 900 tpa were evaluated in this study. The density with the highest LEV is the most desirable.

A large cash outflow occurs at the time of stand establishment (for site preparation, seedling purchase, and planting costs) and an inflow occurs from timber sales when the stand is eventually harvested. Because people value a dollar received today more highly than a dollar received in the future, these cashflows must be adjusted, or discounted at some interest rate, to a common point in time (the rate used here was 6%). The LEV measure discounts these cashflows to the present, the year when the stand is established.

Figure 2 shows the LEV in dollars per acre, plotted over planting density, for the three price-sized curves. The type of curve bears directly on the density decision. For the pulpwood curve, maximum LEV occurs at a density of about 450 tpa. At lower and higher densities LEV is somewhat lower.

For the TMS and consultant curves, LEV is at a maximum at the lowest planting density of 300 tpa. Trees put on diameter growth more rapidly at lower densities than at higher densities. Since the TMS and consultant price-size curves place more value on larger diameter versus small diameter trees, they indicate lower planting densities are appropriate. It is seen in figure 2, that at densities higher than 300 tpa, LEV slowly drops off.

Although the results shown here should not be interpreted as a set of general guidelines, they do indicate that lower planting densities than those traditionally employed may be appropriate in many cases. Most important, the price-size relationship that exists for a specific situation, along with a knowledge of rotation age, site quality, and management costs, can be used to determine the appropriate planting density for almost any landowner.

Caulfield, South, and Somers are Associate Professors in the School of Forestry.

P. JIN, R.T. GUDAUSKAS, D.J. COLLINS, A.K. HAGAN, J.M. MULLEN, AND P.L. MASK

# SOILBORNE WHEAT MOSAIC IN ALABAMA

SOILBORNE wheat mosaic was found for the first time on wheat in Alabama just 3 years ago. However, research by the Alabama Agricultural Experiment Station over the past 2 years has shown that this viral disease is widespread in the State, and some wheat cultivars are more susceptible than others, as shown in the table.

The causal agent of this disease is the soilborne wheat mosaic virus (SBWMV). SBWMV particles are hollow, rigid rods that are submicroscopic in size. The virus persists in the soil in association with the plant parasitic fungus, *Polymyxa graminis* Led. SBWMV-contaminated spores of the fungus may survive in soils for years. Eventually, the resting spores germinate, releasing motile zoospores into the soil. Wheat plants become infected with SBWMV when zoospores carrying the virus penetrate wheat roots, usually during wet, cool periods in the fall or early winter. The virus then multiplies and moves throughout the plant and symptoms develop on infected plants in late winter and early spring. SBWMV is spread by anything that disperses infested soil, such as wind, water, cultivation, and animals.

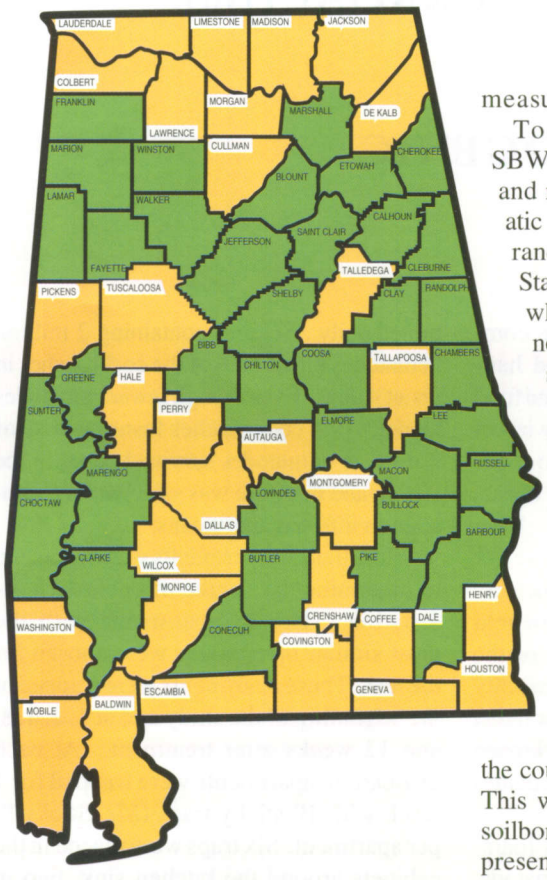



**FIG. 1. (Above right:) SBWMV infected wheat. FIG. 2. (Above) Distribution of soilborne wheat mosaic in Alabama, shown in yellow.**

The most obvious symptoms of soilborne wheat mosaic are the elongated streaks or stripes of various shades of green and yellow that develop in a mosaic pattern on the leaves of infected plants, figure 1. Mild to severe stunting of plants, reduced tillering, and even plant death also may occur. Disease development usually ceases when temperatures exceed 68°F. The overall effects of soilborne wheat mosaic on wheat vary depending on a number of factors, however, significant losses have been reported when susceptible wheat cultivars were grown continuously for a number of years. While crop rotation and late planting may reduce the disease, use of resistant or tolerant cultivars is the best control measure for soilborne wheat mosaic.

