HIGHLIGHTS
OF AGRICULTURAL RESEARCH

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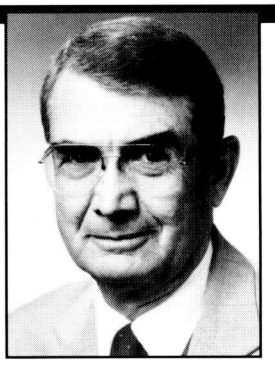
Lowell T. Frobish, Director Auburn University, Alabama

A WORD WITH THE EDITOR



R.E. STEVENSON

THERE IS NOTHING like a year of abundant rain to change our outlook on almost everything related to agriculture. After several years of constant worry about drought, 1989 comes along with so much rain that we begin worrying about dealing with that contrasting situation.

While rejoicing over the blessing of adequate rainfall, there are concerns that we may lose some of our drive for developing programs for water conservation and efficient water use. It's difficult to follow through on installing irrigation systems when we're walking in mud most of the time. Problems other than water shortages and management quickly move to the top of the list.

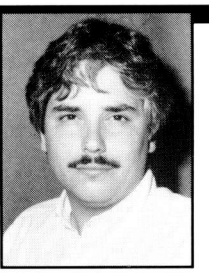
Individuals or groups with specific weather-related causes are also having trouble getting public attention. A good example is the campaign to change practices that are seen as being responsible for the "greenhouse effect." Many people have cited the hot, dry summers of recent years as evidence that the greenhouse effect is rapidly becoming a serious world problem. The wet year of 1989 has done a good job of defusing this worry in much of the United States.

At the same time that some problems are becoming less visible, others are gaining our attention. Problems from weeds, diseases, and insects continue, with wet weather complicating control. Although hay crops made heavy growth this year, wet weather complicated saving the crop, and wheat and other small grains were adversely affected by excess rain. Melons and some fruits suffered both yield and quality loss.

Marketing is also affected by weather. One has only to check the futures markets for various crops to realize that weather, and its anticipated effect on production, is a major determinant of prices for farm products. Thus, the need for innovative marketing continues to be a high priority topic.

All of these weather effects, and many more not mentioned, make an important point: The need for research goes on regardless of weather. And this research must be both forward looking and historically based. Weather over the long term provides the basis for problem solving, not the unusual year's weather. Our need for irrigation and water conservation has not evaporated because of abundant rainfall in 1989. We must gather research data every year, so we have the answers to problems that arise in each type of weather that we will experience in the years ahead.

MAY WE INTRODUCE



Dr. Mark Bain, Assistant Professor of zoology and wildlife science, Assistant Professor of fisheries and allied aquacultures, and Assistant Leader of the Alabama Cooperative Fish and Wildlife Research Unit. A native of Indiana, Bain earned a B.S. degree in wildlife resources from West Virginia University and a M.S. degree in fisheries science from Virginia Polytechnic Institute and State University. He also holds the Ph.D in fish biology from the University of Massachusetts.

Prior to coming to Auburn, Bain served as an ecologist at Chicago's Argonne National Laboratory and as an assistant professor of biology at Ball State University in Muncie, Indiana.

Bain's research team is currently evaluating aquatic resources of the Cahaba and Tallapoosa rivers and assessing the impact of harvest on smallmouth bass in the Muscle Shoals area of the Tennessee River. Though most of his work involves the ecology of rivers and streams, Bain has done some research on Alabama's large reservoirs. One such study involves the use of white amur, commonly known as grass carp, to control aquatic weeds in Lake Guntersville. His report on this project is featured on page 5 of this issue of Highlights.

ON THE COVER. Turfgrass production is big business in Alabama. See related story on page 9.

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J.L. ADRIAN, JR., and W.E. HARDY, JR.

HAVE LAND VALUES IN ALABAMA "BOTTOMED OUT"?

DECLINES in the value of rural land during the 1980's contributed to financial problems confronting farmers and agricultural lenders. Farmers' and lenders' expectations of continued strong, appreciating land markets were not fulfilled. Changes in agricultural profitability occurred in response to variations in product prices, production costs, government programs, weather conditions, and international events influencing markets. While these conditions might not have had as severe an impact in Alabama and the Southeast as in other states and regions, many farmers and financial institutions experienced extreme stress due to the decline in farm asset values.

An Alabama Agricultural Experiment Station study was initiated to identify and describe changes in the farm real estate market caused by these circumstances. Data for the analysis were derived from appraisal reports and bona fide farm sales listings collected and compiled by representatives of the Farm Credit System. A total of 13,438 observations for the period of 1976-87 was available for analysis. These data were analyzed on a statewide, county, and land market area basis. As illustrated by the map, land market areas represented fairly homogeneous regions based on soil type and the nature of agricultural activity conducted there. Analyses were conducted for bare land values (i.e., real estate value adjusted for the value of improvements and marketable timber).

Values of farm real estate in Alabama increased through the 1970's and peaked in 1980 at $1,092 per acre. By 1987, values had declined to levels comparable to the mid-1970's, about $750 per acre.

On a county basis, the highest average values were noted for Baldwin, Jefferson, Madison, Mobile, and Shelby counties, areas with strong nonagricultural influences. Values in these counties ranged from about $1,300 to $2,300 per acre in the peak year to $1,100-$1,400 in 1986. Counties which tended to have the lowest average values were: Bullock, Cleburne, Coosa, Crenshaw, Randolph, and Tallapoosa. Values in these counties ranged from about $500 to $700 per acre in the peak year to $300-$700 during 1986.

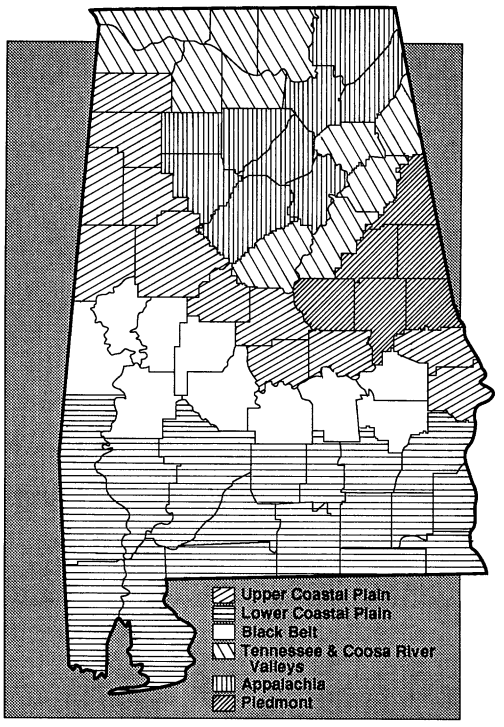
Variability in average values was similar among counties, with the majority experiencing "peak" values in 1980 (15 counties), 1981 (20 counties), and 1982 (11 counties). The greatest appreciation of values between 1976 and the "peak" year occurred in Bibb (205%), Colbert (209%), Marion (239%), and Montgomery (153%) counties.

By 1986, five counties (Cherokee, Henry, Houston, Jackson, and Marengo) had values which were basically the same as those experienced in 1976. Blount, Limestone, Monroe, Montgomery, St. Clair, and Shelby counties showed the most vitality in land markets. In these counties, increases in value experienced over the period were not totally dissipated by the downturn in land markets.

Evaluation of values based on soil type and the nature of agricultural activity indicated similar patterns of variation. Average values tended to be highest in the Tennessee and Coosa River valleys ($1,168 per acre at the peak in 1981) and Appalachia ($1,162 per acre at peak in 1980) regions where substantial nonfarm influences were present. The lowest average values ($518 per acre at the peak in 1981) were found in the Piedmont region.

For the Appalachia region, values increased 64% between 1976 and 1980. Increases in value noted for other areas between 1976 and the 1981 "peak" year were: 80% for the Upper Coastal Plain region; 41% for the Lower Coastal Plain; 73% for the Black Belt; 51% for the Tennessee and Coosa River valleys; and 54% for the Piedmont region.

Between the peak year and 1986, values declined and counties in the Lower Coastal Plain and Black Belt areas experienced declines almost severe enough to drop them to 1976 levels. Land values in the Upper Coastal Plain and Piedmont areas had the least relative decline, with respective values in 1986 being 47% and 43% higher than in 1976.



Land market areas for Alabama based on soil type and nature of agricultural activity.

