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ALABAMA AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY

HIGHLIGHTS

OF AGRICULTURAL RESEARCH

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ON THE COVER: Putting greens on the Robert Trent Jones courses, like the Grand National, are known for their high quality putting greens and lush fairways. See related story on page 12.

from the Director

Mother Nature dealt Alabama farmers a bad hand last year! Most areas of our state were devastated by unprecedented drought and heat. Peanut producers were particularly hard hit, but so were many Alabama cattle producers, who constantly moved cattle or bought hay. Even catfish producers suffered from high prices created by shortages of grain for feed. Perhaps the worst hit were the state's cotton producers, who had to endure both the drought and the worst infestation of tobacco budworms ever recorded in Alabama.

Though 1996 brought us a new year, weather related troubles continued for Alabama producers. Successive late winter, early spring freezes virtually wiped out the state's peach crop and played havoc with speciality crops like blueberries, strawberries, and blackberries. In addition to weather related problems, Alabama growers will suffer long-term from the closing of the USDA Agricultural Weather Information Service at Auburn. Rodger Getz, Karl Harker, Dave Ihle, and others at the Weather Service provided critical information for growers—and to researchers. They will be missed!

The Alabama Agricultural Experiment Station shares many things with farmers and livestock producers in the state. Unfortunately, one of them is the weather. Research projects at several of our research stations were decimated by everything from hurricanes to ice storms. Unlike farmers, we can benefit by hostile weather. Though the primary mission of many of our projects was negated by the weather, we learned valuable information as to how many crops react to prolonged drought, freezing temperatures, and other weather abnormalities. Hopefully, this information will help farmers and researchers alike cope with a common problem that we cannot do much about—the weather.

S u m m e r 1 9 9 6 V o l u m e 4 3 N u m b e r 2

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

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Delayed Planting May Help Corn Growth

Ellen M. Bauske, Paul L. Mask, Karl Harker, C. Dale Monks, and Joseph Kemble

Many corn producers believe that the best way to maximize corn yield is to plant as early as possible, but this may not always be true. AAES computer simulations indicate delayed planting in South Alabama can ensure that corn reaches its most critical growth stage during periods of peak rainfall.

Alabama growers generally plant corn from early March until mid-May. The most critical stage in corn development is during tasseling and silking. Drought, even for a short period of time during this stage, can cause serious yield reduction. Using a simulation model, AAES researchers correlated long-term weather patterns with plant developmental stages to best utilize natural rainfall in dryland crop production. Results of the study indicated that planting too early on farms in South Alabama can result in lower soil profile moisture at mid-silk.

Researchers used 30 years of weather data to drive the corn growth simulation model used to explore the relationship between planting date and soil profile moisture. Resulting analyses allowed researchers to estimate the amount of moisture available to corn at mid-silk in an average year at different planting dates and locations.

An initial step in this project involved determining the number of "heat units" common corn varieties require to reach mid-silk in Alabama. The measurement of heat units reflects the fact that temperatures must be high enough over a period of time to make corn grow. To calculate heat units, subtract 50 from the average temperature each day of the growing season; add the remainder to the ongoing accumulation of heat units. It is possible to accumulate 0-36 heat units per day. Heat units required to reach mid-silk were determined for 30 corn varieties grown in AAES variety trials from 1989 to 1994. The average accumulation was 1,420 heat units, 95% of the varieties were at mid-silk between 1,338 and 1,502 heat units.

To address the issue of moisture availability in the corn growth model, researchers used a water budgeting balance sheet. In water budgeting, a method used to balance available soil moisture, precipitation is a credit entry and evapotranspiration (water used by the plant and water lost to the atmos-

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Delayed Planting, continued from page 3

Optimal Planting Dates for Six Locations in Alabama Based on Average Precipitation and Available Soil Moisture at Mid-silk

Location	Period of increased probability of precipitation	Recommended planting dates
Brewton	July 5-Aug. 22	After April 1
Fairhope	June 14-Sept. 26	After April 1
Headland	June 28-Aug. 22	After May 1
Milstead	June 28-Aug. 22	No optimal date
Belle Mina	June 28-July 25	No optimal date
Sand Mountain	June 21-July 25	No optimal date

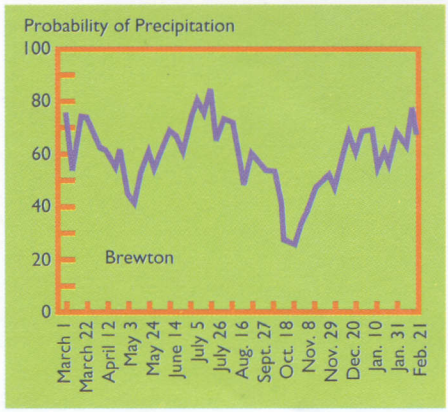

Figure 1. Probability that more than one-half inch of precipitation will occur in Brewton.

phere estimated by pan evaporation) is a debit entry. A water budgeting balance sheet for a fine sand soil type was used in the planting date model. This soil type has a very low available-water holding capacity (one inch per foot), and represents a worst-case scenario. Using 30-year rainfall data, researchers graphed precipitation probabilities for Belle Mina, Sand Mountain, Headland, Milstead, Fairhope, and Brewton (Figure 1). These graphs were used to identify time periods with the greatest probability of precipitation at each location. Pan evaporation data and information on water use rates at each stage of corn development also were used in the model.

Rainfall and temperature data were programmed into the simulation model for each of the six locations. The model was run for six planting dates at two-week intervals beginning on March 1 and ending May 15. Soil profile moisture at mid-silk was graphed for each planting date at each location to determine when mid-silk occurred at favorable soil moisture levels (Figure 2).

Delayed planting in Milstead, Belle Mina, and Sand Mountain (Central and North Alabama) did not increase the likelihood of adequate soil moisture at mid-silk (see table). However, this was not the case in South Alabama. Delayed planting at Brewton, Fairhope, and Headland placed mid-silk in more favorable soil moisture conditions.

Planting dates suggested by this study are still within current Alabama Cooperative Extension Service recommendations, but are later than many growers currently plant. However, field tests must be done to confirm these results, and to identify other potential drawbacks to delayed planting, such as increased insect pressure.

Bauske is an Extension Associate and Kemble is an Assistant Professor in Horticulture. Mask is an Associate Professor and Monks is an Assistant Professor of Agronomy and Soils. Harker is an Agricultural Meteorologist with the Southeast Agricultural Weather Service Center in Auburn.

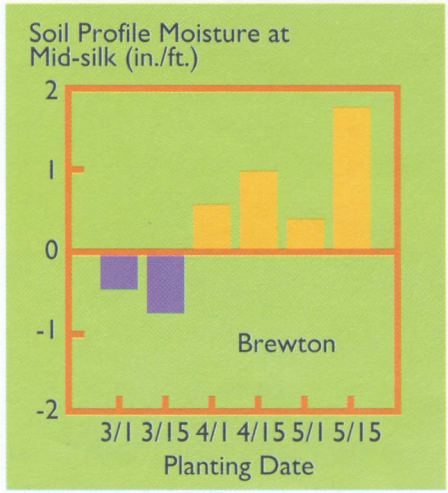

Figure 2. Effect of planting date on soil moisture at mid-silk at Brewton.

Management Key to Controlling Blackspot Disease in Roses

Kira L. Bowen, Bridget K. Behe, and Elizabeth A. Guertal

Roses are among the most valuable and familiar plants in residential and commercial landscapes. In particular, hybrid tea roses, with their large blooms and pleasant fragrance, are favorites among rose enthusiasts. Hybrid tea roses, however, can be devastated by blackspot disease, caused by a fungus called *Diplocarpon rosae*. AAES research is helping identify ways to protect these popular flowers.

Blackspot disease manifests itself as circular black spots on plant foliage, which greatly reduce the beauty and performance of roses in the landscape. Blackspot is easily distinguished from other diseases by the darker color and fringed borders of the spots that can occur on either side of the leaf. Spots often are surrounded by a yellow halo, and infected leaves fall prematurely. This disease may cause severe defoliation, resulting in a weakened plant and reduced flower production.

In Alabama and the Southeast, high humidity and frequent rainfalls promote fungal pathogen development from March through November. Nighttime temperatures between 59° and 80° F and heavy dews or frequent showers are ideal conditions that allow the fungus to thrive and continuously reinfect plants.

The fungicide chlorothalonil (Daconil) is effective in controlling blackspot by killing the fungal spores that spread the disease. However, optimal disease control with chlorothalonil requires frequent applications to protect newly developing leaves and to replace fungicide washed off by rain. Control of blackspot on roses in Alabama, therefore, may require more than 15 fungicide applications, at 7-10 day intervals, during the growing season.

Recent concerns about the safety and environmental impact of frequent fungicide use have caused rose growers to consider alternatives for control. Baking soda in solution with horticultural oil (a light petroleum oil labeled for control of insects), for example, has been shown to reduce diseases on roses in New York state. In addition, many people believe that fertilizing roses with epsom salts ($MgSO_4$) produces more vigorous plants.

Research underway at the E.V. Smith Research Center is evaluating these and other blackspot control methods. Initial research showed that using horticultural oil may damage rose foliage due to the higher temperatures that prevail in Alabama. More recently, during the summer of 1995, applications of the horticultural oil solutions (oil alone and in suspension with baking soda) were alternated with chlorothalonil fungicide applications to avoid the phytotoxic effects previously observed. Oil solutions were applied weekly but were substituted with the fungicide when rainfall between sprays was less than 0.25 inch. Rain removed some of the oil and reduced phytotoxic effects.

Levels of blackspot disease, averaged over the entire season when roses were treated with alternating applications of horticultural oil and chlorothalonil, were statistically similar to disease levels on plants treated weekly with the fungicide and about 20% lower than on nontreated plants (Figure 1).