To determine the distribution of SBWMV in Alabama, samples of leaves and roots were collected from symptomatic and asymptomatic wheat plants in randomly selected fields throughout the State. Samples also were taken from wheat plants received at the Plant Diagnostic Laboratory at Auburn University, and from plants received from personnel in county Cooperative Extension Service offices, the Alabama Department of Agriculture and Industries, and the USDA Animal and Plant Health Inspection Service. Samples were tested for SBWMV by enzyme-linked immunosorbent assay using antiserum developed to an Alabama isolate of the virus.

To date, SBWMV has been found in at least one field in each of the counties shown on the map, figure 2. This widespread occurrence indicates that soilborne wheat mosaic likely has been present in Alabama for sometime, and that it previously was overlooked or attributed to other causes.

More than 70 wheat cultivars have been evaluated for reactions to SBWMV in tests on farmers' fields and in regular small grain variety trials throughout the State. Results from those tests indicate there are apparent differences in susceptibility to the virus, see table. Effects of the virus on performance and yield of these cultivars were not determined. However, in one test on a farmer's field in north Alabama, grain yields from plots with a high incidence of SBWMV were 65% lower than those in which only a few plants appeared to be infected.

These studies have established the widespread nature and potential importance of SBWMV and the need for continued research on this newly-recognized pathogen of wheat in Alabama.

SOILBORNE WHEAT MOSAIC RATINGS FOR SOME WHEAT ENTRIES IN 1991 SMALL GRAIN VARIETY TEST, WIREGRASS SUBSTATION

| Cultivar | Rating[1] Early planting | Late planting |
|---|---|---|
| Bayles | - | 2.00 |
| Caldwell | .33 | - |
| Coker 916 | - | 1.00 |
| Coker 983 | .33 | .00 |
| Coker 9733 | 3.67 | .00 |
| Coker 9766 | .33 | 1.00 |
| Coker 9835 | - | 3.00 |
| FFR 525W | 1.67 | - |
| Florida 302 | 3.67 | 5.00 |
| Florida 303 | - | 4.00 |
| GA Andy | - | 1.00 |
| GA Gore | 2.33 | 4.00 |
| Massey | 1.00 | - |
| Pioneer 2548 | 4.00 | - |
| Pioneer 2555 | .67 | - |
| Saluda | 1.00 | - |
| Terral 101 | .00 | - |
| Traveler | 4.00 | 4.00 |
| Wakefield | .00 | 3.00 |
| Williams | 1.33 | 1.00 |

[1]0-5 scale; 0 = no apparent symptoms, 5 = severe mosaic/striping.

Jin is Graduate Research Assistant, Gudauskas is Professor, Collins is Assistant Professor, Hagan is Professor, and Mullen is Plant Pathologist/Diagnostician in Plant Pathology; Mask is Associate Professor of Agronomy and Soils.

A.G. APPEL, E.P. BENSON, AND J.M. ELLENBERGER

# BIOLOGICAL CONTROL OF GERMAN COCKROACHES WITH ENTOMOPATHOGENIC NEMATODES

**Development of biological control agents, such as nematodes, may provide an environmentally sound alternative to conventional insecticides**

GERMAN cockroaches are common pests in homes, food handling facilities, hospitals, and food storage areas. Unlike many insect pests of agricultural crops, there are no effective and practical biological control agents available for German cockroaches. Even though many insecticides are effective for cockroach control, disadvantages include: objectionable odors, staining of household materials, physiological resistance of the cockroaches to the insecticides, and inability to use near food. In addition, the hot moist environments that the German cockroach prefers tend to degrade many insecticides rapidly.

The 0.02 in. long entomogenous (parasitic inside the body of insects) nematode, *Steinernema caroocapsae*, survives well in warm moist environments and infects and kills many agricultural and urban insect pests. Development of biological control agents, such as nematodes, for German cockroach control may provide an environmentally sound alternative to conventional insecticides and would be particularly valuable for some sensitive locations.

In an Alabama Agricultural Experiment Station test, nematodes were confined in moisture retaining stations because of their need for a moist environment in which to move and feed. The optimum number of nematodes per station was determined in laboratory experiments by selecting several doses of nematodes to be applied in stations and determining how toxic the stations were to German cockroaches. In these studies, 20 male cockroaches were confined in a plastic shoe box with food, water, and a nematode station. There were six replicates for each treatment. Cockroach mortality was determined daily. Stations containing 2 million nematodes killed 50% of the cockroaches in about 4 days. Even though fewer nematodes tended to kill cockroaches faster, a dose of 2 million nematodes survived better in the station and this dose was selected for evaluation in infested apartments.

More than 50 apartments were inspected to determine the degree of cockroach infestation. The 18 apartments with the most similar infestations were chosen for the test. These apartments were trapped at the beginning of the study and at 1, 2, 4, 8, and 12 weeks after treatment. At each evaluation, apartments were trapped for 1 week with 10 sticky traps (Mr. Sticky®) per apartment. Six traps were placed in the cabinets around the kitchen sink, two in the pantry, and one each behind the stove and refrigerator.