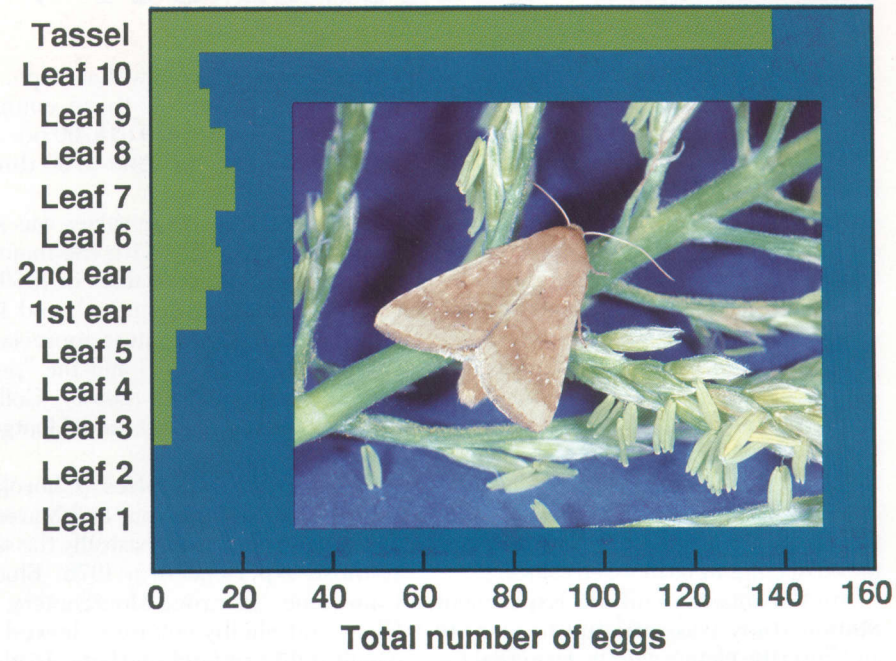
Statistical models were developed and estimated to determine the impacts that such factors as tract size, land use, location, extent of nonfarm influences, and quality of improvements have on value. Also, a variable was included to evaluate whether values were tending to bottom-out and rise. Most of the state, county, and land market models showed good structural quality. Variables that were significant served to explain an acceptable level of the variations in land values. The State, Upper and Lower Coastal Plain land market areas, and Bibb, Chilton, Dallas, Wilcox, and Winston county models indicated a tendency toward more favorable land values for these areas.

USDA reports confirm these tendencies, reporting average values being relatively constant between 1987 and 1988 and showing an increase of about 4% for the State between 1988 and 1989. Expectations are for statewide increases that are comparable to the expected inflation rate (4-6%). Larger increases are expected in counties and areas with substantial nonagricultural influences on rural land markets.

Adrian and Hardy are Professors of Agricultural Economics and Rural Sociology.

R.S. BERGER

WHAT ATTRACTS *HELIOTHIS* MOTH TO CROP PLANTS?



Distribution of *Heliothis* eggs on corn plant and (inset) *Heliothis* moth on corn tassel.

COTTON BOLLWORM, corn earworm, tomato fruitworm, soybean podworm, sorghum headworm—are all names used to describe the larvae and damaging stage of the moth, *Heliothis zea*. This one pest is responsible for more injury to cultivated crops in Alabama than any other insect. Not only does it attack several major crops, it usually feeds on and destroys the fruiting structures of the host plant, the part that the grower intended to harvest and sell.

Why does this insect choose to attack these crops? How does the female moth know to lay her eggs only on these plants and not on cocklebur or morningglory? Is there something special about them that she recognizes and is a signal to her that they offer a favorable place for the larvae that will hatch from her eggs to feed and thrive? These are some of the questions being examined by Alabama Agricultural Experiment Station research.

It is suspected that the oviposition (egg laying) of the female *Heliothis* moth is triggered by the recognition of specific messenger chemicals produced by favored host plants. By studying the oviposition habits of this insect and determining on what parts of host plant eggs are laid, Auburn researchers hope to locate the source of such messenger chemicals so that they can be isolated for identification.

By using a "purge and trap" technique, the volatile chemicals produced by various plant parts, such as corn tassels, corn silk, cotton blossoms, and blooming grain sorghum heads, were collected. Each plant sample was placed in a large container and dry nitrogen was circulated through the container. The gasses exiting from the container were passed through a small trapping device about the size of a cigarette filter. Any volatile chemicals being given off by the plant parts were collected in the trapping device. The chemicals were then flushed from the trap with a small amount of solvent. The resulting solution was analyzed on a gas chromatograph, which separates the many chemicals that might be present in a sample and determines the amount of each. The position of the "peak" for each chemical on the instrument record often allows for identification of the chemical.

When the gas chromatograph record from the volatiles collected from corn tassels was examined, one particular "peak" was especially prominent. This peak corresponded to one produced by a chemical known as ethyl phenyl acetate. The same chemical was found in cotton blossoms and blooming grain sorghum heads, but was not detected in corn silk. This compound has a characteristic odor and also is known to be present in honey. Presumably bees collect this chemical along with the nectar and pollen they gather from various flowers they visit.

Unfortunately, on most host plants, there does not appear to be any one part that is selected exclusively for egg laying. The corn plant, however, does have several distinct and separate parts where eggs can be found. Because the larvae are almost always found in the ear, and some eggs are found on the silk, many assume that the corn earworm must prefer the developing ear shoot and silk for oviposition. Studies of the location of eggs on the various parts of the corn plant, however, have revealed that the preferred site for deposition of eggs is on the blooming tassel—which is the male part of the corn blossom. As shown by the graph, more eggs were found on the tassel than on the rest of the plant.

Research by other investigators revealed that the *Heliothis* female lays more eggs on plants that are blossoming than on plants younger or older. These studies included cotton, tobacco, and soybeans, as well as corn. It would seem there is something in the flower or something is produced by the plant at the time of blossoming that is especially attractive to the female moth that is looking for a place to lay her eggs.

Berger is Professor of Entomology.

M.B. BAIN

STERILE GRASS CARP MAY CONTROL HYDRILLA IN GUNTERSVILLE RESERVOIR

Typical hydrilla growth on Guntersville Reservoir

GUNTERSVILLE RESERVOIR, the largest lake in Alabama, has a long history of serious aquatic weed problems. It is now being rapidly colonized by a new exotic plant called hydrilla. Despite water level manipulation and use of large amounts of herbicides, officials have been unable to curtail the spread of hydrilla in the reservoir. Hydrilla has developed impenetrable colonies in some high-priority recreational areas of Guntersville Reservoir and continues to double in abundance every year, threatening a major recreational industry.

The grass carp (white amur) is a voracious, herbivorous fish from Asia that can effectively control nuisance aquatic plants, especially hydrilla, with a single, high density stocking. Use of grass carp for U.S. aquatic weed control was initially proposed in 1957 by Auburn researchers. However, its use has been limited because of fear that the fish would reproduce and develop large, uncontrolled populations.

In 1983, methods were developed to produce sterile, triploid (three sets of chromosomes) grass carp that pose no long-term threat. As a result, interest in using this fish is greater than ever. Until sterile grass carp became readily available, research and trial use of this fish in large, open waters had not been attempted. Consequently, significant uncertainties exist about the ability to manage weeds with grass carp, when no constraints are placed on movement of these fish in large bodies of water.

In a cooperative research project between the TVA and the Alabama Agricultural Experiment Station (AAES), 25 sterile juvenile grass carp were released into Guntersville Reservoir in 1987 and 10 sterile adults in 1988. Both groups were surgically implanted with radio transmitters, allowing researchers to document their movement and dispersion patterns and to determine if hydrilla infested areas were preferred by the fish. Radio signal receivers were used to locate the experimental fish from summer through spring in 1987 and 1988.

The smaller 1987 grass carp moved an average of 1.4 miles during summer and reduced movement when water temperatures declined in fall (average, 1/4 mile). The 1987 grass carp tended to move upstream and typically remained in hydrilla-dominated areas (average size, 25 acres). Behavior of the 1987 grass carp indicated juvenile grass carp, like those stocked for weed control, will remain near release sites in hydrilla-infested areas for at least a growing season.

Surprisingly, the adult 1988 grass carp moved an average of 20 miles soon after stocking, did not reduce movements when water temperature declined, travelled both upstream and downstream, and ranged well beyond hydrilla colonies. Three radio-tagged fish crossed the Tennessee border soon after being released near Scottsboro. Behavior of the 1988 grass carp was not compatible with weed control needs and would suggest that mature adult grass carp could not be used in large, open waters.

Research indicated that small, stocking-size sterile grass carp can be used in large, open waters, but as stocked fish grow they will disperse widely. Reservoir managers can consider grass carp to be a potential tool, but they probably will have difficulty maintaining densities high enough for selective weed control.

Controlling dense and abundant weed colonies in Guntersville Reservoir may require large numbers of grass carp (possibly over 100,000) and repeated stockings because the stocked fish will grow and leave weed control areas. Even without reproduction, successive stocking of large numbers of grass carp could have some undesirable environmental consequences. Therefore, potential impacts were assessed in the study.

Introduction of fish diseases, changes in water quality, and shoreline erosion are potential problems associated with stocking large populations of grass carp. These are not expected to be a problem at Guntersville Reservoir because of the lake's size, topography, and water movement. Significant losses of fish habitat (weedy cover) would not be expected with moderate grass carp stockings because most shallow water plants in the reservoir are not preferred by grass carp.