Blackspot Disease, continued on page 6

Blackspot Disease, continued from page 5

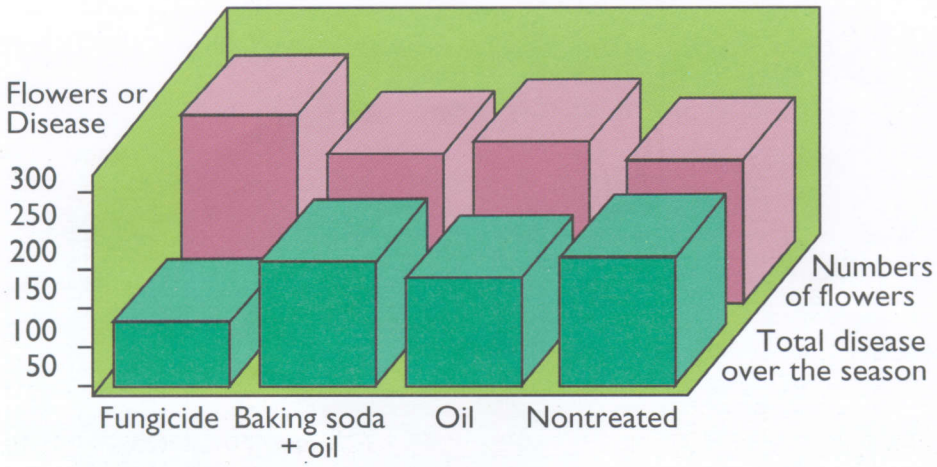

Figure 1. Treatments were applied weekly until run-off. "Fungicide" was Daconil 2787 at two teaspoons per gallon of water; one tablespoon of baking soda and two and a half tablespoons of oil were mixed with one gallon of water. "Baking soda-plus-oil" and "oil-alone" treatments were substituted with a fungicide application if no rain occurred between spray dates.

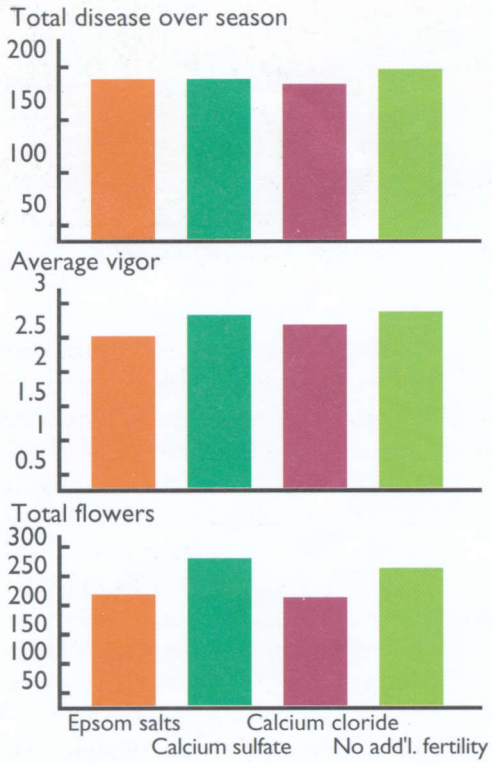

Figure 2. Disease, plant vigor, and flower numbers on rose plants treated with differential additional fertilizers, 1995.

Numbers of flowers produced on rose plants treated with oil alternated with the fungicide were not statistically different from plants treated weekly with the fungicide. Still, more flowers were produced on plants sprayed alternately with oil and the fungicide than on nontreated or baking soda-plus-oil treated plants.

In addition, alternating oil and fungicide according to rain events resulted in eight fungicide applications out of 22 total foliar applications.

Blackspot disease reduction and increased flower production on plants sprayed with the oil solution alternated with the fungicide, compared to nontreated plants, indicate that rose lovers can reduce the number of fungicide sprays using this alternate strategy. Although these spray schedules involve a weekly regime, the number of applications of potentially hazardous fungicides is reduced.

Nutrients such as calcium (Ca) and magnesium (Mg) have been associated with disease control and improved flower production on roses. This has caused some people to use epsom salts to treat roses. Indeed, one manufacturer of epsom salts even includes a recommendation for rose use on its label of one cup espsom salts per plant per month.

To test this idea, a study was initiated in 1995 to evaluate different fertilization practices for roses and how these practices affect disease and plant growth. Treatments consisted of monthly applications of epsom salts (245 grams, or one cup), calcium chloride ($CaCl_2$, 133 grams), calcium sulfate [gypsum ($CaSO_4$, 163 grams)] plus sulfur (S, 27 grams), or no treatment. These nutrient applications were made in addition to regular N-P-K applications and were adjusted for equivalent amounts of Mg and Ca. Fertilizers were applied as granular formulations to the base of plants.

Preliminary data showed that epsom salt application (in addition to N-P-K), on a monthly schedule, did not reduce the disease incidence but did reduce defoliation compared to plants receiving no secondary nutrients. However, the plants treated with epsom salts or $CaCl_2$ were less vigorous and produced fewer flowers than nontreated plants or plants treated with calcium sulfate (Figure 2).

These results suggest that specific nutrient treatments will not effectively control blackspot disease in roses, but they may provide other benefits and lessen the need for application of fungicides.

Complete control of blackspot disease may never be attained without the use of fungicides, but proper management of rose plants will reduce the amount of fungicide needed. Proper rose management includes annual replacement of ground cover, proper pruning and fertilization, and removal of fallen leaves. Pruning and removal of debris is important because the fungus readily survives in fallen leaves, buds, or infected canes. Proper fertility will keep a plant in optimal health, which makes it less susceptible to disease.

Bowen is an Associate Professor of Plant Pathology, Behe is an Associate Professor of Horticulture, and Guertal is an Assistant Professor of Agronomy and Soils

Recreational Fishing is Big Business in Alabama

Rebecca J. Travnichek and Howard A. Clonts

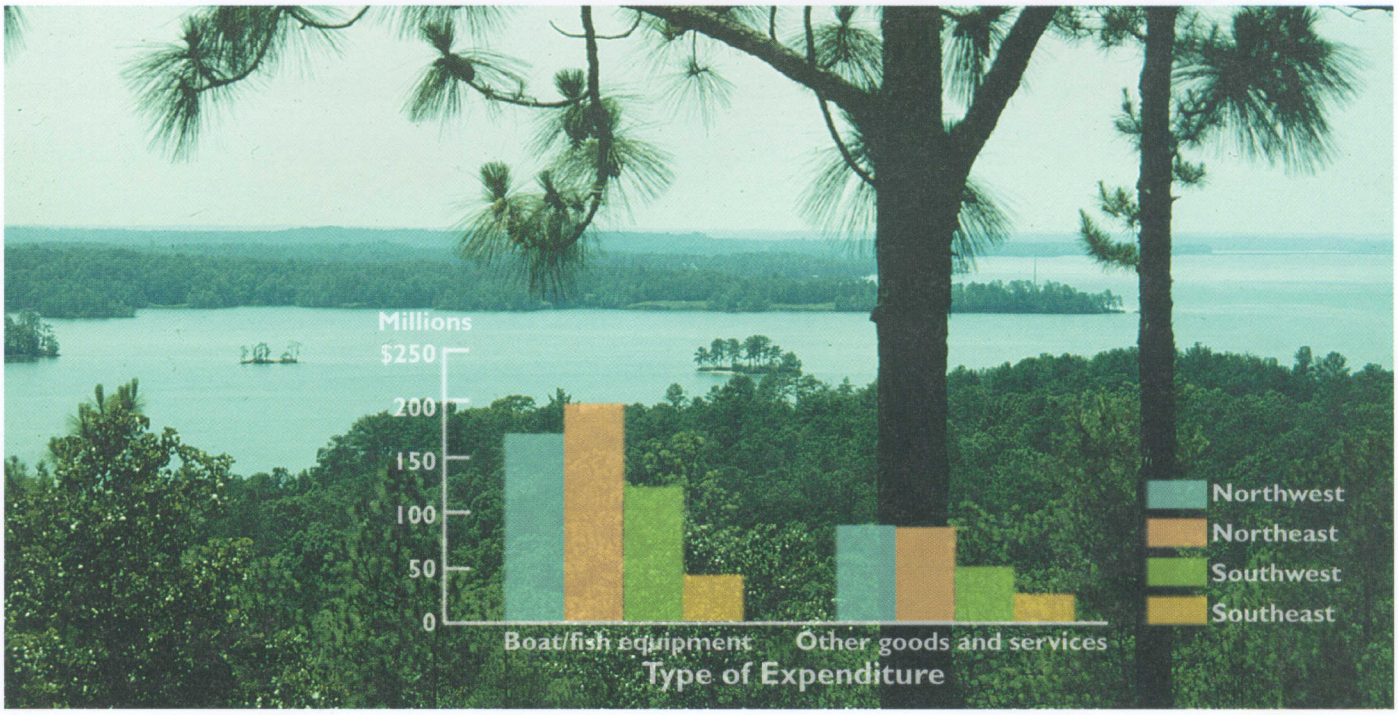

Figure1. 1994 estimated fishing-related expenditures by expenditure category and region.

More than one million acres of rivers, reservoirs, and private impoundments in Alabama support an industry with a dramatic economic impact, primarily in rural communities. A recent AAES study found that licensed Alabama anglers spent almost $800 million on fishing and fishing-related activities in 1994. When this amount is combined with estimated expenditures of resident nonlicensed and nonresident licensed anglers, Alabama's economy gained about $1.3 billion from recreational fishing.

These expenditures were determined by surveying individuals who purchased fishing licenses during 1994. Questionnaires were mailed to a random sample of 1,750 residents holding rod-n-reel, saltwater, fresh- and saltwater combination, hunting and fishing combination, lifetime fishing, and lifetime hunting and fishing permits. Usable survey forms were returned by 23% of this sample. Nonresponse bias was tested and found not to be a problem.

The typical licensed angler in Alabama is a white, married, middle-aged male. Most come from small towns and have completed some college education. Household income was relatively high—$46,600. Respondents also reported that fishing was a lifetime, family activity, for which $2,330 per angler was spent in 1994. Fish species most sought by respondents were largemouth bass, bream, catfish, and crappie in fresh waters; and snapper, red fish, flounder, and mackerel in saltwater. Expenditures for fishing-related equipment and activities have a significant impact on Alabama's economy (see table).