Apartments were treated with either 12 nematode exposure stations, 12 insecticidal bait stations (Combat/Maxforce®), or were left untreated at the request of the residents. Nematode or insecticidal stations were positioned throughout the kitchen: two behind the stove, two behind the refrigerator, six in the cabinets around the sink, and two in the pantry. After treatment, the average number of cockroaches trapped per treatment was determined, and the percent change from the pretreatment average was calculated.

Apartments treated with nematodes or insecticidal bait had reduced trap catch relative to the untreated control apartments at weeks 1 to 4 after treatment. Reductions for both treatments improved from about 40% after 1 week to more than 50% at week 4. German cockroach trap catch increased approximately 23% during the same period. Thereafter (weeks 8 and 12) only the nematode treatment was better than the control.

In this first study of nematodes against populations of German cockroaches, performance was as good as the standard insecticidal bait treatment. The maximum percent reduction was only 67%, but further studies will likely increase performance. This nematode product is the first true biological control organism tested that is both practical and effective for German cockroach control.

Appel is Associate Professor, Benson is Assistant Professor, and Ellenberger is Research Technician IV of Entomology.

PERFORMANCE OF NEMATODES AND INSECTICIDAL BAIT AGAINST GERMAN COCKROACHES IN INFESTED APARTMENTS

| Treatment[1] | Cockroaches/ apartment pretreat, average | Reduction of cockroaches/apartment, average at | | | | |
|---|---|---|---|---|---|---|
| | | 1 week | 2 weeks | 4 weeks | 8 weeks | 12 weeks |
| | No. | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| Nematodes | 326.67 | 33.78 | 39.89 | 52.03 | 67.13 | 57.47 |
| Combat | 384.33 | 45.07 | 42.26 | 53.11 | -19.59[2] | - 3.89 |
| Control | 225.44 | -26.75 | -23.69 | -17.99 | -35.45 | -69.18 |

[1]Six apartments in each treatment.
[2]Negative percent reduction indicates an increase in cockroach numbers.

B.R. MOSS, J.C. LIN, AND R.C. SMITH, III

# Feather Meal as a Protein Source for Dairy Cows

FEEDING feathers to dairy cows? Not exactly, but a recent Alabama Agricultural Experiment Station (AAES) study evaluated the use of feathermeal for dairy cows and suggests there is potential for feeding this by-product of the poultry industry.

Alabama's poultry industry processes tons of feathers annually, providing a meal that is high in protein (70%). Dairy cows require large amounts of protein and in Alabama, due to the poor protein content of most forages, producers must purchase large amounts of protein supplements. Feather meal (FM) is usually priced about the same as soybean meal (SBM), even though FM is higher in protein than SBM. Therefore, FM may be an economical alternative to SBM for Alabama producers.

Feeding FM to beef cattle has produced favorable results, especially when fed in combination with other products. Very few FM studies have been conducted with dairy cattle, but is of interest because feather meal contains protein, which is considered

***Feather meal may be an economical alternative to soybean meal for Alabama producers***

to have high "by-pass." However the amino acid composition may be limiting for milk production. Several trials were conducted at the E.V. Smith Research Center Dairy Unit to evaluate FM for dairy cows.

Twenty lactating Holsteins were fed one of five diets (treatments) for 12 weeks. All diets had similar amounts of corn silage, alfalfa hay, ground corn, oats, dried fat, minerals, and buffers, but differed in protein source. Treatments were total mixed diets (TMD) with one of the following protein bases: (1) 18.8% SBM; (2) 4.0% FM and 12.0% SBM; (3) 8.0% FM and 5.9% SBM; (4) 4.0% FM. 4.0% BM (bloodmeal), and 5.0% SBM; (5) and a low protein (14.0%) diet with 4.0% FM and 4.8% SBM. The first four diets were formulated to meet requirements for about 70 lb. of milk per day. The final diet was a low protein diet to determine if the protein concentration (17%) in diets 1-4 was really needed. In diets 2-5, SBM and corn were adjusted with FM or BM to obtain desired protein content.

Cows were fed twice a day at 7 a.m. and 2 p.m. and milked at 1 a.m. and 1 p.m. Individual feed intakes were determined daily and weekly samples were taken on all feeds. Milk yields for each milking were recorded and weekly samples were taken for milk fat and protein analyses. Body weights were measured every 4 weeks and blood samples also were taken from all cows every 4 weeks to determine if a difference in the amount of protein degraded in the rumen existed.

Average values of milk yields, composition, and body weight changes are shown in the table. Cows in early lactation, with a negative energy balance, often respond to protein supplements that have a high by-pass component by increasing milk yield. In this study, the addition of FM or FM plus BM did not significantly increase milk production in early lactation even though there was a trend toward higher production. Interestingly, milk production for the control and low protein diets was not different, whereas the normal protein diets containing FM resulted in greater milk production than the low protein diet.