There is clear evidence that grass carp can have a significant impact on some waterfowl populations by destroying hydrilla, which is a highly preferred plant for waterfowl. Case studies in Florida, and changes in the waterfowl distributions of the Southeast, indicate that grass carp consumption of hydrilla reduces local waterfowl populations. This is important because Guntersville Reservoir supports more waterfowl than any other Tennessee Valley reservoir.

Guntersville Reservoir supports a large and regionally important recreation industry that is being threatened by an expanding infestation of hydrilla. The TVA-AAES study indicates that grass carp are a potentially valuable tool for controlling hydrilla, although repeated stocking will be needed because adult fish disperse widely. Potential and significant impacts from stocking sterile, triploid grass carp appear limited; however, degradation of waterfowl habitat is a potentially significant impact that needs to be considered when developing specific grass carp stocking plans.

Bain is Assistant Professor of Zoology and Wildlife Science, Assistant Professor of Fisheries and Allied Aquacultures, and Assistant Leader for Alabama Cooperative Fish and Wildlife Research Unit.

L.U. HATCH, W.E. ZIDACK, T.A. BARNES, and T.K. THORPE

CATFISH ACCEPTANCE VARIES ACROSS U. S.

MARKET INFORMATION is a critical need for the catfish production industry. Because of this need, the USDA Southern Regional Aquaculture Center commissioned a cooperative university research group to assist in developing a more comprehensive picture of catfish markets. The Alabama Agricultural Experiment Station joined experiment stations in Arkansas, Louisiana, Mississippi, South Carolina, and Texas in a study that focused on consumer and product characteristics, substitutability, and market constraints.

Results of a national survey of 3,600 consumers provided insights into consumer attitudes toward fish in general and catfish specifically. Differences in attitudes were identified among individuals who eat both catfish and other fish and those who do not eat catfish but eat other fish. Each of nine census subdivisions was equally represented.

As a food group, fish and seafood are well accepted; 87% of respondents reported consumption. The range was from 91% in East North Central and West South Central states to 84% in West North Central States. Lowest fish eating rates were reported by the under-30 age group and people in agricultural occupations, 80% and 77%, respectively.

Sixty percent of respondents who eat fish or seafood reported they had eaten catfish. New England and Middle Atlantic consumers were lowest, 31% and 36%, respectively. The South Central states led catfish consumption with approximately 87% of consumers who eat fish and seafood. In general, characteristics associated with having tried catfish include nonsuburban, male, Protestant, and black.

In the respondents' list of "favorite fish or seafood," catfish ranked third (7%) behind shrimp (22%) and lobster (9%). Catfish ranked second to shrimp in the retail grocer survey and third to shrimp and cod in the restaurant survey. Catfish received the highest number of "favorite fish" responses (15%), followed by its closest competitor, flounder, with 6% in the consumer survey.

Consumer attitudes and perceptions about availability, quality, packaging, odor, flavor, nutrition, boniness, home preparation, and relative cost in comparison to other fish were determined. Of those who had eaten catfish, 60% rated catfish 6 or higher on a 1 to 10 scale, as reported in the table. Nutrition, ease of home preparation, flavor, and consistent quality were assets among catfish consumers. Packaging, smell, and product availability were considered liabilities.

NATIONAL CONSUMER ATTITUDES RELATED TO CATFISH

Perception of characteristic	Rating, by consumer group[1]		
	Fish only, Group 1	Have eaten catfish, Group 2	Catfish consumer, Group 3
Availability	8.32	6.75	7.20
Quality	7.66	7.30	7.88
Packaging	6.88	6.20	6.71
Smell	5.53	6.01	6.55
Flavor	7.38	7.22	7.91
Nutrition	8.92	8.15	8.58
Bones	6.18	6.58	7.13
Home preparation	7.81	7.62	8.14
Cost	5.43	6.61	7.09

[1]Group 1 = consumers who eat fish but not catfish; Group 2 = consumers who have eaten catfish at least once; and Group 3 = catfish consumers who rate catfish favorably.

It is important to note that smell was rated as less of a problem with catfish relative to other fish. In addition, relative cost to meat and fewer bones were found to be distinct advantages of catfish over other fish. These attributes might be stressed in advertising and promotional campaigns.

Packaging and nutrition perceptions are slight disadvantages to catfish compared to other fish. Both catfish consumers and the "have eaten catfish" group rated appearance and packaging of catfish lower than fish. On nutrition, both catfish consumer groups rated catfish lower than fish consumers rated fish.

There was no clear advantage to catfish or other fish in ratings of quality, flavor, and ease of home preparation. For each of these attributes, catfish consumers rated catfish higher than fish consumers rated other fish, but the "have eaten catfish" group rated catfish lower.

Most consumers do not appear to perceive a difference between farm-raised and other catfish. Only blue collar and agricultural occupations indicated such a perception. The larger degree of environmental control associated with farm-raised catfish production might be useful in dealing with health concerns about fish harvested from polluted oceans and streams.

Some attitudes among catfish consumers show distinct regional variations. However, nutrition and ease of home preparation are both highly rated in all regions of the nation. In general, the central regions rate quality high and do not rate availability a problem nor flavor an asset. In contrast, the North-Central States rate flavor high and availability low and do not rate consistent quality high. Cost is not a problem for catfish marketing in New England, Mountain, and Pacific regions. Smell and packaging are problems in all regions except New England.

Promotion might include: (1) less smell and fewer bones of catfish relative to other fish; (2) relatively low cost with respect to meat; (3) blind taste tests that establish high quality; and (4) the high quality of water in which farm-raised catfish are produced.

Hatch is Associate Professor and Zidack, Barnes, and Thorpe are Research Associates of Agricultural Economics and Rural Sociology.

R.R. HITCHCOCK and R.E. MIRARCHI

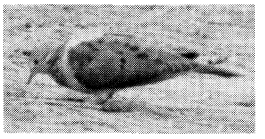
MOVEMENTS OF FLEDGLING MOURNING DOVES SUGGEST LAND MANAGEMENT PRACTICES

MOURNING DOVES are among the most popular game birds in the State. They are able to maintain almost continuous production of young during the primary breeding season (February through September). Because of this, Alabama hunters are able to harvest some 3 million birds each year. To maintain such a liberal harvest, the reproductive potential of the birds must be maximized.

This high reproductive rate of mourning doves is made possible by their nesting habits which allow them to raise five to six broods a year. Male and female doves share the incubation of a two-egg clutch for 14 days, as well as the brooding and feeding of the nestlings until they leave the nest at 15 days of age. From 15 to 17 days, as the young birds are improving their flight and survival skills, the male parent feeds the fledglings close to their former nest site. At this time the female parent begins initiating a new nest. When the fledglings become independent, the male bird rejoins the female and helps with the new brood.

One way to maximize the reproductive potential of mourning dove populations is to ensure the survival of fledglings as they become self-sufficient. Little information was available concerning the movements of fledglings during the period of dependence on parental care, so research was begun by the Alabama Agricultural Experiment Station to investigate the movements of juvenile mourning doves from nest sites.

Mourning dove nests were located in east-central Alabama from March through October. Nestlings were equipped with radio transmitters which were attached to their backs at 7 to 8 days of age with a harness made from surgical tubing. Movement data were collected from 24 fledglings. Each was located and observed for approximately 2 hours, three times daily, at 15-21, 24-27, and 30 days of age. Roost checks were conducted 30 minutes after dark on observation days.



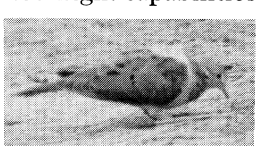
Locations used for feeding interactions with parents, and where fledglings were found for three or more observation periods, were designated as reference areas. Distances from the nest tree to reference areas were averaged by age for each fledgling. The maximum distance that fledglings were found from the nest tree on any given day and the daily distance from roost site to nest tree also were recorded. Distances of less than 275 yd. were measured by pacing and longer distances were measured using aerial photographs.

Fledglings generally loafed in reference areas within 50 yd. of nest trees until they were 27 days old. They used reference areas farther from the nest tree as they grew older, table 1. Fledglings used an average of three different reference areas during their period of dependence on parents. Reference areas were located in trees (often on particular limbs) and on the ground. Both areas had dense overhead cover interspersed with openings that facilitated parent-young feeding interactions.

The maximum distance fledglings moved each day increased with age. The rate of increase was greatest after they reached 21 days old, table 2.

Distance moved from nest trees to roost sites also increased with age. Fledglings seldom used the same roost site, probably to avoid nocturnal predators, and often moved relatively great distances to seek out new roost sites. Consequently, the maximum distance that dependent fledglings (15-17 days old) moved each day was usually to the roost site.

In summary, fledgling mourning doves 21 days of age or younger have limited flight capabilities and usually stay within reference areas where they are fed by male parents. By 21 to 24 days of age, fledglings are capable of feeding themselves and, when deprived of parental care, will fly moderate distances to abundant food sources. Fledglings 27 to 30 days of age are capable of flying with flocks of juvenile and adult mourning doves, and travel great distances to food sources. Fledglings usually abandon reference areas and become independent of their parents when they attain this level of flight capability.