North Alabama counties account for slightly more than 60% of the state's population, but the anglers who live there accounted for nearly three-fourths of total fishing-related expenditures (figures 1 and 2). This finding suggests that northern recreational anglers tend to spend more money on their fishing activities than southern anglers. However, a definite pattern of money flow from North to South was recognized. North Alabama anglers spend a significant portion of their money in southern counties. One reason for this spending pattern is that many northern fishing enthusiasts buy boats and related equipment in South Alabama for use in their home counties.

Unfortunately, 15% of the fishing-related equipment and activity

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Recreational Fishing, continued from page 7

ing-related equipment and activity purchases by Alabama anglers were made outside the state. This finding suggests the possibility that (a) manufacturers and businesses may not offer recreational anglers in Alabama the equipment they need at a price competitive with other states, (b) licensed anglers who are fishing outside Alabama would rather purchase equipment and supplies closer to their intended fishing location, or (c) both fresh- and saltwater fishing activities were pursued in states other than Alabama. Anglers in northeast and southwest counties accounted for 66% of the total dollars spent in other states. The lower amounts spent out-of-state in Northwest and Southeast Alabama suggest that local resources sufficiently meet the needs of anglers in those regions.

Surprisingly, relatively little of the expenditures made in Alabama were specifically for saltwater fishing. Initially, anglers living in southern counties, especially in the Southwest, were expected to be primarily interested in saltwater fishing activities. However, this did not prove true. Expenditures for freshwater fishing activities were dominant in both southern regions.

In summary, the estimated 1994 expenditures of Alabama's 452,113 resident licensed anglers were quite substantial. This spending is important to Alabama, especially to the rural communities that are home to most fishing areas. Fishing-related expenditures support many businesses and industries in Alabama and surrounding states.

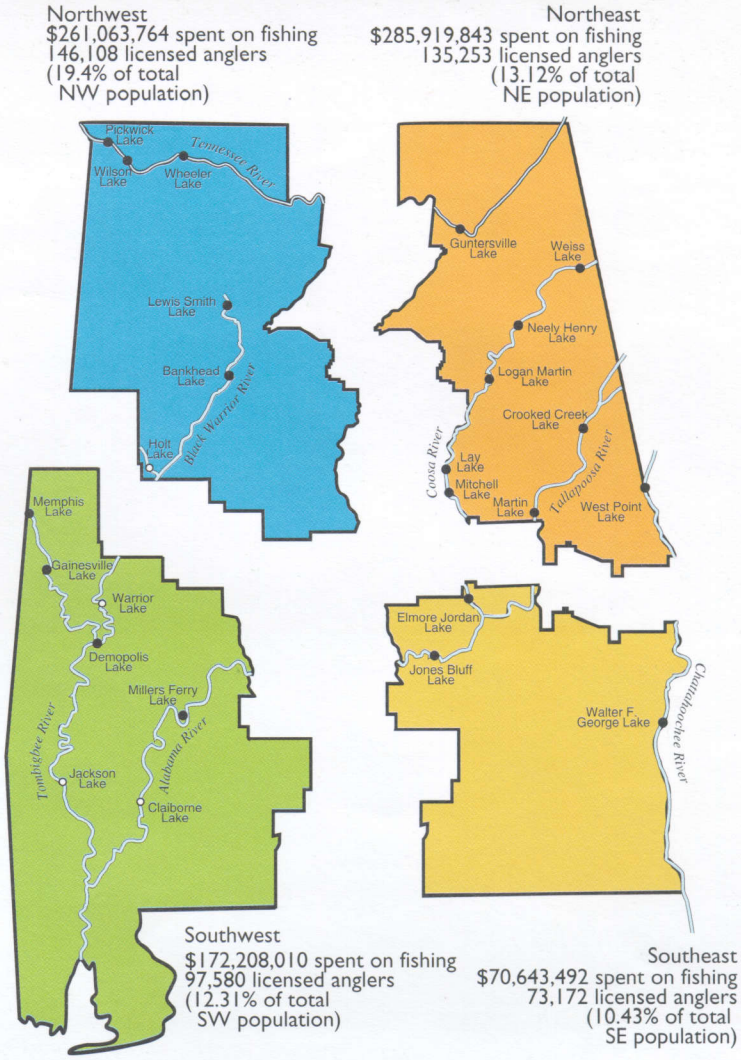

Figure 2. The AAES study examined regional differences in expenditures for fishing and related activities.

Travnichek is the Regional Consumer and Family Sciences Specialist with the University of Missouri Extension System in Savannah, Mo., and a former Doctoral Candidate in Agricultural Economics and Rural Sociology. Clonts is the Interim Director of the Auburn University Environmental Institute.

Estimated Economic Impact by Resident Licensed, Resident Nonlicensed, and Nonresident Licensed Angler Expenditures During 1994

Expenditure	Totals	Resident licensed angler	Resident non-licensed angler[1]	Out-of-state licensed angler[2]
	millions	*millions*	*millions*	*millions*
Camping equipment	$ 83.0	$ 50.0	$ 26.9	$ 6.1
Boat/boating equipment	650.0	407.5	219.4	23.1
Fishing equipment, licenses, & fees	199.4	125.8	67.7	5.9
Food and lodging	137.7	87.6	47.2	2.9
Transportation	152.6	96.5	52.0	4.1
Miscellaneous goods and services	36.5	22.3	12.0	2.2
Totals	1,259.2	789.8	425.2	44.2

[1]A national survey of fishing, hunting, and wildlife-associated recreation determined the average percentage of anglers who do not purchase fishing licenses. This percentage was applied to the expenditures of Alabama's resident licensed anglers to estimate expenditures by resident nonlicensed anglers.

[2]This estimate assumes that licensed anglers from other states spend the same amount outside their respective states that Alabama anglers did. Accordingly, the total number of fishing licenses purchased by nonresidents was multiplied by the expenditure amount reported by licensed Alabama anglers who fished out-of-state.

Reduce Risk of Beet Armyworms: Fertilize According to Soil Test

Fudd Graham and
Michael J. Gaylor

BEET ARMYWORMS are major pests of cotton in Alabama, especially in hot, dry weather. Farmers have indicated that armyworms appear to be more numerous in fields that are deficient in potassium (K). AAES research indicates that, under drought conditions, cotton grown in soil containing medium levels of potassium may be more attractive to armyworms.

Soil low in potassium was collected from an established cotton fertility test at the Prattville Experiment Field. This soil was amended to produce soils low, medium, and high in potassium (71, 168, and 318 pounds of K per acre, respectively, based on Auburn University Soil Testing Laboratory recommendations) and placed in two-gallon pots. DPL 90 cotton was planted in the pots. Half the plants in each potassium treatment were supplied with adequate moisture and half were drought-stressed (leaves wilting during the heat of the day and recovering at night). The plants were divided into three tests to determine beet armyworm egg-laying preference, larval development in a growth chamber, and larval development in a greenhouse.

Screen cages were used to segregate groups of three plants, one plant from each of the three potassium treatments. Half the cages contained drought-stressed plants, and the other half contained plants receiving adequate moisture. Fifty male and 50 female moths were placed in each cage late in the afternoon. Egg masses deposited on the plants were counted early the next morning.

Potassium concentration did not effect the egg-laying preference of armyworm moths placed in cages with plants receiving adequate moisture (Figure 1). Potassium concentration did affect egg-laying in the drought-stressed treatment. Moths deposited 74% more egg masses on drought-stressed plants in the medium-potassium treatment than drought-stressed plants in the high-potassium treatment. Statistically, however, the number of egg masses per

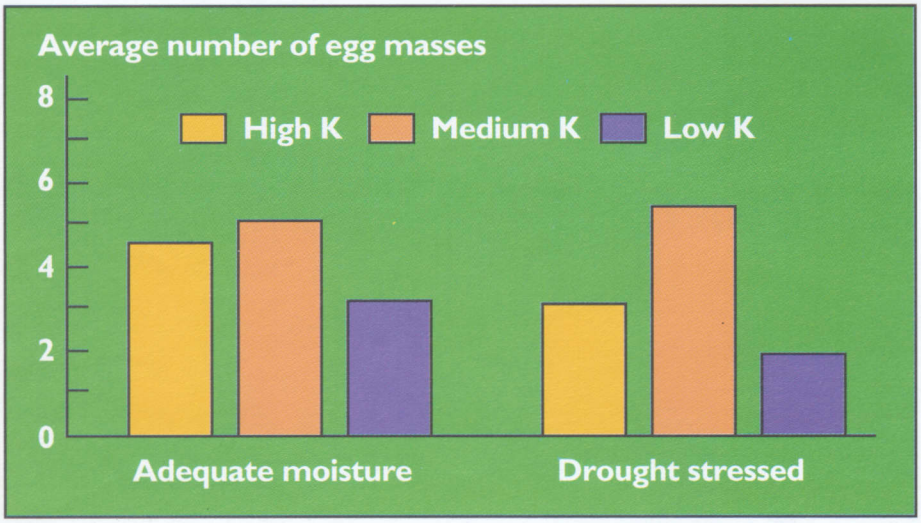

Figure 1. On drought-stressed cotton, armyworm moths preferred to lay eggs on cotton reared in soil with a medium potassium level.

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Beet Armyworms, continued from page 9

plant in the medium-potassium cotton was not different from the high-potassium cotton, at either moisture level.

In the growth chamber portion of the study, larvae reared on high- and medium-potassium cotton treatments developed more rapidly than larvae reared on the low-potassium treatment (Figure 2). Armyworms in the greenhouse study also pupated faster on these two treatments. In both the greenhouse and the growth chamber, larvae developed faster on drought-stressed cotton.

Results from this experiment indicate that armyworms develop faster on cotton grown in hot, dry conditions. Larvae developed equally well on high- and medium-potassium cotton, but if plants were under drought stress, female moths preferred to deposit eggs on cotton grown in medium-potassium soil. This indicates that fields testing medium in potassium could incur more damage during a hot, dry summer due to increased beet armyworm egg deposition and rapid development of larvae. However, if a farmer perceives this to be a problem, a simple preventative would be to apply potassium to all fields according to soil test recommendations. This would promote maximum cotton growth and possibly reduce attractiveness to beet armyworms.

Graham is a Laboratory Supervisor and Gaylor is an Associate Professor of Entomology.