The milk fat content from cows fed diets containing FM or BM also tended to be greater (3.63%) than those fed SBM alone (3.43%), but was not enough to cause major differences in the 3.5% fat-corrected milk.

In this study, FM depressed milk protein, with more depression at the 8% concentration than the 4% concentration of FM. Addition of BM did not improve milk protein. Low dietary protein in treatment 5 depressed milk protein more than 4% FM alone in treatment 2. This reduced milk protein may be due to decreased protein quality, availability, or digestibility.

Cows increased body weights on all diets with no difference due to treatment.

The dry matter intake (DMI) was slightly reduced for cows fed diet 2 reduced more for cows on diets 3, 4, and 5 than for cows fed diet 1. Palatability problems with FM also occurred in earlier trials, but is not always a problem. In this study, the FM diet reduced DMI but the feed efficiency was better for cows fed FM than SBM.

The plasma urea nitrogen concentration indicated that there was not a major difference in the rumen degradation of the high protein diets with or without SBM or FM.

Feed cost (Cost per 100 lb. dry matter of feed) was lower for TMD with 4 or 8% FM when current prices ($200.00 per ton for SBM and FM; $400 of BM) were used, but BM increased cost per hundred weight of feed. The low protein TMD (4) was the least costly, but milk production was lower. Use of FM could have a strong promise for the future as an economical feedstuff for lactating cows, if not fed at more than 4% (dry matter basis) of FM in the diet. Additional studies on FM in combination with other feeds are needed to further explore its potential.

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

Milk Yield and Composition, Feed Intake, and Body Weight Changes of Lactating Dairy Cows Fed Various Protein Supplements

| | Diets | | | | |
|---|---|---|---|---|---|
| | SBM | 4%FM | 8%FM | FM+BM | LP-4%FM |
| Yields, lb/d | | | | | |
| Milk | 74.1 | 76.2 | 76.1 | 76.7 | 71.9 |
| FCM* | 73.7 | 77.8 | 77.7 | 78.1 | 72.7 |
| Milk composition, % | | | | | |
| Fat | 3.43 | 3.63 | 3.62 | 3.63 | 3.61 |
| Protein | 3.28 | 3.20 | 3.10 | 3.12 | 3.04 |
| Body weight changes, lb/d | .95 | 1.45 | 1.21 | .99 | .79 |
| Intake, lb/d dry matter | 57.4 | 54.2 | 49.2 | 52.3 | 49.1 |
| Feed efficiency DMI/milk | .77 | .71 | .64 | .68 | .68 |
| Plasma urea N mg/dl | 17.8 | 17.8 | 17.9 | 18.4 | 11.2 |
| Cost/cwt of feed dry matter, $ | 6.83 | 6.68 | 6.58 | 7.04 | 6.29 |

FCM = Fat corrected milk.

H.A. TORBERT, C.W. WOOD, AND D.P. DELANEY

# Poultry Litter Has Promise as a Fertilizer for Bermudagrass

Bermudagrass hay fertilized with poultry litter.

USING poultry litter as a fertilizer for bermudagrass may provide an environmentally sound disposal method for this by-product of Alabama's flourishing poultry industry, and at the same time produce high yielding, high quality bermudagrass.

Poultry production is growing rapidly in the U.S., especially in the Southeast where production in Alabama alone has increased 48% since 1986. Associated with this production is a massive quantity (2 million tons per year) of poultry litter, which is a combination of bedding material, feed, and manure that collects on the floor of chicken houses. Environmentally sound disposal methods for this waste material are essential to maintain the sustainability of the poultry industry.

Poultry litter typically has been applied to tall fescue pastures, particularly in the Sand Mountain region where poultry production is concentrated. Though this provides a way to recycle nutrients in poultry litter back into the land, continuous applications to relatively small production areas can pose potential water quality problems. An Alabama Agricultural Experiment Station (AAES) study evaluated poultry litter as a source of nitrogen (N) fertilizer on bermudagrass pastures as an alternative disposal method.

Bermudagrass is a high yielding, high quality forage often used for hay production. This forage also has a high nutrient requirement and is extremely efficient in taking up N from the soil. The AAES study was conducted on Wynnville fine sandy loam soil near Snead to determine the impact of poultry litter on bermudagrass yield and quality. Treatments included three rates of poultry litter (2.5, 5.0, and 10.0 tons per acre), three rates of ammonium nitrate (100, 200, or 300 lb. N per acre in a split application), and a control treatment (0 lb. per acre). Hay was harvested in six cuttings during a 2-year period and yield and quality measurements were taken.

Yield response of bermudagrass to either N source during the 2-year study was comparable among treatments, as shown in the table. However, ammonium nitrate did perform better at the 200 lb. per acre rate compared to the 5 tons per acre rate of poultry litter. This difference probably occurred because much of the N in poultry litter is not immediately available to plants and, at this rate, there likely was a lack of available N at some point during the growing season. The 10-tons-per-acre rate provided N at a rate equivalent to 300 lb. per acre of ammonium nitrate.