These results suggest that landowners should conduct certain land management practices, such as bushhogging and prescribed burning, to periods when the fledgling populations would be least affected by such activities (October to March).

Hitchcock is former Graduate Student and Mirarchi is Professor of Zoology and Wildlife Science.

TABLE 1. AVERAGE DISTANCES BETWEEN REFERENCE AREAS AND NEST TREES RELATIVE TO AGE OF FLEDGLING

Age, days	Fledglings sampled	Distance
	No.	*Yd.*
15	22	6.5
16	23	12
17	23	18
18	23	22
19	22	23
20	22	25
21	22	30
24	20	42
27	15	45

TABLE 2. MAXIMUM DISTANCE MOVED FROM NEST TREE BY DIFFERENT AGED FLEDGLINGS

Age, days	Fledglings sampled	Maximum distance from nest tree
	No.	*Yd.*
15	24	96
16	23	176
17	21	78
18	24	98
19	23	281
20	22	132
21	23	279
24	22	377
27	21	812
30	19	1,609

P.M. ESTES, G.D. GRAY, and W.C. JOHNSON

MANAGEMENT OPTIONS AVAILABLE FOR HESSIAN FLY CONTROL

IN 1989, wheat yields of 5-10 bu. per acre were common in some fields in central and south Alabama. These poor yields were mostly a result of severe infestation of the Hessian fly, *Mayetiola destructor*. Prior to 1980, outbreaks of Hessian fly occurred only every 7 or 8 years, but during the last decade this species has been a regular pest of small grains in Alabama. Research in the Alabama Agricultural Experiment Station was initiated to evaluate various methods of Hessian fly management.

The Hessian fly is common in all of the wheat-growing areas of the United States. It goes through the summer in wheat straw. Adults emerge in the fall, usually after a cooling trend and rain, and lay eggs on the leaves of wheat, barley, rye, or triticale. Eggs hatch in a few days and larvae crawl down the leaf and begin feeding within the leaf sheath. Feeding results in stand reduction, weakened nodes, lodging, and reduced grain fill. In Alabama there may be as many as five generations per year and during mild winters adults can be found from September to June.

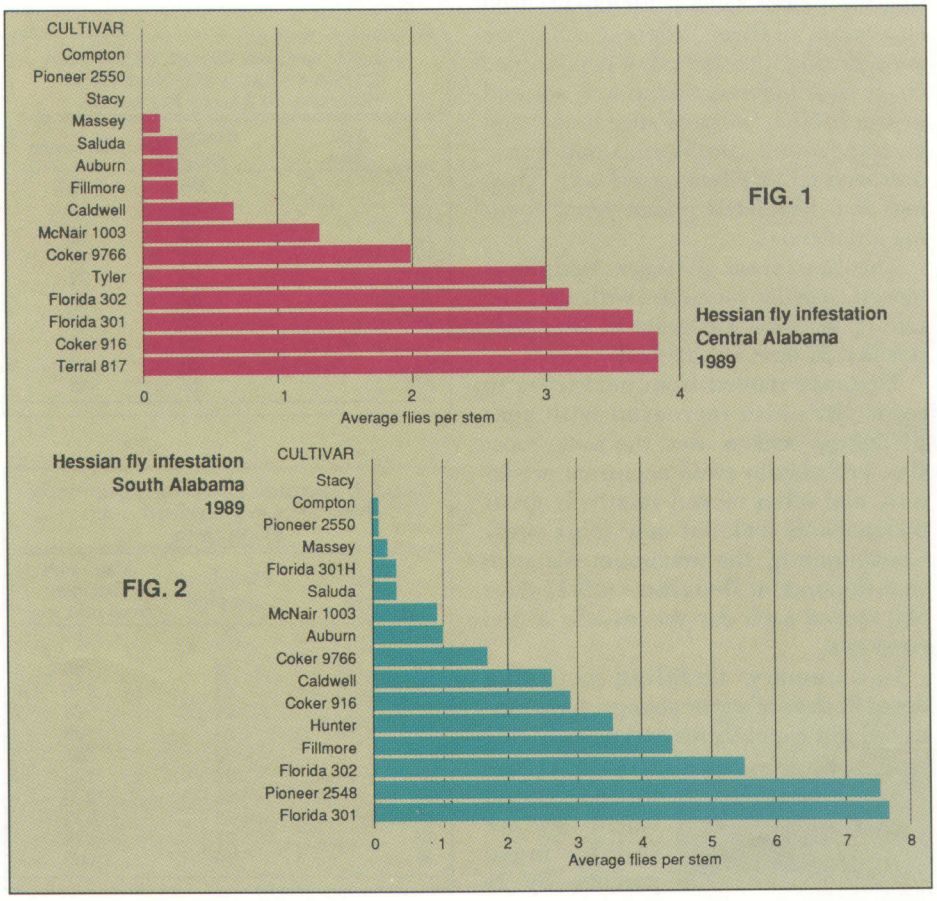
Hessian fly control in the winter wheat-growing regions of the United States has been obtained by delaying planting until the period for fly oviposition (egg laying) has passed. However, in Alabama adults may be present throughout the fall, winter, and spring. In tests at the Plant Breeding Unit near Tallassee, yields of untreated susceptible wheat cultivars were about the same regardless of planting date.

In these tests, in-furrow treatments of disulfoton at planting increased yield of susceptible varieties (Florida 302 and Terral 817) 10-12 bu. per acre. However, use of insecticides on nonsusceptible varieties (Massey and Stacey) had little effect on yield. Susceptible varieties contained an average of eight flies per stem, compared to zero for nonsusceptible ones.

Because of the severe Hessian fly infestation during 1988-89, records were taken of crop damage in small grain variety trials at the Lower Coastal Plain Substation in Camden (central Alabama) and at the Gulf Coast Substation in Fairhope (south Alabama). In both locations, several varieties were outstanding in their resistance to fly infestation, figures 1-2. Varieties listed that have two or fewer flies per stem can probably be considered resistant to moderately tolerant. In some cases, susceptible varieties such as Terral 817 and Florida 301 had as many as 25 to 30 Hessian fly puparia in a single stem.

Number of flies per stem is not always an accurate indicator of resistance, because some cultivars, such as Coker 9766, can tolerate a low to moderate infestation and show little yield reduction or damage. Planting wheat varieties resistant to the fly has been complicated by its ability to develop races that will attack previously resistant varieties. Consequently, varieties that have a low infestation one year may be heavily infested the next, and growers should be aware of this when selecting a variety to plant.

Effective management of Hessian fly requires the consideration of all available techniques. In Experiment Station tests, the choice of a resistant cultivar that has the required agronomic characteristics to produce good yields has been the best approach. Research also indicates the potential value of planting time treatments of insecticides and/or later planting dates.



Estes is Assistant Professor of Entomology; Gray is former Graduate Student and Johnson is Professor of Agronomy and Soils.

J.L. ADRIAN, JR., R. WHITE, and R. DICKENS

ALABAMA'S TURFGRASS-SOD INDUSTRY SHOWS STEADY GROWTH

TURFGRASS-SOD production emerged as an important farm enterprise in Alabama during the last decade. Little was known about the nature and economic status of the industry until an Alabama Agricultural Experiment Station study in the late 1970's provided technical and economic information about this agricultural enterprise and industry. About 10 years later, the Experiment Station undertook a follow-up study to ascertain progress of the industry.

Comparison of surveys of State sod producers in 1978 and 1987 shows Alabama's turfgrass-sod industry has grown at a rapid pace over the last decade. It increased from about 3,300 acres and 30 producers in 1978-79 to 14,000 acres and 85 producers in 1987-88.

Turfgrass-sod operations are currently located in 41 of Alabama's 67 counties. Baldwin County has the most acreage, about 3,500 acres. Calhoun, Lee, St. Clair, and Talledega counties are also production centers. These top five counties contribute almost two-thirds of the total acreage in the State.

Bermudagrass is the dominant species produced in the State, comprising 56% of the identified acreage in 1978-79 and 52% in 1987-88. Next in importance for 1987-88 are zoysiagrass with 25% (3,375 acres) and centipedegrass with 22% (2,970 acres) of the total. The proportion of total production for both of these grasses increased slightly from 1978-79 to 1987- 88.

Over the time period analyzed, farm level gross sales expanded from about $4 million in 1978 to approximately $28 million in 1988. Bermudagrass was the primary contributor to receipts in both periods, with 60% of the total in 1978-79 and 61% in 1987-88. Zoysiagrass and centipedegrass were of about equal importance, each comprising 20% of sales in each period. In relative terms, sales of zoysiagrass declined slightly while sales of centipede, St. Augustine, and fescue increased slightly between the two time periods.