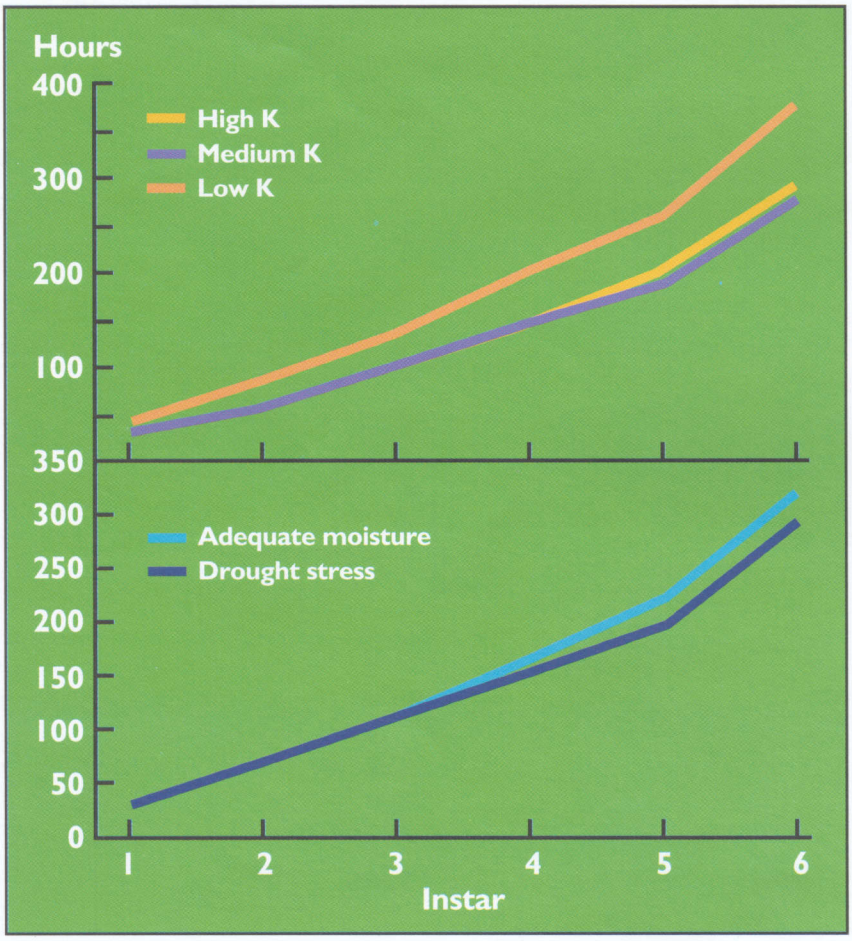

Figure 2. Larvae developed faster in cotton grown in medium- and high-K soil and in the drought-stressed treatment.

High Feed Strategies

An important reason for the successful growth of the catfish industry in Alabama has been the consistent supplies and prices of feed ingredients. During the past 25 years, or since the beginning of the catfish industry in Alabama, prices for soybean meal and corn have rarely exceeded $200 and $100 a ton, respectively. This spring, however, prices for soybean meal reached $260 per ton and corn prices averaged $136 a ton. Predictions are that prices may reach record highs in 1996. Because feed typically constitutes about 60% of variable expenses, the aquaculture industry will need to adjust feeding practices to avoid waste. AAES research has identified ways to achieve that goal and thus keep fish farming operations profitable.

Prices in 1996 Will Affect Feeding for Catfish Farmers

R.T. Lovell

Overfeeding expensive feed is an obvious problem. Feed conversion ratio (pound of feed per pound of gain) on commercial farms is generally two or above, whereas feed conversion ratio in experimental ponds, where feed is dispensed and measured carefully, is 1.35 to 1.75 depending on fish size (conversion increases with fish size). AAES research indicates that high feed conversion ratios are at least partially caused by overfeeding.

Feed consumption by catfish in ponds varies daily, especially when fish are fed to near satiation, due to temperature, air pressure, water quality, disease, and other environmental changes. Therefore, if a heavy feeding regimen is used, the feeder should be well trained and have accurate and current information on each pond with regard to water quality factors, size and health of fish, and response of fish to feed allowance during previous days. Judicious attention to these factors will allow the feeder to decide how much feed to dispense in each pond with minimum waste. Underfeeding catfish in ponds favors minimizing unconsumed feed; however, this can reduce yield and allow larger or more aggressive fish to eat most of the feed.

Forcing catfish to eat also can be an economic liability. If the fish do not eat well because of disease or adverse environmental conditions, the feeder should not force them to eat. Catfish not fed several days can compensate in weight gain for the unfed days when they are put back on feed. AAES research has shown that year-two (harvest-size) channel catfish fasted for up to three weeks during summer can catch up with continuously-fed fish in another three weeks. The fasted fish will eat more, and need to, in order to catch up so the feeder should allow for this.

Restricting winter feeding can reduce feed costs. Generally, catfish in ponds do not need to be fed during the cold months in winter. AAES studies indicate that year-two and year-one (fingerling) channel catfish not fed during the three coldest months of winter (December, January, and February) but fed generously from the first of March, weighed the same by mid-April as catfish fed continuously during winter. If fish are to be harvested before mid-April, however, they should be fed during winter to prevent weight loss.

Managing animal protein in feeds can reduce total feed costs. The most expensive ingredient in catfish feeds is fish meal. Early studies at the AAES showed that small catfish or food-size fish under a restricted feeding regimen required 6-10% fish meal in their feed. Recent studies in Alabama and at Mississippi State University have shown that good production can be obtained without animal protein in catfish feeds when the primary protein source is soybean meal and when feed allowance to the fish is not restricted. As the quality and quantity of protein in the feed decreases and as daily feed allowance decreases, the value of fish meal in the feed increases. However, under most commercial catfish feeding regimens, amounts of fish meal greater than 3-4% would be difficult to justify.

Recent studies at the AAES have shown that 26-28% amino acid-balanced protein feeds will yield the same weight gain as the conventionally used concentration of 32% for food-size catfish fed to satiation during the growing season. However, under restricted feeding conditions, the higher protein feed yielded the greatest weight gains. These results agree with early pond feeding experiments at Auburn in which a ceiling was placed on daily feed allowance that resulted in the fish being underfed during the latter part of the growing season. Under such a feeding regimen 32-36% protein was optimum.

Today, most farmers try to feed the fish as much as they will consume all season, in which case the lower protein concentrations will be more profitable, especially if large fish (larger than seven ounces) are being fed. The lower protein feeds will result in slightly higher feed conversion ratios; however, under 1994 cost and price conditions, feeding 26% protein feed was more profitable than feeding a 32% protein feed. Profitability of a lower protein catfish feed should be even greater in 1996.

Because of the interacting effects among dietary protein percentage, dietary protein quality, and daily feed allowance on weight gain by catfish, research indicates producers should be cautious about lowering these factors simultaneously. For example, protein quality is less important in a 32% protein feed than in a 28% protein

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Feed Prices, continued from page 11

feed; also, protein quality is less important when the fish are fed to satiety than when they are restricted.

Feed manufacturers should adjust the protein level to meet the requirement of the first limiting amino acid(s). Research at the AAES has shown that with channel catfish, this will usually be lysine. Therefore, if the feed is formulated to meet the lysine requirement, the other amino acids will be in sufficient or excess quantity. Traditionally, catfish feeds are formulated to contain a minimum amount of crude protein and not be deficient in any essential amino acid. This usually results in an excess of several amino acids being fed.

Conceivably, less protein could be used if attention is given to meeting the minimum requirement of the first limiting amino acid(s) instead of meeting a minimum protein requirement. This will require convincing catfish farmers that meeting amino acid requirements is more important than meeting protein requirements. High protein prices may provide incentive for feed manufacturers to use synthetic lysine in catfish feeds.

Recent studies at the AAES showed that increasing the lysine content of lysine-deficient diets with synthetic lysine was not as beneficial as increasing the lysine by substituting with soybean meal, which is high in lysine. Approximately 25% more free lysine supplement was needed as compared to protein-bound lysine (soybean meal) supplement to give maximum weight gain.

A great amount of research data has been produced in recent years with catfish on practical feed formulation and feeding strategies for catfish with emphasis on reducing cost (as opposed to increasing yield). But because catfish feed prices have been reasonable and consistent during recent years, the industry has been slow to make changes in formulations or feeding practices. The world supply of protein is expected to reach record costs in 1996. This will be strong incentive for practitioners to be especially innovative and to carefully review the research literature.

Lovell is a University Distinguished Professor of Fisheries and Allied Aquacultures.

Evaluation of the bermudagrasses includes such measurements as thatch dep

ting depth and rate of growth.

ON A GREEN...

Bermudagrass for Alabama Putting Greens

Elizabeth A. Guertal, R. Harold Walker, Ray Dickens, and Coleman Y. Ward

Golf is a billion dollar industry in the United States, and the popularity of the game shows no signs of slowing down. The Southeast, in part because its warm climate attracts retirees and vacationers, has become a popular golfing region, and quality courses have become a hallmark of many southern towns. However, increased competition for a golfer's dollar means that golf courses must be well-maintained, challenging, and well-groomed.

Although many courses pride themselves on creeping bentgrass putting greens, bentgrasses are cool-season grasses adapted to the northern United States. The hot, humid climates of the Southeast can exert a toll on creeping bentgrass greens, and their putting quality may decline rapidly as temperatures rise during the summer.

Hybrid bermudagrasses are the best adapted grasses for putting greens in warm, humid regions because they have superior heat tolerance and persist well under low mowing heights. However, only a limited number of bermudagrass cultivars with turf quality similar to bentgrass have been identified or developed for use on putting greens.

In 1994, AAES researchers began a study to identify new bermudagrasses for use on southern putting greens. The study evaluated both cultivars and ecotypes.

A cultivar is a "cultivated variety" - one that has been selected through breeding, evaluation, and research as a superior type. Ecotypes, or variants, are usually first observed as an "off-type" when certain plants within a cultivar demonstrate growth or appearance different from the normal cultivar.