Bermudagrass Yield and Quality Factors as Affected by N Source and Rate at Snead, Alabama

| N source | Yield | Crude protein | TDN[1] | Crude fiber | $NO_3$-N | Ca | K |
|---|---|---|---|---|---|---|---|
| | *Tons/ac.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| No fertilizer | 2.6 | 8.1 | 5 5.5 | 30.6 | 0.021 | .26 | 1.04 |
| **Ammonium-nitrage, lb./ac.** | | | | | | | |
| 100 | 9.8 | 8.7 | 55.1 | 30.9 | .018 | .26 | 1.03 |
| 200 | 14.6 | 10.3 | 53.7 | 31.2 | .019 | .25 | .89 |
| 300 | 16.6 | 12.2 | 52.6 | 32.5 | .023 | .26 | .85 |
| **Poultry litter, tons/ac.** | | | | | | | |
| 2.5 | 9.4 | 8.6 | 54.5 | 31.3 | .020 | .26 | 1.29 |
| 5 | 13.3 | 9.7 | 53.3 | 32.1 | .021 | .28 | 1.43 |
| 10 | 17.6 | 11.9 | 53.2 | 32.1 | .058 | .31 | 1.73 |

[1] TDN = total digestible nutrients.

Bermudagrass quality, measured by the concentration of crude protein, total digestible nutrients, and crude fiber, increased as the rate of ammonium nitrate and poultry litter increased, but no difference was observed between N sources, see table. Crude protein content of bermudagrass increased with increasing N application, with the highest rate of ammonium nitrate closely matching the highest rate of poultry litter. However, bermudagrass calcium and potassium concentrations were improved by poultry litter compared to ammonium nitrate, see table.

Nitrate ($NO_3$-N)concentrations in forages are a potential source of toxicity problems for livestock. While the 10-tons-per-acre treatment did increase nitrates in the forage up to 0.058%, this concentration is well below the 0.12% critical limit for feeding. This suggests that nitrate concentrations in bermudagrass fertilized with poultry litter should not affect feeding quality of bermudagrass hay.

The results of this study indicate that poultry litter can be used as an alternative N source for bermudagrass hay production. Yield and quality of bermudagrass amended with poultry litter was as good or better than bermudagrass amended with ammonium-nitrate. Therefore, the use of poultry litter as a N source for bermudagrass hay could be an economical and environmentally sound method of utilizing this waste product, providing a sustainable practice for bermudagrass production. In addition, using poultry litter on bermudagrass may provide farmers with year-round application options for broiler litter by growing bermudagrass, a warm-season grass, along with fescue, a cool-season forage.

Torbert is Post Doctoral Research Associate and Wood is Assistant Professor of Agronomy and Soils; Delaney is an Extension Resource Conservationist.

J. WONG-VALLE, G.R. MCDANIEL, D.L. KUHLERS, AND J.E. BARTELS

# Incidence of Tibial Dyschondroplasia and Performance of Broilers Under Two Lighting Programs

TIBIAL dyschondroplasia (TD) is a common leg abnormality in rapidly growing broilers that often reduces productivity of these birds. Altering photo periods, or light, during the first few weeks of production has been suggested as a means for overcoming TD, however, recent Alabama Agricultural Experiment Station research indicates use of intermittent light to reduce the disease is ineffective.

Chicks selected for low incidence of TD.

A total of 1,010 broiler chicks of both sexes was used from three lines of broilers: a high, a low incidence of TD at 7 weeks of age, and a control or nonselected line. The 350 control, 300 high, and 360 low chicks were from generation two of a selection experiment for high or low incidence of TD at 7 weeks of age. A low intensity x-ray imaging Lixiscope was used for TD diagnosis. Two lighting programs were tested; (1) continuous light, 23 hr. of light and 1 hr. of dark, and (2) intermittent light, 1 hr. of light followed by 3 hr. of dark repeated six times in a 24 hr. period.

Tibial dyschondroplasia was recorded as 0, for normal broilers, or 1, for broilers with an abnormal mass of cartilage accumulation in the proximal tibiotarsus, indicating TD. Body weight gain and feed efficiency were calculated for 0 - 4 and 4 - 7 weeks of age. Birds were fed a standard broiler diet.

The percentage incidence of TD at 4 weeks of age was 15, 30, and 5% for the control, high, and low lines, respectively. At 7 weeks, incidence of TD was 34, 47, and 11% for the control, high, and low lines, respectively. At 4 weeks of age, incidence was 21 and 12%, and at 7 weeks was 37 and 25% for males and females, respectively.

Body weights of the high and low lines were similar at 4 and 7 weeks of age. However, the high and low lines were heavier than the control line. At 4 weeks, body weights were 40, 42, and 43 oz. and at 7 weeks were 79, 80, and 91 oz. for the control, high, and low lines, respectively. The effect of TD on body weights was studied in birds from the high and control lines.