Landscape and building contractors are the major market outlet for turfgrass-sod in Alabama. These entities purchased almost two-thirds of the product in 1978-79 and half in 1987-88. In the latter period, landscape contractors purchased 30% of the grass, while building contractors purchased 20%. The decline in purchases by contractors between the two time periods was offset by increases in purchases by garden centers (18 to 24%), homeowners (12 to 20%), and golf courses (4 to 6%).

Most of the turfgrass-sod operations in Alabama are relatively small. Sixty-one percent of the producers (52) had operations of less than 100 acres in 1987-88. Nineteen percent of the producers (16) had farms in the 100-250 acre grouping, while 16 and 4% were included in the 250-1,000 and greater than 1,000 acres groupings, respectively.

While the industry is comprised primarily of small operations, a few firms control most of the acreage. The three largest firms had 45% of the total acreage in the 1987-88 period and the largest 20% of the firms (17 with more than 250 acres) controlled 80% of the acreage. Thus, the industry is highly concentrated among the few largest firms.

Preliminary estimates indicate that production costs per acre of sod marketed increased from about $2,700 in 1978-79 to $3,150 in 1987-88. Similar estimates for an investment outlay for a 150-acre farm increased from $550,000 in 1978-79 to $800,000 in 1987-88, a 45% increase. Given these input levels, it appears obvious that management skills are important in influencing the success of turfgrass-sod operations.

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J.C. McKISSICK, N.R. MARTIN, and E.F. KOLAJO

ALTERNATIVE PRICING METHODS REDUCE RISKS WITH STOCKER CATTLE

ALABAMA CATTLEMEN produce an estimated 800,000 to 900,000 head of feeder cattle annually. Most of these are shipped to feedlots outside the Southeast, primarily in Texas, Oklahoma, and Kansas.

Alabama's long growing season for forage and a large supply of lightweight calves offer opportunities for profitable stocker production. However, producers face significant management problems because of price risk associated with unstable buying and selling prices. In addition, there is a large cash outlay for the major input, the feeder calves. Therefore, stocker operators must consider more complex forms of pricing strategies than crop producers who are influenced by government price support programs.

Several alternatives are available to help reduce price risk. Forward pricing through the futures market provides a way of transferring price risk (hedging) from producers to speculators. The relatively new options market for fed and feeder cattle also provides an outlet, but little information is available to adapt the options market for stocker operations. Therefore, this alternative was included in an Alabama Agricultural Experiment Station evaluation of alternative pricing strategies for Alabama stocker producers. The alternatives studied were the cash market, the feeder cattle futures market, and the feeder cattle options market.

Only the cash market was available for Alabama cattlemen prior to 1971, the year the feeder cattle futures market was introduced. Options on feeder cattle futures were added to the pricing alternatives in January 1987.

A fall/spring stocker system, using 350-lb. steer calves grown out on winter grazing until May, was chosen as the production system for the Auburn analysis. Production costs which affect short-term decisions, representing approximately 86% of all nonland, labor, and management costs for such operations, were used.

Three pricing methods were compared:

1. Cash market price—Existing price for 600- to 800-lb. steers during the second full week of May in various Alabama markets.

2. Futures market (hedging)—Cattle placed on pasture in November and contracted for sale (at a specified price) in the second week of May. The cost of this hedging transaction was the brokerage commission and the interest charge (or lost interest income) of the margin money required to cover the transaction.

3. Options market (simulated)—A forward pricing method whereby cattle producers can (by paying a premium) establish a price floor in November for stocker cattle to be sold in May. If May cash prices are lower than the floor price already established, the producer exercises the option established in November and receives the guaranteed price. If the May cash price is above the price floor set by the option, the producer lets the option expire and sells for the higher cash price.

Using one or more of the pricing methods along with one or more pricing indicators, such as economic forecasts, constitutes a pricing strategy. Comparisons of many such strategies indicate that forward pricing is an important part of a successful pricing strategy for Alabama stocker producers. Furthermore, the feeder cattle options market alternative offers risk and return characteristics similar to more sophisticated hedging strategies.

When the only available forward pricing method is hedging, producers typically use the cash sales with no forward pricing (the maximum risk/return strategy). In contrast, the options-only strategy would be expected to return an additional 2.0%, and with about half the expected risk.

At comparable risk levels, efficient option marketing offered 2.0-2.4% greater returns than hedging. This amounts to about $1.00-$1.20 per hundredweight more than when only hedging strategies were used (based on $49 per hundredweight cost of production).

The options-only strategies eliminated less risk than hedging. For those unwilling to accept risk, strict hedging is the best alternative. Producers willing to accept moderate to high risk can use the option strategies satisfactorily. Its risk/return pattern is similar to the most efficient pricing strategies, and at a cost of only about $1 per hundredweight in reduced returns.

Most Alabama cattlemen probably are unaware of how to access the futures market and of the potential trade-off between risks and returns. Many producers are new to the stockering enterprise and are more familiar with other enterprises in which income risk is dominated by yield uncertainty rather than marketing uncertainty. Results of this study should provide motivation for considering use of the futures market. The results indicate that hedging used with price indicators offers significant opportunities for reduced risk and increased return as opposed to routine hedging only.

Producers who cannot use the futures market should benefit from learning about using the feeder cattle options market. The use of option pricing provides a simple forward pricing alternative that overcomes transactional problems associated with futures contracts.

Small operations might make use of alternative marketing methods by grouping together through marketing associations or other cooperative organizations to capture the benefits from effective pricing strategies.

McKissick is former Graduate Research Assistant, Martin is Professor, and Kolajo is former Research Associate of Agricultural Economics and Rural Sociology.

B.R. MOSS, J.L. HOLLIMAN, S. SOLAIMAN, and D.I. BRANSBY

AU Triumph Fescue Promising As Dairy Cow Pasture

PERENNIAL PASTURES that support high milk production would be welcomed by Alabama dairymen. Such pasture has generally been considered an impossibility, with only cool season annuals providing forage quality needed by high producing cows. Now there is research evidence that AU Triumph tall fescue can support milk production similar to winter annuals if a higher level of concentrate feed is provided.

Following the discovery at the Black Belt Substation in the late 1970's of the association between an endophytic fungus, *Acremonium coenophialum*, in tall fescue and poor weight gains in beef cattle, it became evident why milk production on fescue was so poor. Since that time, many studies have compared beef production on infected and fungus-free fescue, and several fungus-free varieties of tall fescue have been released. For dairy cattle, however, a more useful comparison would be between fungus-free fescue and winter annuals (which constitute the current alternative), but little is known about the potential of fungus-free fescue as a dairy pasture. The purpose of this Alabama Agricultural Experiment Station study was to compare milk production from a mixed pasture of wheat and annual ryegrass with that from AU Triumph, a fungus-free variety of tall fescue released several years ago by the AAES.

In March 1988, 18 Holstein cows were assigned to one of three treatment groups for a 6-week study. The treatments were (1) AU Triumph stocked at one cow per acre, (2) AU Triumph stocked at two cows per acre, and (3) wheat and ryegrass pasture stocked at two cows per acre. The cows remained on pasture day and night, except for milking, and for about an hour following milking, during which time they were fed a 20% protein/grain mix. The grain mix was given to individual cows at the rate of 1 lb. for each 2.5 lb. of 4% fat-corrected milk they produced during the 2 weeks before the study began.

Milk was weighed at each milking, and a morning and afternoon milking was sampled weekly for butterfat and protein analysis.

Pastures were subdivided into three equal sections by an electric fence, and each section was grazed for 1 week at a time. The amount of forage available was measured before and after grazing to estimate forage consumption. Forage samples were taken weekly for quality analysis.

Results in the table show that the wheat/ryegrass pasture was a little taller than AU Triumph, but all pastures were grazed down to about the same level by the time the cows were moved to the next section. Moisture, protein, and total digestible nutrients contents were higher and acid detergent fiber was lower for winter annuals. Pasture consumption per cow on AU Triumph was higher on the low stocking rate compared to the high stocking rate, presumably due to available forage per cow. Consumption of wheat/ryegrass pasture was higher than for AU Triumph at equivalent stocking rates. Cows on AU Triumph consumed all the grain mix offered to them, but those on winter annuals refused some.

Total milk production, butterfat, protein content, and fat-corrected milk differed among treatments. Butterfat was lower on winter annuals, but was partially compensated for by slightly higher milk production as indicated by the fat-corrected milk level. The lower butterfat content is of concern to producers because milk price depends on butterfat content; however, feeding 3 to 6 lb. of hay before releasing cows onto pasture each day should limit this problem. Buffers have been tried for this purpose with ryegrass, but provided no benefit.

Feed and pasture cost was highest for the low stocking rate on AU Triumph, intermediate for the high stocking rate, and lowest for winter annuals. The high stocking rate on AU Triumph clearly reduced pasture costs per cow compared to the low stocking rate. The low feed costs for milk production observed on winter annuals is attributed mainly to reduced composition of the grain mix.

Results from this study show that both AU Triumph fescue and wheat/ryegrass pastures can support high milk production when stocked at two cows per acre. However, higher consumption of grain mix is required for AU Triumph.