Two bermudagrass cultivars developed for golf greens are Tifgreen and Tifdwarf, both released from turf breeding programs at the Georgia Agricultural Experiment Station. Tifgreen was released first and, soon after its release, distinct off-types appeared in Tifgreen putting greens throughout the Southeast. Of these off-types, Tifdwarf was identified and later released as a cultivar and has become

Best Bermudagrass, continued on page 14

established in the turf trade. However, there is evidence that other off-types also exist, and turf managers continually report the occurrence of variants within Tifdwarf and Tifgreen putting greens.

To learn more about the potential of these cultivars and ecotypes for putting greens, researchers evaluated grasses on both native soil and United States Golf Association (USGA) putting greens. Native soil is soil that is found naturally at the putting green location and has not been amended with sand or foreign soils. The USGA greens are typically constructed of approximately 80-90% sand and 10-20% organic amendments.

Sprigs (stolons) of Tifgreen, Tifdwarf, their ecotypes, and other bermudagrass cultivars were collected from golf course greens and turf breeders from across the Southeast (see table). Among the grasses evaluated were ecotypes collected from two greens on the Country Club of Mobile (Azalea City) golf course, one from The Gulf State Park golf course in Gulf Shores, two new bermudagrass cultivars from the Georgia Agricultural Experiment Station (T596 and TW72), and two African bermudagrasses from the Oklahoma State University turf breeding program.

Grasses were planted on April 14, 1994, in the USGA and native soil greens in replicated strip plots located at the Auburn University Turfgrass Research Unit in Auburn. All plots were maintained as a putting green, with daily mowing at a 3/16-inch height. To keep the putting surface continually green, the plots were overseeded with rough bluegrass in the fall as the bermudagrass became dormant.

Plots were evaluated for rate-of-cover during the grow-in period. Rate-of-cover is important because plots that establish quickly can be opened for play sooner. The grasses also were evaluated for fall color, fall seedhead production, spring greenup, and spring seedhead production. Color is important because golfers desire a green appearance, and over-abundant seedhead production is an undesirable trait because seedheads are unsightly and affect the putting quality of the green.

During the grow-in period, the only significant difference in rate-of-coverage was due to the type of putting green rather than the bermudagrass cultivar or ecotype. When averaged over all grasses, percent turf cover on May 19 in the native putting green was 74%, compared to 56% average cover observed on the USGA putting green. This difference was still observed on June 21, when percent cover was 96% and 85% for the native and USGA putting greens, respectively.

Differences in rate of establishment on USGA and native soil putting greens may be caused by many factors, including soil moisture and/or fertility. Additional studies are planned to examine factors that affect rate of grow-in on USGA and native putting greens.

Bermudagrass grown on the USGA putting green was usually darker than grasses grown on native soil. The two Oklahoma bermudagrasses were lighter green than other entries. The cultivars Tifdwarf, T596, and the Tifdwarf ecotype from the Mobile Country Club (Number 10 green) were greener than other grasses. Unfortunately, the Mobile country club ecotype was the only grass to produce a profusion of seedheads in the fall.

More grasses produced seedheads in the spring, and there were more seedheads produced on the USGA green than the native soil putting green. Two grasses never produced seedheads— an ecotype selected from the Number 9 green of the Mobile country club and the Georgia cultivar TW72.

When all factors are examined, the new bermudagrass cultivar TW72 shows excellent promise as a bermudagrass for putting greens. Of selected ecotypes, the best performance was demonstrated by selections from a Gulf Shores course and the Number 9 green of the Mobile country club.

Additional cultural treatments of mowing height and traffic intensity will be superimposed on the main blocks of grasses, allowing further evaluation of the ecotypes and cultivars in stress situations.

**This research is funded in part by the United States Golf Association, the Alabama Turfgrass Association, and the Alabama and Gulf Coast chapters of the Golf Course Superintendents Association.*

Guertal is an Assistant Professor, Walker is a Professor, and Dickens is a Professor Emeritus of Agronomy and Soils. Ward is a Professor Emeritus of Horticulture.

Rate-of-Cover of Various Tifdwarf and Tifgreen Ecotypes in USGA and Native Soil Putting Greens

Grass	May 19		June 21	
	Native	USGA	Native	USGA
	Pct. cover		*Pct. cover*	
C.C. of Mobile #10	80	60	98	90
Tifdwarf	79	58	98	86
Gulf Shores	79	59	98	88
2352-OK	78	61	96	87
Tifgreen	77	46	97	79
TW72	77	49	97	81
Lakewood	76	70	97	93
2747-OK	72	61	96	87
T596	70	54	93	85
C.C. of Mobile #9	70	50	93	85
Southern Turf	70	46	93	77
Texas	70	56	93	85

Fertility & Fumigation

Chris E. Welsh, Elizabeth A. Guertal, and C. Wesley Wood

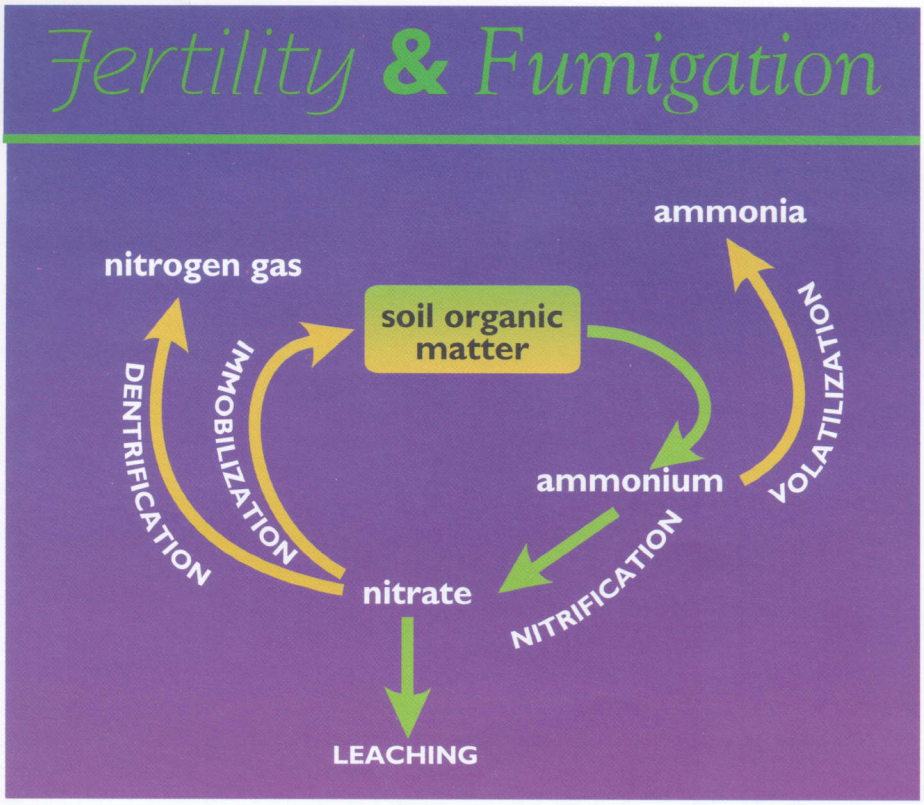


Figure 1. The nitrogen cycle.

Soil fumigation— the process of chemically or physically sterilizing soil to eliminate viable weeds and plant pathogenic microorganisms— is a common practice in vegetable and strawberry production. However, results of an AAES study suggest that soil fumigants may affect the availablity of certain types of nitrogen (N), implying that new fertility strategies may be needed for certain crops.

Methyl bromide and metham sodium are two common agricultural soil fumigants that chemically kill weeds and microorganisms. Unfortunately, these chemicals kill not only pathogenic microorganisms, but also eliminate or reduce beneficial soil microorganisms, such as *Nitrosomonas* and *Nitrobacter.* These bacterium are responsible for converting ammonium (NH_4-N) to nitrate (NO_3-N), an important step in a process called the nitrogen cycle (see Figure 1). The conversion of NH_4-N to NO_3-N is called nitrification.

Although most plants will take up both forms of nitrogen and use these for growth, previous research has shown that some vegetable crops may favor NO_3-N forms of nitrogen. A simple management strategy for vegetable crops is to add nitrogen as a nitrate source, such as in calcium nitrate [$Ca(NO_3)_2$]. However, these sources of nitrogen may be more expensive than such sources as ammonium nitrate (NH_4NO_3). An AAES experiment was conducted to find out if it is necessary to use NO_3-based fertilizers right after fumigation.

To help answer this question, an AAES laboratory study was conducted to examine soil nitrogen release in fumigated and nonfumigated soils. Portions of the soil were fumigated with either methyl bromide or metham sodium and a control group of soils was not fumigated. Nitrogen rate treatments included four rates of nitrogen at 0, 60, and 120 pounds of N per acre (120 lb. is the recommended rate for most vegetable crops in Alabama) and 240 pounds per acre. All N treatments were applied to fumigated and nonfumigated soils alike.

The treatments were enclosed in sealed canning jars. Soil samples were taken daily for 11 days and every other day for 11 more days. Samples were analyzed for NO_3-N and NH_4-N content, and differences in N content as affected by soil fumigant and N fertilizer were evaluated.

After 22 days of sampling, the nonfumigated soil samples contained more soil NO_3-N than those fumigated with either methyl bromide or metham sodium. This indicates that soil fumigation, regardless of the type of fumigant used, did slow nitrification, and less NH_4-N was being converted to NO_3-N. Fumigated soils exhibited net increase in NH_4-N while nonfumigated soils had net decreases (see Figure 2).

The decrease in nitrification caused by fumigating soil with these two chemicals suggests that producers using fumigants may need to adjust their starter fertilizer applications on vegetable crops that are sensitive to N form. Additional research is underway to determine if these laboratory findings will also occur in a field setting and perhaps fine-tune fertility recommendations for fruit and vegetable growers.

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

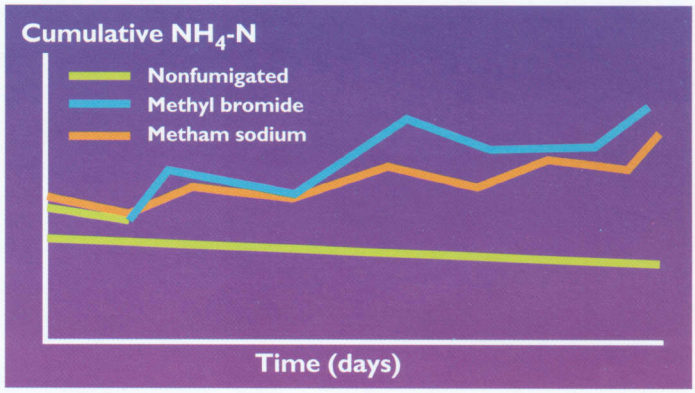


Figure 2. Cumulative ammonium-N as affected by fumigant.