Incidence of TD was reduced by intermittent light only in birds from the control line. The response of the high and low lines was the same in continuous or intermittent light at 4 weeks. In contrast, the average response of the selected lines within each treatment was significantly different at 4 and 7 weeks of age from that of the control line. The average incidence of TD of the high and the low lines was 17.6 and 15.7% at 4 weeks and the same at 7 weeks in the two lighting programs. In the control line, incidence of TD was 22.6 and 77.4% at 4 weeks and 38.8 and 28.7% at 7 weeks in the lighting programs, respectively.

Intermittent light was only able to reduce the incidence of TD in the control line, thus body weights of the high and low lines were similar at 4 and 7 weeks of age. However, the high and low lines were heavier than the control line. At 4 weeks, body weights were 34, 36, and 37 oz. and at 7 weeks were 80, 81, and 82 oz. for the control, high, and low lines, respectively.

The effect of TD on body weights was studied in birds from the high and the control lines. TD had an effect on body weights at 4 and 7 weeks and the effect was the same across lighting programs and sexes. At 4 weeks of age, broilers with TD were 1.2 oz. heavier than broilers without TD. At 7 weeks of age, broilers with TD were 1.7 oz. lighter than those without TD. It is possible that the effect of TD on body weights depends on the age of the broiler and the severity of the TD lesions.

Wong-Valle is a Former Research Associate and McDaniel is Professor of Poultry Science; Kuhlers is Professor of Animal and Dairy Sciences; Bartels is Professor of Radiology.

A.K. HAGAN, J.R. WEEKS, AND K.L. BOWEN

# New Fungicides Promise Better White Mold Control on Peanuts

WHITE mold has consistently been the most damaging disease of peanuts in Alabama, cutting expected peanut yields by nearly 20% annually. Yield in fields heavily infested with white mold may plummet 40% below those a peanut producer might expect. Alabama Agricultural Experiment Station research has shown that the experimental fungicides Folicur 3.6F® and Moncut 5OW® give better control of white mold and higher yield response in recent field studies than previously obtained with currently registered fungicides.

Fungicidal Effect of White Mold Infection and Yield in Peanuts

| Treatment | White mold hits/100 ft. of row | Yield/ acre |
|---|---|---|
| | *No.* | *Lb.* |
| **1989** | | |
| Terraclor 10G | 10.7 | 3,894 |
| Moncut 50W | 2.1 | 4,154 |
| Folicur 3.6F | 2.8 | 4,466 |
| Nontreated control | 14.2 | 3,686 |
| **1990** | | |
| Terraclor 10G | 4.2 | 3,740 |
| Moncut 50W | 1.4 | 3,970 |
| Folicur 3.6F | 2.0 | 3,682 |
| Nontreated control | 9.8 | 3,405 |
| **1991** | | |
| Terraclor 10G | 18.8 | 3,209 |
| Moncut 50W | 1.8 | 4,662 |
| Folicur 3.6F | 2.8 | 4,592 |
| Nontreated control | 25.3 | 2.945 |

Data are averages for three farms in 1989 and 1990 and one farm in 1991.

Fungicidal activity of Moncut and Folicur against white mold was compared with that of Terraclor in a series of on-farm trials from 1989 to 1991. Terraclor 10G® was applied 80 to 90 days after planting at 50 lb. per acre on a narrow band. Full canopy sprays of Moncut were made 60 and 75 days after planting in 1989, and at 60 days in 1990 and 1991. Folicur also was sprayed at 60 and 75 days in 1989 and 1990, and a third spray was made at 90 days in 1991. White mold hit counts (one hit = 1 ft. of row with one or more diseased plants in 100 ft. of row) were made after the peanuts were inverted, and the plots were then harvested with a field combine. Data are averages for three farms in 1989 and 1990 and one farm in 1991, as shown in the table.

In 1989, reductions in white mold damage, as measured by the number of white mold hits, were obtained with all fungicides. Folicur and Moncut proved equally effective against white mold, and both gave disease control superior to that of Terraclor. Peanut yield was increased by all fungicides. The best yield response of 790 lb. per acre more than the control value was obtained with Folicur. Yields in the Moncut and Terraclor treated plots were 480 and 208 lb. per acre, respectively, higher than those in the nontreated control.

A severe summer drought in 1990 reduced white mold damage on peanuts. Again, less disease was seen in the fungicide-treated plots than the nontreated controls. Folicur and Moncut continued to give better protection from white mold than Terraclor. Yields were 277-565 lb. per acre higher in the treated plots than the nontreated control. Highest yield gains were seen in the Moncut-treated plots. Surprisingly, yield in the Terraclor treated plots was similar to those treated with Folicur.

At a single location in 1991, Moncut and Folicur gave excellent control of white mold. Despite severe disease pressure, both fungicides reduced disease damage by nearly 90%. Terraclor provided some suppression (26%) of white mold, but failed to give the level of disease control seen with the other two fungicides. Yields were increased following treatment with either Folicur and Moncut by approximately 1,650-1,700 lb. per acre. Yield gains of 264 lb. per acre were seen in the plots treated with Terraclor.