PASTURE DESCRIPTION, FEED AND PASTURE CONSUMPTION, AND MILK PRODUCTION ON AU TRIUMPH AND WINTER ANNUAL PASTURE

Performance measure	Result, by pasture and stocking rate		
	Fescue		
	1 cow/ acre	2 cows/ acre	Wheat/ryegrass, 2 cows/acre
Pasture description			
Av. height before grazing, in.	11.0	10.4	13.3
Av. height after grazing, in.	4.3	3.8	4.1
Moisture content, pct.	71.4	73.5	81.5
Protein content, pct.	19.0	17.8	22.3
Acid detergent fiber, pct.	27.1	26.6	23.5
Total digestible nutrients, pct.	70.9	71.3	73.8
Daily consumption per cow			
Pasture, wet weight, lb.	114	91	142
Pasture, dry weight, lb.	32.5	24.1	26.2
Grain mix, lb.	20.0	20.0	13.9
Daily production per cow			
Milk, lb.	55.6	58.0	59.0
Butterfat, pct.	3.47	3.47	3.15
Protein, pct.	3.18	3.25	3.18
Fat-corrected milk, lb.	55.3	57.8	55.5
Average daily gain, lb.	.10	.47	.03
Feed and pasture cost/cwt. of milk[1]	$3.66	$3.11	$2.54

[1]Estimated by assuming pasture production costs of $120 and $70 per acre for winter annuals and AU Triumph, respectively, a 150-day grazing period for both pastures, and a price of $170 per ton of grain mix.

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R.R. HARRIS, D.I. BRANSBY, N.R. MARTIN, N.R. McDANIEL, and W.B. WEBSTER

MODERATE PASTURE STOCKING RATE BEST

JUST AS moderation is advisable in many areas of living, so is moderation a useful guide in such things as steer stocking rate on winter annual pastures. Too many animals per acre result in low per animal daily gain, while too few animals cut beef gain per acre. Best overall production comes from an intermediate (moderate) stocking rate that makes efficient use of available forage for good gains per animal and per acre.

That is the obvious lesson coming from new Alabama Agricultural Experiment Station research underway at the Gulf Coast and Tennessee Valley substations. The study was begun in the fall of 1987 to determine the effect of stocking rate on performance of steers grazing cool season annual pastures.

Four test pastures were planted to rye (90 lb. seed per acre), ryegrass (30 lb. seed), and a mixture of arrowleaf, ladino, and red clovers (3 lb. seed of each per acre). Another four pastures were planted to rye and ryegrass without clover. The pastures were fertilized in the fall with phosphorus and potassium according to soil test. Nitrogen was added at the rate of 100 lb. per acre in the fall and another 60 lb. per acre in the spring.

The pastures were grazed at four stocking rates, ranging from 1 to 3 yearling steers per acre. Steers were Hereford, Angus, and Hereford-Angus crosses at the Tennessee Valley Substation and British-Brahman crosses at the Gulf Coast Substation. Average weight of steers was 518 lb. when stocked January 20 at the Gulf Coast and November 14 at the Tennessee Valley Substation. Grazing was started late at the Gulf Coast because pastures were planted following a soybean crop, and dry fall weather slowed pasture development.

Average daily gain was highest at a stocking rate of about 1.6 steers per acre. As shown by data in the table, however, gain per acre was maximized at slightly above 2 steers per acre. Therefore, the best compromise appears to be between 1.8 and 2.0 steers per acre.

The lowest stocking rates resulted in low average daily gains per animal and low production per acre. These pastures were definitely under-utilized, resulting in a dominance of low quality rye and wasted forage in spring. At the intermediate stocking rates, more of the high quality ryegrass forage was available, which contributed to higher gains.

At the highest stocking rates, cattle had only limited amounts of forage available. This caused poor animal daily gains.

Clover made up only a small proportion of forage in the grass-clover pastures. Thus, it did not contribute much to rate of gain or total gain per acre. With high quality rye and ryegrass, clover should not be expected to improve rate of gain. However, adding clover to the pasture mix would typically lengthen the grazing season.

The Tennessee Valley Substation had similar average daily gains but higher per acre gains than pastures at the Gulf Coast Substation. This probably reflected the longer grazing season at the Tennessee Valley (170 days vs. 119 days at the Gulf Coast). Under normal weather conditions, however, 150 to 180 days of grazing can be expected in south Alabama.

Following grazing, the cattle were full-fed a blended fattening mixture until sold for slaughter at an average grade of high Select to low Choice. At the Gulf Coast Substation, the feedlot period was 14 days longer for steers from heavily grazed pasture because they were shifted to the feedlot when forage was exhausted. The feedlot period was the same for all treatments at the Tennessee Valley Substation.

Rate of gain in the feedlot generally was inversely related to daily gain on grazing at the Gulf Coast Substation, but not at the Tennessee Valley Substation. In other words, cattle from the heavily grazed pastures (that gained slowly on pasture) tended to compensate during the feedlot period. Compensatory gain was lower at the Tennessee Valley Substation where grazing gains were less variable (1.7 to 2.3 lb. per day) than at the Gulf Coast location (1.0 to 2.5 lb. per day). As expected, feed conversion was inversely correlated to rate of gain, with values being within a normal range of 8 to 11 lb. feed per pound of gain.

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INFLUENCE OF STOCKING RATE ON STEER PERFORMANCE AND SPECIES COMPOSITION

Measure	Result, by steers stocked/acre							
	Gulf Coast				Tennessee Valley			
	1.0	1.7	2.3	3.0	1.2	1.6	2.0	2.4
ADG on pasture, lb.	2.3	2.5	2.3	1.0	2.3	2.3	2.0	1.7
Gain/acre from grazing, lb.	288	538	582	350	463	623	690	673
Feedlot ADG, lb.	2.0	2.1	2.3	2.6	2.6	2.6	2.6	2.4
Feed/lb. of gain	11.1	10.0	9.6	8.3	9.1	9.8	9.5	9.3
Days in feedlot	152	152	166	166	98	98	98	98
Pasture composition								
Rye, pct.	*66*	*28*	*2*	*0*	*76*	*62*	*18*	*2*
Ryegrass, pct.	*23*	*71*	*97*	*99*	*20*	*35*	*80*	*95*

D.L. HUFFMAN, T.F. WHITE, and W.R. EGBERT

NEW METHOD FOR BREAKING BEEF CARCASSES PROVIDES BETTER CUTS, MORE PROFIT

AN ALTERNATIVE method for breaking beef carcasses may help provide higher quality cuts of meat for consumers while increasing profits for beef producers.

After slaughter, beef carcasses are chilled and then divided (or fabricated) into primal cuts (round, loin, rib, and chuck), subprimal cuts (sirloin, ribeye roll, tenderloin), and fabrication products such as lean trimmings, fat, and bone. The distribution of weight among the primal and subprimal cuts, as well as the possible resulting cuts, depends on how the carcass is broken and the orientation of the cuts made during fabrication. Cuts resulting from the rib and loin primals are typically higher priced cuts. These account for the majority of the price differences between carcasses with respect to carcass quality grade.

A study conducted through the Alabama Agricultural Experiment Station considered an alternate carcass breaking method which would provide more high quality cuts for consumers while making beef carcasses more valuable to the producer. It involved (1) breaking the forequarter and hindquarter (loin from the rib) of the carcass between the tenth and eleventh rib rather than the twelfth and thirteenth rib, and (2) separating the primal rib from the chuck primal between the second and third rib rather than the fifth and sixth rib.

The alternative processing method also called for separating the primal round into subprimal cuts by following natural muscle seams. This approach increases the proportion of high priced cuts in the carcass and therefore adds value to the beef carcass.

Eight lean and eight typical 650-lb. carcasses were selected from a packing plant on the basis of yield grade and quality grade. Lean carcasses had an average yield grade of 1.7 and a quality grade of high USDA Select. Typical carcasses had a yield grade of 3.0 and a quality grade of low USDA Choice. One side of each carcass was broken by the alternative method while the other side was broken conventionally.