Poultry Litter Looks Promising in Surface Mine Land Reclamation

Jeff L. Sibley, William A. Dozier, Jr., James O. Donald, David G. Himelrick, John H. Wilhoit, and E.S. Lyle, Jr.

An Auburn University demonstration project in Walker County shows the potential value of poultry litter as a soil amendment in reforestation and revegetation of surface coal mine land to mitigate nonpoint source water pollution impacts in the surrounding watershed.

Applying poultry litter in surface coal mine reclamation is especially appropriate for Alabama. These are two major state industries, both concentrated in the north-central part of the state. Alabama ranks second in U.S. broiler production, generating $1.4 billion annually, or one-eighth of the state's economy. The Alabama coal industry ranks twelfth in the U.S., mining just under 30 million tons annually. Coal-fired plants supply more than 75% of all electricity used in Alabama, and about 57% nationwide. About 20% of Alabama is underlain by coal, compared with 12% nationally. The two industries also face the challenge of converting waste byproducts into environmentally sound assets: for the poultry industry, broiler litter; for the coal industry, unreclaimed land following surface mining.

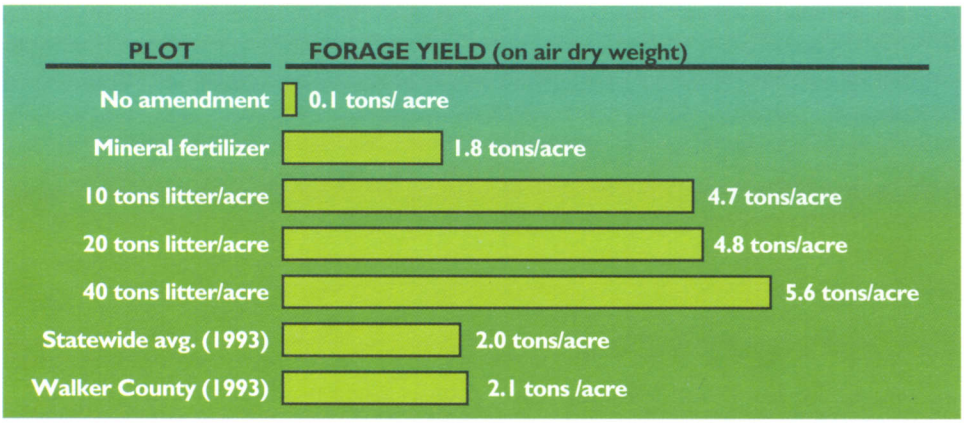
In producing more than 900 million broilers annually, Alabama growers also produce more than two million tons of broiler litter. This nutrient-rich byproduct potentially could supply the necessary nitrogen for all row crops grown in Alabama. In the past, broiler litter has represented a disposal problem and a potential environmental hazard when applied to farmland at sometimes excessive rates. However, its utilization potential is increasingly being recognized.

More than 100,000 acres in Alabama have been surface mined for coal. If not properly restored through reclamation, surface-mined lands can contribute to significant environmental problems, chiefly nonpoint source water pollution. Prior to the implementation of reclamation laws, removal of vegetative cover and adverse modification of the soil surface increased soil erosion and runoff, resulting in siltation of streambeds. The chemical quality in surface water runoff can be changed as a result of mining activities and may affect water quality if reclamation laws and regulations are not properly followed.

Currently, coal companies are reclaiming surface-mined land systematically as part of the overall mining operation. However, land mined before passage of the Surface Mining Control and Reclamation Act of 1977 (referred to as pre-law land) is reclaimed at a much slower pace.

An on-going AAES study, begun in the spring of 1994, is focusing on reclamation of a portion of the Sunlight Mine, a pre-law mine site adjacent to Blackwater Creek, a tributary of the Upper Black Warrior River. The site is owned by Drummond Company, Inc., which has made a long-term commitment for site land management and contributed heavy equipment operation for

Figure 1. (left) Before: a portion of the Sunlight Mine prior to reclamation. Figure 2. (Center) During: heavy equipment and technical expertise
Figure 3. (right) After: heavy vegetation now covers the majority of Sunlight Mine. A mixture of legumes and forages following preparation and ame



Forage yield results, 1995.

the project. Auburn University's role in the project is overall coordination, linking industry and agency interactions to assure successful site reforestation and revegetation to mitigate nonpoint source impacts on, and downstream from, Blackwater Creek. Baseline water quality data and hydrology studies were conducted by the Alabama Department of Environmental Management (ADEM), to determine the impact of remediation on nonpoint source runoff. Auburn also is conducting local and statewide educational programs to involve and educate citizens in the value of reclamation as a water quality improvement tool.

The eight-acre project site was heavily eroded and practically devoid of vegetation. Initial on-site soil samples revealed pH ranged from 3.3-4.2. The site was amended with finely ground limestone at rates ranging from four to eight tons per acre, effectively raising the soil pH to 4.9. A slurry pond with a pH of less than three was eliminated, with the entire project effectively contoured into one watershed, raising runoff pH to 4.5.

Three one-acre plots were established and amended with litter from a Walker County broiler operation at rates of 10, 20, and 40 tons per acre. These plots were compared to a plot that received mineral fertilizer at standard reclamation rates of 600 pounds of 13-13-13 per acre and another plot that did not receive any fertilizer or poultry litter. All soil amendments were disced in to a depth of 12 inches with a D-5 dozer and Rome disc. A mixture of fescue, lespedeza, rye, and clover was broadcast over the entire area and mulched with hay.

Previous research has shown that hardwood trees respond favorably to the nutrient and organic matter content of broiler litter, leading to the selection of a 75% hardwood, 25% evergreen mix of eight tree species. Containerized tree seedlings provided by International Forest Seed Company, Inc., were planted during the winter and early spring of 1994-95 at 600 trees per acre using a dibble matched to the uniform root systems of the seedlings.

By late spring of 1995, the previously bare, highly-eroded site was covered with heavy vegetative growth, with the litter-amended plots showing an advantage over the fertilizer-only plot. Sampling of yields from the grasses and legumes show the benefits of broiler litter amendment from the standpoint of potential for grazing or hay cropping. Forage yields from the litter-amended plots were two to three times higher than the statewide and Walker County averages (see graph). Even the high rates of litter have had no negative effects at this point on ground cover or tree survival, and surface runoff has been nearly eliminated. Additionally, ground water sampling by ADEM has not indicated a significant increase in nitrates (NO_3).

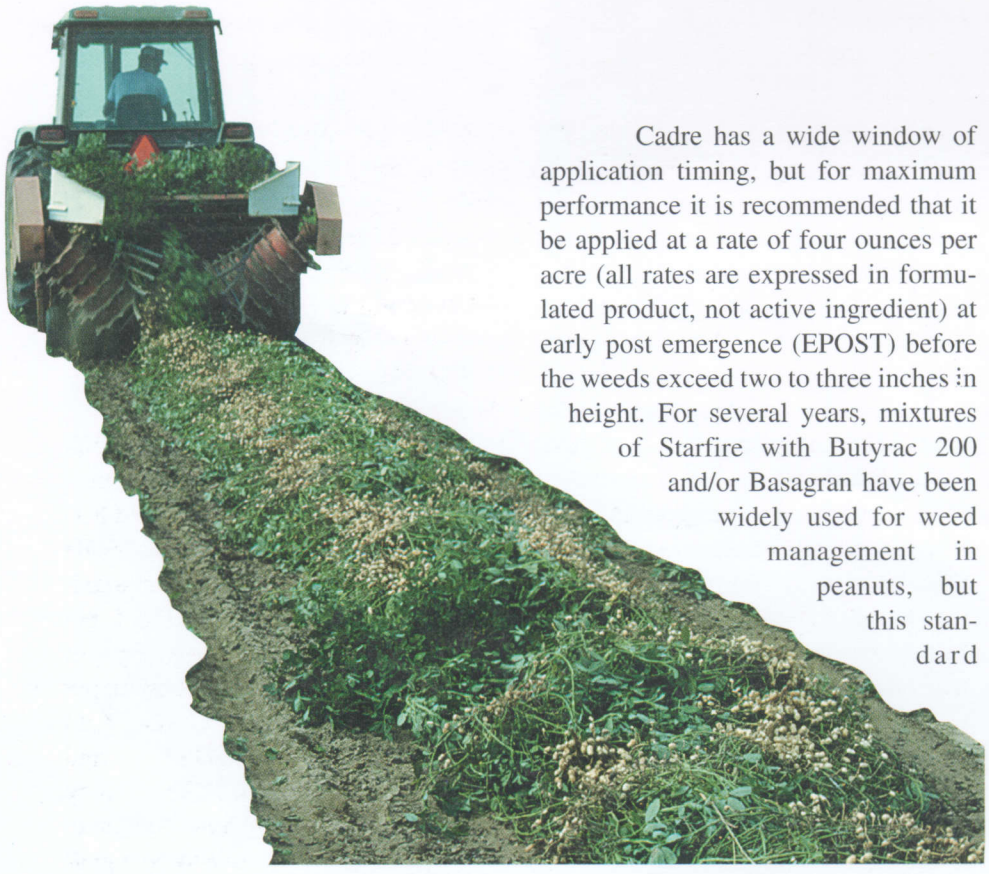
This project is demonstrating how the Alabama coal industry can address environmental hazards of pre-law mine sites by utilizing one of Alabama's poultry industry byproducts in an environmentally beneficial way. The project also models productive cooperative efforts in a more general way.

by the Drummond Company's Jasper Revegetation Group during preparation of the site. with poultry litter resulted in greatly improving what was previously a heavily eroded site.

Sibley is a Research Assistant, Dozier is a Professor and Department Head, and Himelrick is a Professor of Horticulture. Donald is a Professor and Wilhoit is an Associate Professor of Agricultural Engineering. Lyle is a Professor (retired) of Forestry.