**White mold reduces Alabama peanut yields by 20% annually.**

Folicur and Moncut fungicides have been shown to have activity against white mold on peanuts superior to that of the only currently available fungicide, Terraclor. Over a 3-year period, both fungicides consistently reduced white mold damage on peanuts by 80-90%, compared to 26-57% damage reduction with Terraclor. Under heavy disease pressure, Folicur and Moncut effectively controlled white mold while Terraclor failed to protect peanuts from this disease. Yield was increased above those of the nontreated control by all fungicides.

Largest yield gains generally were obtained with Moncut and Folicur. Under moderate to severe disease pressure, yield response was far better with Moncut and Folicur than with Terraclor. When little white mold damage occurs, yield gains with both Folicur and Moncut have been modest.

Folicur and Moncut offer the possiblity of largely eliminating yield loss due to white mold on peanuts. Terraclor and soil insecticides, such as Lorsban®, Mocap®, and Dyfonat®e have been effective only under light to moderate disease pressure in past research. None of these products gives much protection from the destructive white mold outbreaks seen each year in some Alabama peanut fields.

Hagan is Associate Professor of Plant Pathology; Weeks is Associate Professor of Entomology; Bowen is Assistant Professor of Plant Pathology.

J.F. KABILIGI, B.R. MOSS, J.L. HOLLIMAN, AND D.I. BRANSBY

# COMPARISON OF THREE TALL FESCUE CULTIVARS AND CORN SILAGE FOR DAIRY COWS

**Even though corn silage may support more milk production during extended periods, similar milk production can be obtained for short periods of time on noninfected tall fescue**

TALL FESCUE is one of the most widely grown forage crops in the United States; however an endophytic fungus, *Acremonium coenophialum*, has been associated with tall fescue toxicity that severely depresses milk production. Recent Alabama Agricultural Experiment Station tests indicate that fungus-free fescue can be used effectively for grazing dairy cattle.

Studies concerning the nutritive value of the newly developled fungus-free fescue varieties for dairy cows are limited. In tests at the Black Belt Substation, Marion Junction, performance of lactating cows was evaluated when grazing AU Triumph (AU-T) and Johnstone, two popular fungus-free varieties, and Kentucky 31(Ky-31) tall fescue pastures (noninfected), or when fed corn silage.

For each of the cultivars studied, two 2-acre pastures were established in the fall of 1988. The study was conducted for 4 weeks during the fall and for 6 weeks during the spring of 1989-90 and 1990-91. Available forages in the pastures were measured and sampled weekly. Cows on the pasture treatments were rotated from one pasture to its replicate on a weekly basis and received a 16% crude protein (CP) grain mix supplement (1 lb. per 2.75 lb. of 3.5% fat-corrected milk) after milking. Cows on the corn silage treatment received corn silage, hay, and a 20% CP grain mix based on milk production. Cows on silage were kept in a dry lot, but cows on other treatments were kept on pasture except during milking and grain-feeding times.

Results indicated that AU-T tended to be the tallest and have the largest amount of available dry matter per acre, see table 1. Chemical analyses indicated that forage protein content was less and fiber values greater for AU-T than for Johnstone, resulting in greater energy for milk production. However, Johnstone could not be grazed as long in the spring because available forage was limited.

Cows on pasture consumed less of the grain offered than those fed silage, see table 2. Despite some seasonal differences, actual milk yield was generally similar for all treatments. Cows grazing Johnstone produced more milk overall than those grazing AU-T, but their production was similar to those grazing Ky-31 and to those fed silage for both years.

Cows grazing the AU-T pasture produced less milk than others during the spring of each year. However, this decreased production was compensated by an equal or greater yield during the fall, making the yearly averages of AU-T similar to those of other treatments. The greater milk production on Johnstone as compared to other pastures was probably due to greater values for CP and energy. The fat and protein in milk were not affected by treatment.

More desirable body weight change patterns were observed for cows fed corn silage than for those grazing the various fescues. Data also show that cows in early lactation (fall) lose weight, whereas those in mid-lactation (spring) gain or maintain their weights. This indicates that cows in early lactation on pasture may have been using more body fat to produce milk. If kept on pasture longer, these cows would have lost more body weight or milk production might have decreased more with time than those on silage.

The results of the study suggest that Johnstone grows and matures slower than Ky-31 and AU-T tall fescue when the three cultivars are established under the same conditions. During spring seasons, milk production per day may be better on Johnstone than the other fescues, but carrying capacity may be more limited. Even though corn silage may support more milk production during extended periods, similar milk production can be obtained for short periods of time when cows are on high quality, endophyte free fescue pasture.