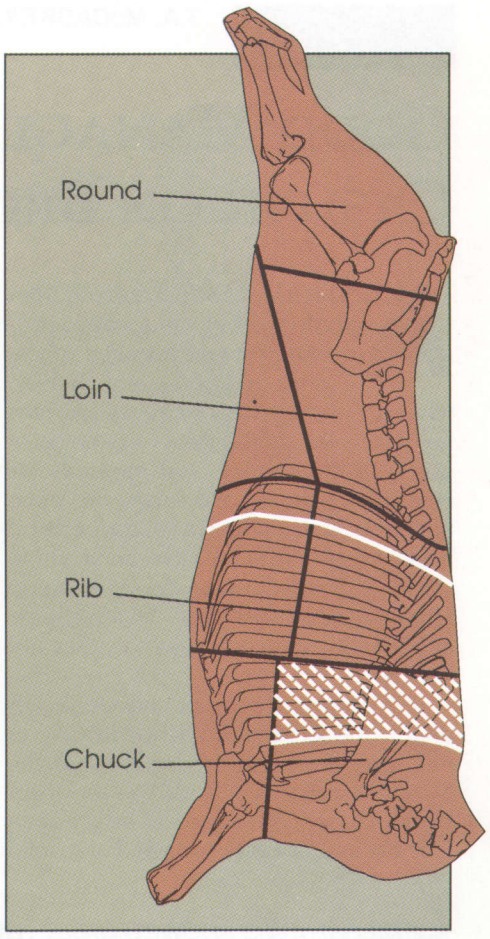
Results show that the two breaking methods yielded different proportions of retail cuts from the chuck, rib, loin, and round primals, table 1. The ribeye roll and loin strip (high value cuts) accounted for a greater percentage of retail cuts when the alternative fabrication method was used (36.6% for lean carcasses, 36.5% for typical) as compared to the conventional method (31.6% lean, 33.4% for typical).

Typical carcasses were fatter than lean carcasses, with approximately 6% more waste fat, table 2. Thus, lean carcasses provided greater percentages of saleable meat products. The alternate method provided less total retail cuts (2.90%) though this difference was accounted for by greater percentages of lean trim (1.62%), ground beef (0.45%), and trimmable fat (0.83%) as compared to the conventional method. This variance occurred because the alternative method of cutting beef included closer trimming of the cuts.

Market value of carcasses and resulting products of fabrication were assigned values and used to determine profitability differences between carcass types using both fabrication methods.

Lean carcasses were substantially more profitable than typical carcasses ($3.60 per cwt.) and the alternative method was consistently more profitable ($1.43 per cwt.) than the conventional method. The alternative breaking method has the potential to add $9.30 to the value of a 650-lb. carcass.

This study shows that lean carcasses are more profitable for fabrication than typical carcasses and that the alternative carcass breaking method will enhance the overall return from the beef carcass.



Shaded area indicates increase in high value cuts obtained by using alternative breaking method.

TABLE 1. PERCENTAGE OF RETAIL CUTS FROM THE PRIMALS OF THE BEEF CARCASS

Primals	Pct. retail cuts, by breaking method and carcass types			
	Alternative		Conventional	
	Lean	Typical	Lean	Typical
	Pct.	*Pct.*	*Pct.*	*Pct.*
Chuck	22.3	23.4	28.1	28.3
Rib	14.3	15.6	11.2	12.4
Loin	22.3	20.9	20.4	21.0
Round	35.6	34.8	35.4	33.2
Other[1]	5.5	5.3	4.9	5.1

[1]Boneless brisket and flank steak.

TABLE 2. DISTRIBUTION OF CARCASS COMPONENTS FROM FABRICATION

Component	Pct. carcass weight of components, by breaking method and carcass type			
	Alternative		Conventional	
	Lean	Typical	Lean	Typical
	Pct.	*Pct.*	*Pct.*	*Pct.*
Retail cuts	30.96	28.93	34.61	31.06
Lean trim ..	3.84	2.95	1.66	1.90
Ground beef	28.01	27.11	27.43	26.80
Waste fat ..	19.72	25.92	18.91	25.06
Bone	17.47	15.11	17.39	15.18

Huffman is Professor, White is former Graduate Research Assistant, and Egbert is Research Associate of Animal and Dairy Sciences.

T.A. McCASKEY, A.H. STEPHENSON, and B.G. RUFFIN

GOOD MANAGEMENT NECESSARY TO CASH IN ON BROILER LITTER RESOURCE

ANIMAL WASTES derived from poultry, beef, and swine production contain nitrogen, phosphorus, and potassium (N-P-K) which can be used as a source of low-cost fertilizer nutrients, or as a source of crude protein, fiber, and minerals for ruminant animals. However, the same nutrients that make these agricultural by-products valuable also make them sources of environmental pollutants. Hence, animal wastes can be a resource or a liability, depending on how they are managed.

In Alabama, the major collectable animal waste is broiler chicken litter. Annual production of broiler litter in the State is estimated at 2 million tons (wet basis). Essentially all of the litter is collectable and is easily managed as a solid material. Much of the litter is treated as a waste for disposal, usually deposited directly on land. When application of litter exceeds 10-12 tons per acre per year, excessive nutrient loading of the soil can cause concern for surface and groundwater contamination.

Litter samples showed great variation in nutrient content.

Expanding the use of litter as a nutrient resource would be a prudent way to regain some of the fixed costs of handling litter, cut down on the use of more expensive nutrient sources, and alleviate some of the concerns about its impact on water quality. But litter nutrient content and quality have proven to be limiting factors in the use of litter as a resource. A recent Alabama Agricultural Experiment Station study investigated these issues by analyzing 106 samples of broiler litter collected at several locations in Alabama, some collected from broiler houses and some from stacks of litter held for various periods of time.

These litter samples showed great variations in nutrient content. The nitrogen content (dry basis) ranged from a low of 2.3% up to 6.0%, with an average of 4.0%, table 1. Crude protein (N x 6.25) ranged from 14.4 to 37.5% and averaged 24.9%. Ash content (total minerals) of the samples ranged from 8.9% to 54.4%. Dirt collected inadvertently from the broiler house floor when litter is removed will raise ash content. Litter that has 19.5% moisture (average) and 54.4% ash contains 73.9% of non-organic nutrients. Therefore, moisture and ash dilute litter's nutrient components such as crude protein.

If litter is being considered for use as a low-cost fertilizer or as an alternative crude protein source for ruminants, it is important to have the litter analyzed to determine its nutrient content. Based on the survey results, broiler litter of average composition has an estimated value as a fertilizer replacement of $27.59 per wet ton of litter, table 2. The value of litter in an 80% litter, 20% ground corn diet for beef cattle to replace a diet of corn, Coastal hay, and soybean meal is estimated at $104.95 per wet ton of litter, based on current feed prices.

Good quality litter purchased for use as a fertilizer should contain in excess of 3% nitrogen on a dry basis. If used as an alternative, low-cost crude protein source for ruminants, litter should have 3% or more nitrogen (18.8% crude protein). Less than 25% of the nitrogen should be insoluble, and the ash content should not exceed 30 percent.

Management of litter has a great impact on the by-product's nutrient value. If dirt is mixed with the litter when it is collected from the broiler house floor, ash content will be higher. Management of the litter after it is removed from broiler houses and stored, usually by stacking, can affect its value as a crude protein source for ruminants. Previous research has shown that if litter heats excessively in a stack, which is evident by its dark, crumbly appearance, much of the litter's crude protein will become insoluble and unavailable to ruminants.

TABLE 1. ANALYSIS OF BROILER LITTER COLLECTED IN ALABAMA[1]

Component	Minimum	Maximum	Mean
Dry matter, pct.	61.0	95.3	80.5
Pct. of dry matter			
Nitrogen (N)	2.3	6.0	4.0
Crude protein	14.4	37.5	24.9
Crude fiber	10.8	51.6	23.6
Acid detergent fiber	18.0	69.1	41.1
Bound nitrogen[2]	5.1	64.3	15.0
Ash (minerals)	8.9	54.4	24.7
Ca	.81	6.13	2.31
K	.73	5.17	2.32
Mg	.19	.88	.52
P	.56	3.92	1.56
S	.22	.83	.50
Cu (p.p.m.)	25	1,003	473

[1]Minimum, maximum, and mean of 106 samples.
[2]Percent of total nitrogen.

TABLE 2. REPLACEMENT VALUE OF AVERAGE QUALITY BROILER LITTER, 1989 PRICES[1]

Component replaced	Amount replaced per ton	Value per ton
	Lb.	*Dol.*
As fertilizer		
Nitrogen	64	15.36
P_2O_5	58	6.38
K_2O	45	5.85
Total		27.59
As feed[2]		
Corn	550	30.94
Soybean meal	273	36.31
Coastal hay	1,178	37.70
Total		104.95

[1]Based on regional prices of nitrogen ($0.24/lb.), P_2O_5 ($0.11/lb.), K_2O ($0.13/lb.), corn grain ($3.15/bu.), soybean meal ($266/ton), and Coastal bermudagrass hay ($64/ton).
[2]Based on a ration containing 80% broiler litter and 20% corn compared to a ration containing 41.5% corn, 47.6% Coastal hay, and 10.9% soybean meal.

The study illustrated the need for careful litter management practices to ensure that quality characteristics are preserved. By enhancing the economic value of this by-product, producers can help promote economy in plant and ruminant animal production and reduce the impact of this nutrient resource on the environment.

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C.C. MITCHELL and A.E. HILTBOLD

INDUSTRIAL WASTE PRODUCTS PROVIDE CROP NUTRIENTS

LANDFILLS are filling, public resistance to new ones is increasing, yet wastes continue to accumulate. But is it all waste? Plant nutrients such as nitrogen, phosphorous, potassium, and sulfur are valuable components of industrial "wastes" which may be used to advantage by hungry crops. Now industrial manufacturers and agricultural researchers are exploring economical ways to salvage these nutrients and turn wastes into valuable products.