[1]This project is unique in that it links major Alabama industries—coal, poultry, and forestry—with a major educational institution (Auburn University), under the umbrella of the governmental agency responsible for environmental affairs (ADEM). The project is funded in part by the U.S. Environmental Protection Agency. Major cooperators include ADEM; AAES; AU's departments of Horticulture and Agricultural Engineering; Drummond Company, Inc.; International Forest Seed Co., Inc. (IFSCO); and the Alabama poultry industry.

Comparison of Cadre and Starfire-based Wee



The introduction of Cadre to the assortment of herbicides currently available in peanut production has opened new doors for weed control. Cadre offers control of many troublesome broadleaf and grass weeds that are left unchecked by Pursuit, a herbicide with similar chemistry that has been available to peanut growers the past few years.

Cadre has a wide window of application timing, but for maximum performance it is recommended that it be applied at a rate of four ounces per acre (all rates are expressed in formulated product, not active ingredient) at early post emergence (EPOST) before the weeds exceed two to three inches in height. For several years, mixtures of Starfire with Butyrac 200 and/or Basagran have been widely used for weed management in peanuts, but this standard may change with addition of new herbicides to the peanut market place. Starfire is registered for post emergence (POST) application on peanuts between emergence and 28 days after peanut emergence, a relatively limited window of application. Basagran and/or Butyrac 200 are often added as a tank mixture in order to control weeds that may escape Starfire, such as smallflower morningglory, coffee senna, prickly sida, and bristly starbur. Also, the addition of Basagran reduces the amount of Starfire-induced injury to the peanut plants.

An AAES study evaluated and compared Starfire-based herbicide programs with systems containing Cadre for weed control, peanut yield, and net returns when used in Alabama peanut production systems. Ongoing experiments are being conducted at the Wiregrass Substation in Headland. The first year's data are discussed here.

Natural populations of yellow nutsedge, bristly starbur, sicklepod, Texas panicum, and Florida beggarweed infested the experimental plots. Prowl was applied (one quart per acre) preplant incorporated (PPI) over the entire test area and incorporated to a depth of 2.5 inches one day before planting Florunner peanuts.

Six EPOST-applied and four POST-applied treatments were arranged with all possible combinations. EPOST treatments included (1) none, (2) Starfire, (3) Cadre at two ounces per acre, (4) Cadre at four ounces per acre, (5) Starfire plus (tank-mixed) Cadre at two ounces per acre, and (6) Starfire plus Cadre at four ounces per acre. The POST treatments were: (1) none, (2) Butyrac 200, (3) Starfire plus Basagran, and (4) Starfire plus Basagran and Butyrac 200. Starfire, Basagran, and Butyrac 200 were applied at 11, 16, and 16 ounces per acre, respectively, at both EPOST and POST applications. Visual estimates of weed control were recorded at periodic intervals throughout the growing season.

Test plot data on inputs and yield were evaluated at the farm production scale level using enterprise budgets developed by the Alabama Cooperative Extension Service for nonirrigated peanut production. Peanut net return calculations were based upon the assumption that the

Control Systems in Peanuts

Daniel I. Padgett, Glenn R. Wehtje, Veronique Perrin, and Neil R. Martin, Jr.

crop would have a normal grade and be marketed at a 3:1 ratio of quota peanuts and additional peanuts. Prices for quota and additional peanuts were $610 and $300 per ton, respectively.

Yellow nutsedge control was rated at greater than 90% for Cadre at both the two or four ounces per acre rate applied alone, regardless of whether a POST treatment was used. Control of Florida beggarweed, sicklepod, and bristly starbur was similar, thus only an average rating for these broadleaf weeds is presented. As seen in previous studies and this study, both an EPOST and POST treatment was required for maximum (greater than 90%) weed control; this was also true for the maximum yield and maximum net returns. Starfire applied EPOST followed by Starfire plus Basagran plus Butyrac 200 provided this level of control. However, nearly all the treatments in which Cadre was applied EPOST at four ounces per acre followed by any POST application that contained Starfire provided comparable weed control.

Starfire is fairly competitive with Cadre with respect to weed control, yet maximum yields and net returns reflected the application of Cadre. Maximum yield and net return was achieved with Cadre applied alone EPOST, at either the two or four ounces per acre rate, followed by a POST application of a Starfire, Butyrac 200, and Basagran tank mixture. For both maximum weed control and maximum yield to be obtained, it was required that both an EPOST and POST herbicide application be utilized.

These results reveal the excellent weed control and yield-preserving benefits of this recently registered herbicide. Yet, two separate herbicide applications were required for maximum weed control, yield, and net return. Further research involving split application of Cadre at two ounces per acre for both EPOST and POST may show the practice to be equally if not more effective than the best treatment of this study.

Padgett is a Graduate Research Assistant and Wehtje is a Professor of Agronomy and Soils. Perrin is a Graduate Research Assistant and Martin is a Professor of Agricultural Economics and Rural Sociology.

Results from 1995 Peanut Production Season

Treatment[1]		Cost of herbicides	Avg. broadleaf weed control[2]	Avg. yellow nutsedge control	Yield	Net returns
EPOST	POST					
		dol./a	*pct*	*pct.*	*lb./a*	*dol./a*
None	none	6.43	0	0	2,561	-131.76
None	DB	9.46	62	51	3,004	-46.80
None	Star+Bas	13.24	46	57	2,886	-91.50
None	Star+Bas+DB	16.21	78	76	3,230	-13.60
Cadre 0.5X	none	20.74	66	91	3,612	43.80
Cadre 0.5X	DB	23.77	81	93	4,084	130.50
Cadre 0.5X	Star+Bas	27.55	83	96	4,347	173.60
Cadre 0.5X	Star+Bas+DB	30.52	92	93	4,501	197.80
Cadre 1X	none	34.99	83	97	3,884	80.50
Cadre 1X	DB	38.02	86	95	4,256	144.30
Cadre 1X	Star+Bas	41.80	90	97	4,102	112.60
Cadre 1X	Star+Bas+DB	44.77	96	93	4,556	198.00
Star	none	9.04	65	93	3,068	-51.70
Star	DB	12.07	87	93	3,848	99.40
Star	Star+Bas	15.85	88	71	4,102	141.50
Star	Star+Bas+DB	18.82	91	94	3,793	83.20
Cadre 0.5X + Star	none	23.29	78	94	3,585	39.60
Cadre 0.5X + Star	DB	26.32	95	95	4,066	123.20
Cadre 0.5X + Star	Star+Bas	30.10	94	97	4,093	124.50
Cadre 0.5X + Star	Star+Bas+DB	33.07	93	96	4,111	123.40
Cadre 1X + Star	none	37.54	92	94	4,184	131.60
Cadre 1X + Star	DB	40.57	96	94	4,111	115.00
Cadre 1X + Star	Star+Bas	44.35	95	98	3,902	53.50
Cadre 1X + Star	Star+Bas+DB	47.32	95	98	4,129	4.50

[1] Cadre 0.5X and 1X = Cadre applied at two and four ounces per acre, respectively; Star = Starfire; Bas = Basagran; and DB = Butyrac 200.

[2] Control ratings of Florida beggarweed, sicklepod, and bristly starbur were averaged into an overall composite rating.

SILVER QUEEN

MAY NO LONGER BE THE RULING SWEET CORN VARIETY

Amy Simonne, Eric Simonne, Jim Pitts, and Gary Gray

THE SWEETNESS, TEXTURE, AND AROMA of sweet corn, along with its high yield and desirable grain color, makes this a $2.7 million crop in Alabama. For almost 20 years, the most popular sweet corn variety has been the white cultivar Silver Queen. However, results of a recent AAES study indicate that Silver Queen may no longer be the reigning monarch of sweet corn varieties.

Sweet corn connoisseurs prefer Silver Queen and claim they can identify its typical flavor. An AAES study was conducted to determine if Silver Queen is actually recognized for its own attributes or if it benefits primarily from name recognition. A taste-testing panel in this study rated six sweet corn varieties as superior to Silver Queen, and only a few tasters could properly identify this popular variety. Silver Queen is a traditional sugary (su) sweet corn variety. Varieties that challenged Silver Queen in this study were hybrid sugar-enhanced (se) or super-sweet (sh2) sweet corn cultivars.

A taste-test panel rated six sweet corn varieties superior to Silver Queen.

Sucrose (sugar) content, which is genetically controlled, is the most important sensory attribute of sweet corn. At harvest, sugar concentration in su sweet corn is 5-15%; se, 8-20%; and sh2, 25-40%. After harvest, the sugar in kernels of su varieties is rapidly converted to starch, but this conversion occurs more slowly in sh2 varieties. The characteristic creamy texture of sweet corn is due to the accumulation of water-soluble polysaccharides. Silver Queen and other traditional su sweet corn varieties have more polysaccharides than the hybrid varieties. Aroma, which is not as easily defined as sweetness or texture, is most often associated with dimethyl sulfide, a compound that provides a pleasing corn-like characteristic.

Cooked ears from the sweet corn variety trial conducted at the Chilton Area Horticulture Substation in Clanton were served to a panel of tasters. A total of nine varieties were evaluated, but each panelist was asked to rate a selection of only five cultivars. Each five-sample set included Silver Queen, along with four other varieties. Samples were identified only by random three-digit numbers. The panel was comprised mainly of growers, gardeners, and retirees; 67 completed answer sheets were used for statistical analysis.

Ratings of appearance, sweetness, flavor, and overall preference were significantly affected by variety (see table). However, most of the selected cultivars received acceptable ratings. The appearance of Silverado and Even Sweeter ears was rated highest, while Fantasia and Snow White were rated lowest. Sweetness was found the highest in SS 7801, Treasure, and Even Sweeter. The sweetness rating of Snow White was the closest to being undesirable. Flavor ratings were highest for Starshine and lowest for Snow Belle. Treasure and Silverado received the highest scores for overall preference. Overall, Treasure was ranked first, Even Sweeter and Silverado tied for second, and SS 7801 was ranked fourth. Three of these four top-rated cultivars are supersweet varieties. Silver Queen was ranked seventh out of nine in overall preference.