Table 1. Height, Dry Matter Available, Chemical Analysis, and Estimated Energy Values of the Treatment Pastures

| | Johnstone | Ky-31 | AU-T |
|---|---|---|---|
| Height, in. | 5.7 | 7.9 | 8.6 |
| Forage DM[1], lb/ac. | 842 | 1,282 | 1,407 |
| Nutrient content | | | |
| DM, % | 26.2 | 28.2 | 28.5 |
| CP, % of DM | 16 | 14.7 | 14.3 |
| ADF[1], % of DM | 32.1 | 35.6 | 36.4 |
| NDF[1], % of DM | 64 | 63 | 66.7 |
| NEL[1], Mcal/lb. | .66 | .57 | .53 |

[1]DM = dry matter; ADF and NDF = fiber; NEL = energy, lactating cows

Table 2. Milk, Milk Components, and Body Weight Changes by Cows Allotted to Treatments

| | Johnstone | Ky-31 | AU-T | Silage |
|---|---|---|---|---|
| Milk, lb./day | | | | |
| 89-90 Fall | 59.5 | 58.4 | 59.6 | 57.6 |
| Spring | 53.5 | 55 | 52 | 55.7 |
| 90-91 Fall | 53.1 | 53.7 | 55.1 | 56.4 |
| Spring | 57.7[12] | 54.6[1] | 50.3[3] | 58.03 |
| Body weight change, lb./day | | | | |
| Fall avg. | -2.38 | -1.64 | -1.78 | -1.22 |
| Spring avg. | 1.12 | .82 | 1.06 | 1.42 |
| Combined data | | | | |
| Grain intake, lb./day | 20.7 | 20.5 | 20.7 | 23.2 |
| Milk, lb/day | 55.9 | 55.4 | 54.3 | 57 |
| Milk fat, pct. | 3.65 | 3.7 | 3.66 | 3.79 |
| Milk protein, pct. | 3.14 | 3.15 | 3.14 | 3.22 |
| BWT change, lb./day | - .62 | - .40 | - .35 | - .09 |

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O.L. CHAMBLISS AND A.G. HUNTER

# GENEGREEN: A UNIQUE SOUTHERNPEA VARIETY RELEASED BY AAES

Genegreen growing at the E.V. Smith Research Center in Shorter. Inset: Peas of Genegreen show green seedcoat and blackeye.

GENEGREEN, the blackeye southernpea variety with a persistent green seedcoat, will be available to gardeners and fresh market growers next season as a result of plant breeding and genetic research by the Alabama Agricultural Experiment Station (AAES). The green seedcoat of Genegreen results from genetically delayed chlorophyll breakdown in the seedcoat of mature seed which consequently stays green until dry. It is named "Genegreen" because its persistent green seedcoat is controlled by a single gene, symbolized by *gt* (green testa).

YIELD OF GENEGREEN VS. OTHER SOUTHERNPEA VARIETIES

| Year | Genegreen | Pinkeye Purple Hull-BVR | Mississippi Silver |
|---|---|---|---|
| **Shelled yield, lb./a** | | | |
| 1986 | 1,541 | 1,654 | 2,048 |
| 1987 | 1,983 | 1,799 | 1,816 |
| **Shelled-imbibed yield, lb./a** | | | |
| 1988 | 3,951 | 3,411 | 3,929 |
| 1989 | 2,609 | 1,982 | 2,864 |
| Avg. | 2,623 | 2,250 | 2,741 |

[1]Average yield of Genegreen was not significantly different from Pinkeye Purple Hull-BVR and Mississippi Silver, the checks.

The the combination of a green seedcoat and a blackeye is the distinguishing characteristic of Genegreen, which is resistant to the most serious disease of southernpeas in Alabama, blackeye cowpea mosaic, a seed-borne virus. It has a slightly viney bush type growth habit and is considered medium early in maturity. Average pod length at the mature green stage is 7.5 in. Pods are green when fresh, medium brown when dry, and are held level with or above the foliage. Seeds retain their green color when dry, but may bleach to white if exposed to sunlight for 7-10 days after pods dry. Seeds are small to medium size and are oval to kidney shape, with a small black eye on an olive-green seedcoat.

The yield of Genegreen is similar to the popular varieties, Pinkeye Purple Hull-BVR and Mississippi Silver. Yield data in the table summarizes the results from the Southern Cooperative Trials. In most cases the yield is based on the weight of a hand shelled sample from an once-over harvest. These regional trials are usually conducted in Alabama, Arkansas, Georgia, Louisiana, Missouri, Oklahoma, South Carolina, Tennessee, and Texas (not all states participate every year).

Continuity and persistence of plant breeding and genetic programs were important contributing factors to the successful development of this new variety, representing a new horticultural type.

Genegreen is derived from a cross between Freezegreen, source of the *gt* gene, and an advanced blackeye breeding line, AU 71.3, which was developed by the pedigree method using the parent lines Giant Blackeye, Conch, and Princess Anne blackeye. Freezegreen was derived from a single gene mutation for seedcoat color from the cream-seeded Lady type, Ala. 963.8, known for its resistance to cowpea curculio. The pedigree breeding procedure was used to develop Genegreen, with the exception of one backcross to AU 71.3 following single plant selection for green seedcoat in the segregating generation. Green-seeded blackeyes were selected to the $F_5$ generation when seed were bulked for evaluation.

Genegreen seed have been increased and will be available soon in seed stores for planting in the 1993 growing season. Genegreen has excellent potential for success as a shelled fresh product on the roadside market and in the supermarket due to its appealing green color.

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

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