When officials with a Mobile-area company noticed their waste products were promoting the growth of bahiagrass at disposal sites, an Alabama Agricultural Experiment Station study was instituted to help evaluate this waste as a potential crop nutrient source.

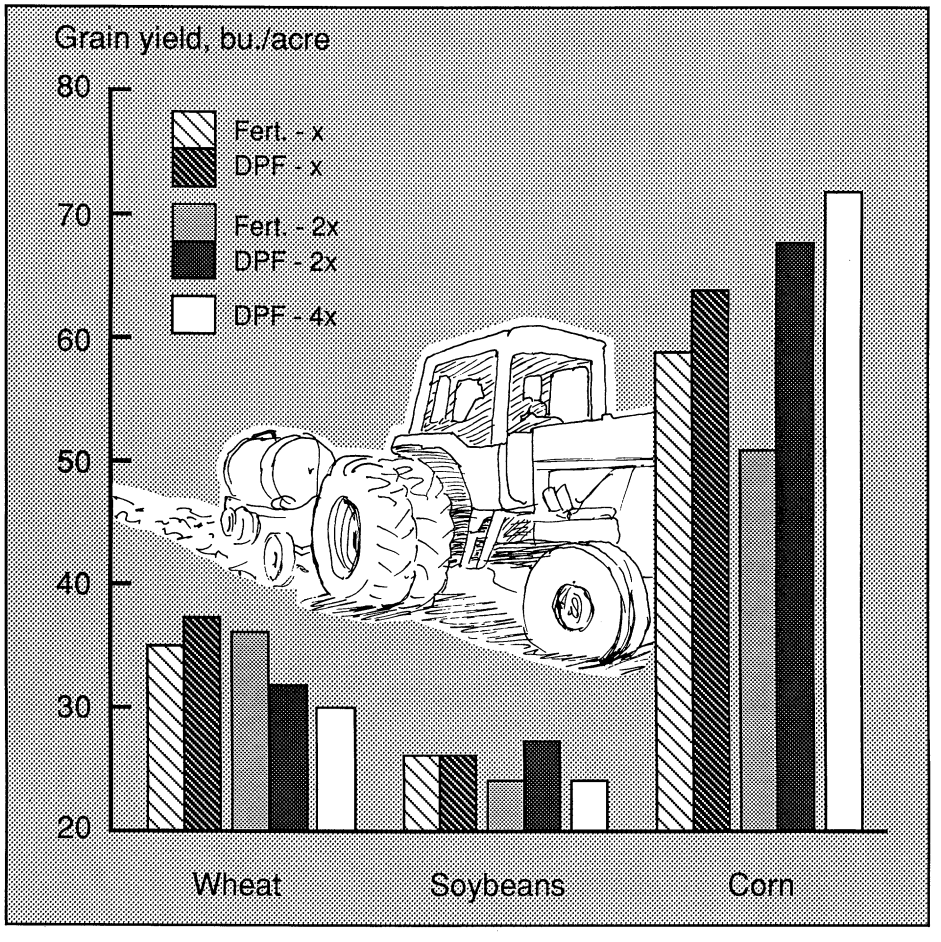
The waste product, produced during the manufacturing of methionine (an amino acid) as a livestock feed supplement, is a water solution of potassium bicarbonate with smaller amounts of amino acids and organic sulfur compounds. Analysis of this product on a fertilizer basis showed a nutrient content of 2-0-12 (N-P_2O_5-K_2O) and 3% sulfur, suggesting it is potentially a valuable source of potassium for crops with fringe benefits of nitrogen and sulfur.

AAES studies compared this waste product, known as Degussa's Potassium Fertilizer (DPF®), with commercial fertilizers in field experiments at the E.V. Smith Research Center in Shorter. DPF was applied at planting to millet in 1985, to wheat in 1986, and to corn in 1988. Rates used included a control rate (120 lb. K_2O per acre) to provide potassium as recommended by the initial soil test, as well as a double rate (240 lb. K_2O) and a quadruple rate (480 lb. K_2O). Other treatments used muriate of potash (KCl), ammonium nitrate, and gypsum as sources of potassium, nitrogen, and sulfur, respectively. Supplemental fertilizer nitrogen was used with the DPF treatments to ensure equal concentrations of nitrogen on all tests. Soybeans were grown in 1987, utilizing residues of 1985 and 1986 applications.

Crop yields with DPF did not differ from those with commercial fertilizer, as illustrated by the graph. These results were verified in a greenhouse experiment comparing DPF with equivalent rates of ammonium nitrate and muriate of potash. In a soil deficient in nitrogen and potassium, yields of sorghum-sudangrass and corn responded equally to DPF and fertilizer salts. Plants recovered 65% of the nitrogen and 59% of the potassium in DPF, the same as they absorbed from the fertilizer salts. Rates of DPF up to four times the recommended rate of potassium had no detrimental effects on crops grown in the field or greenhouse.

These results were not surprising. Potassium carbonate has long been recognized as an excellent source of fertilizer potassium, but it is not generally used by growers because of its cost and availability. DPF is a liquid which makes it convenient for applicators who are familiar with handling liquids. Its main drawback is a disagreeable odor, but this may be minimized by injection into the soil or incorporation immediately after application.

All the DPF now produced is being used by farmers in the five-county area around Mobile. Though it is not available statewide, its popularity illustrates the possibility that other industrial wastes could be an alternative source of plant nutrients. By exploring these possibilities, these wastes may become valuable resources rather than expensive disposal problems.



Crop yields with DPF compared to equivalent commercial fertilizer, 1985-88.

Mitchell is Assistant Professor and Hiltbold is Professor of Agronomy and Soils.

R.T. LOVELL

LOWER FEED ENERGY NEEDED FOR CATFISH THAN OTHER FOOD ANIMALS

COMMERCIAL CATFISH feeds contain about 32% crude protein, compared to 12-20% for poultry and swine feeds. However, all contain nearly the same amount of available (digestible or metabolizable) energy, 2.8 to 3.0 kcal (kilocalories) per gram. Thus, it is generally assumed that fish have a higher protein requirement than farm animals, but recent Alabama Agricultural Experiment Station tests indicate this is not the case.

A study was conducted to determine energy and protein requirements of channel catfish for maximum growth (protein gain). Nine semipurified diets, containing three percentages of protein at three digestible energy (DE) concentrations, were each fed to different sizes of channel catfish. Fish were fed as much as they would consume for 10 weeks and consumption and gains of protein and energy were measured.

As shown in table 1, daily protein requirement per 100 grams (g) of fish for maximum growth is 1.64 g for 3-g fish, decreasing to 0.43 g for 266-g fish. The DE requirement decreased from 16.8 kcal for 3-g fish to 5.0 kcal for 266-g fish. Thus, as fish size increased from 3 to 266 g, the protein requirement decreased by 73% and the energy requirement decreased by 70%. This indicates that the dietary ratio of digestible energy to protein (DE/P) changed relatively little, from 10.2 kcal to 11.6 kcal of digestible energy per gram of protein, as fish size increased.

These DE/P ratios for optimum growth of channel catfish are much lower than those for poultry (14-16 kcal of DE per gram of protein) and swine (18-20 kcal DE per gram of protein). National Research Council (NRC) data show that the amount of dietary protein required per gram of body protein gain is approximately 3.2 for fish and 3.4 for warmblooded animals, indicating that the protein requirement for growth would be about the same for fish and farm animals. Thus, the primary difference between fish and farm animals in protein and energy nutrition appears to be a lower energy requirement rather than a higher protein requirement.

Using data from pond feeding experiments for catfish and NRC values for livestock, comparisons in feed, protein, and energy efficiency are made in table 2. The protein requirement for protein gain is about equal for catfish and broilers, but energy requirement for protein gain is much less for catfish.

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TABLE 1. DAILY PROTEIN AND DIGESTIBLE ENERGY (DE) REQUIREMENTS BY VARIOUS SIZES OF CHANNEL CATFISH FOR MAXIMUM PROTEIN SYNTHESIS

Fish size, grams	Protein per 100 g of fish/day	DE per 100 g of fish/day	Dietary DE/protein ratio
	Grams	*Kcal*	*Kcal/gram*
3	1.64	16.8	10.2
10	1.11	11.4	10.3
56	.79	9.0	11.4
198	.52	6.1	11.7
266	.43	5.0	11.6

TABLE 2. EFFICIENCY OF UTILIZATION OF FEED, PROTEIN, AND ENERGY BY VARIOUS FOOD ANIMALS

Food animal	Feed/gram weight gain	Dietary protein/ gram protein gain	Dietary energy/ gram protein gain
	Grams	*Grams*	*Kcal*
Channel catfish	1.3	3.2	21
Poultry	2.0	3.4	43
Swine	3.2	4.6	83

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