Panelists were asked to identify Silver Queen among the five corn samples they tasted. Thirty percent of the panelists properly identified Silver Queen, 58% could not identify it, and 12% did not give any answer. Since each panelist was presented five varieties, the odds of correctly choosing Silver Queen at random were 20%. Therefore, only a small fraction of the panel recognized Silver Queen.

Panelists also were asked to list all the sweet corn variety names they could remember. Of 67 responses, 34% did not name any sweet corn variety. The most commonly named varieties were Silver Queen (by 61% of the responding panelists), Golden Queen (10%), and Bantam (5%). These results illustrate the popularity of Silver Queen.

Results of this first year of an ongoing study emphasize the importance of cultivar selection in the production of sweet corn. Sugar levels in sweet corn kernels are genetically controlled, thus variety choice is critical. Rankings from this study should be used in conjunction with yield performance and disease resistance before selecting which white sweet corn to plant.

Amy and Eric Simonne are Post-Doctoral Fellows in Nutrition and Food Science and Horticulture, respectively. Jim Pitts is Superintendent of the Chilton Area Horticulture Substation. Gary Gray is an Assistant County Agent in Chilton County.

Table 1. Average Ratings of Selected Sweet Corn Varieties [1]

Variety	Type[2]	Overall preference	Appearance	Sweetness	Flavor	Overall rank sum[3]
Treasure	sh2	9.7	8.5	9.1	8.8	8
Silverado	se	9.4	10.4	7.6	8.6	14
Even Sweeter	sh2	8.3	10.1	9.0	7.7	14
SS 7801	sh2	8.0	7.6	9.9	8.6	15
Fantasia	se	7.3	7.0	8.0	8.8	21
Starshine	se	7.0	7.9	7.4	9.4	22
Silver Queen	su	7.9	7.3	7.9	7.7	23
Snow Belle	se	7.5	8.2	7.7	6.1	25
Snow White	sh2	6.0	6.1	5.6	6.3	35

1 Varieties were rated on a 0-14 scale (0 = undesirable/dislike; 14 = desirable/like extremely).
2 The types of sweet corn are sugary (su), sugar enhanced (se), and supersweet (sh2).
3 Overall rank sum was calculated by adding the ranks of each attribute (maximum value = 36); the smaller the overall rank sum, the better. For example, the top overall sweet corn, Treasure, ranked 1st in overall preference, 3rd in appearance, 2nd in sweetness, and 2nd in flavor. Adding these rankings yields an overall rank sum of 8 (1+3+2+2=8).

Retail Pork Products Often Contain Meats Other Than Pork

Yun-Hwa P. Hsieh, Carla J. Wetzstein, and Nancy R. Green

An AAES study has identified a widespread problem in Alabama retail markets: much of the state's fresh ground pork and pork sausage contain significant amounts of meats other than pork. The major adulterating species in these pork products are beef, poultry, and mutton. Mixing undeclared species in meat products is illegal under food labeling regulations mandated and monitored by the United States Department of Agriculture (USDA), as well as by state agencies. Apart from regulatory requirements, prevention of undeclared species in meat products is important for economic, religious, and health reasons.

A total of 129 samples, including 42 ground pork samples and 87 fresh pure-pork sausage products, were collected by Alabama food inspectors from different manufacturers and retail stores across the state as part of routine, regulatory sample collections. Samples were analyzed to detect beef, poultry, and mutton substitution and to confirm that pork was actually used in the products. Researchers used Enzyme-Linked Immunosorbent Assay, a sensitive technique that can identify proteins from specific animal tissues.

Ninety percent of the ground pork samples, all of which were market-made, contained beef and/or poultry (Table 1). Sheep tissue was not found in the ground pork samples. The 87 pork sausage samples included 42 name-brands and 45 market-made products. Overall, 54% of the pork sausage samples contained undeclared meat. Twelve percent of the of name-brands were in violation of labeling regulations, while 93% of market-made sausage was adulterated.

Of the 38 adulterated ground pork samples, 99% contained beef, and 18% contained poultry (Figure 1). Of the 47 adulterated sausage samples, 96% contained beef; 38%, poultry; and 2%, mutton. In ground pork, 84.6% of the adulterated samples were contaminated by one species, and 15.4% were contaminated by two species (Figure 2). In adulterated pork sausage samples, 62% were contaminated with a single species, 36% with two species, and 2% with three species.

Since beef is more expensive than pork, there is no

In an AAES study up to 90% of market made ground pork contained other meats.

apparent economic reason for the addition of beef to pork products. Results indicated that the primary problem centers around the meat grinding operation. Market managers readily admitted that they did not routinely clean grinders when changing from ground beef to another meat. Poultry, on the other hand, is cheaper than pork, indicating the possibility of intentional adulteration for economic reasons. The addition of lamb meat to pork is thought to be done to utilize the unmarketable trimmings left from expensive meats and to extend the bulk of pork products. Fatter trimmings from beef or poultry also could be added to ground pork products to extend bulk. USDA allows a fat limit of 50% for fresh pork sausage, while regular ground beef can contain only 30% fat. There is no fat content limit for fresh ground pork.

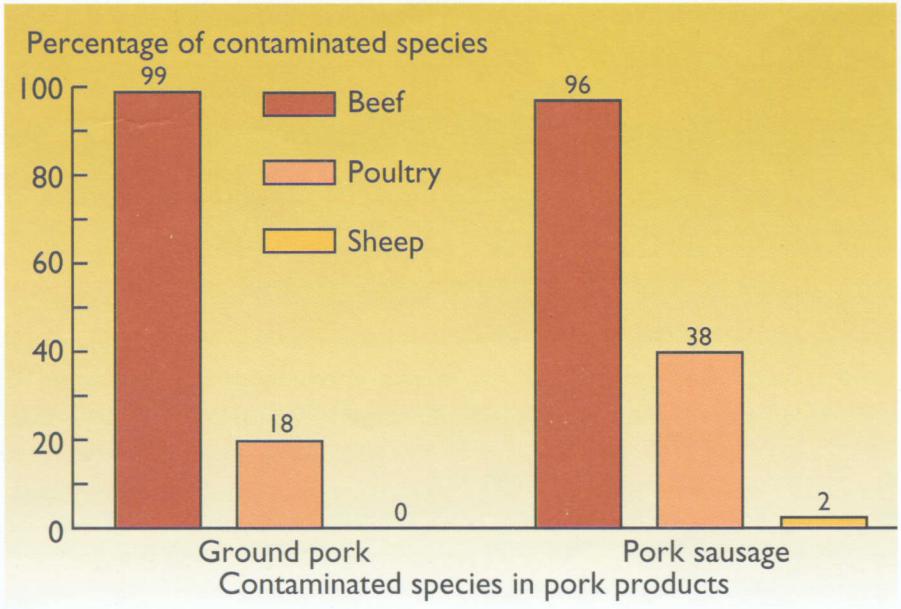


Figure 1. The pattern of species contamination in adulterated ground pork and pork sausage samples.

Most of the adulterated meat contained 1-10% of undeclared species (Table 2). Low concentrations (less than 1%) of meat contamination may be due to poor market grinder cleaning practices. However, the presence of higher concentrations and multiple undeclared species in meat products are likely indications of intentional adulteration.

Retail Pork, continued on page 24

Retail Pork, continued from page 23

As revealed in this study, current retail practice in Alabama meat markets shows a widespread species adulteration. In the past, the Alabama Department of Agriculture did not implement the meat species monitoring program at the retail level due to insufficient facilities and technology. Recently, Alabama strengthened its retail meat regulatory program to discourage meat adulteration.

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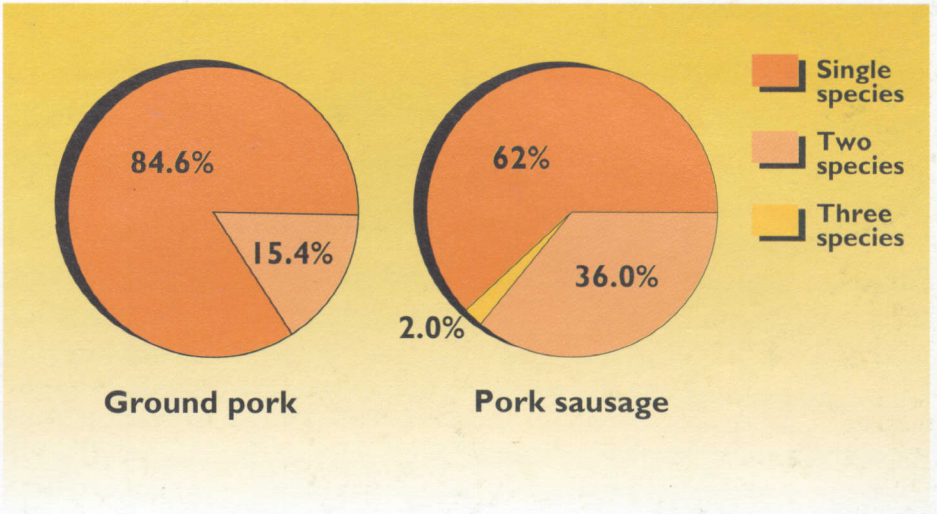

Figure 2. The distribution of contaminating species in fresh pork samples.

Table 1. Pork Product Samples in Violation of Labeling Regulations

Product	Samples	Violations	Violation rate
	no.	*no.*	*pct.*
Ground pork	42	38	90
Name-brand sausage	42	5	12
Market-made sausage	45	42	93

Table 2. Number of Samples of Ground Pork and Pork Sausage Containing Undeclared Species at Various Adulteration Concentrations

Adulterating species	No. of samples adulterated at 0.5-10% concentrations[1]			
	0.5-1%	1-5%	5-10%	>10%
	no.	*no.*	*no.*	*no.*
Beef	5/4	16/17	17/12	0/12
Poultry	3/6	2/4	1/7	*1/1
Mutton	0/1	0/0	0/0	0/0
Total[2]	19(17%)	39(36%)	37(34%)	14(13%)

[1] Numbers to the left of the slash are the number of ground pork samples found adulterated at each of the concentrations; numbers to the right of the slash represent adulterated pork sausage samples.
[2] Values in parentheses represent the percent of total violations.

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