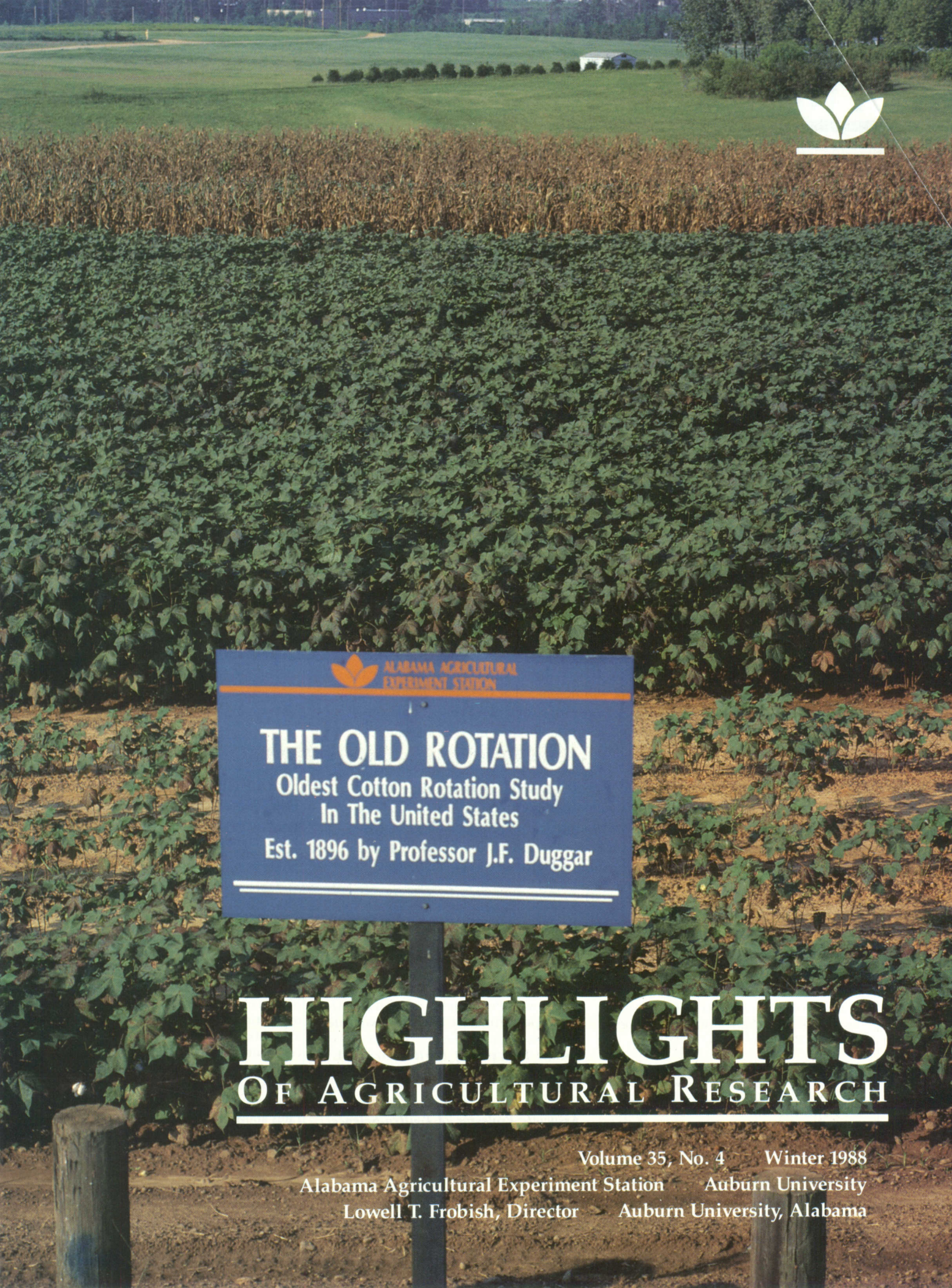
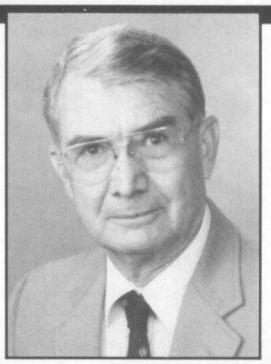


HIGHLIGHTS
OF AGRICULTURAL RESEARCH

Volume 35, No. 4 Winter 1988
Alabama Agricultural Experiment Station Auburn University
Lowell T. Frobish, Director Auburn University, Alabama

A WORD WITH THE EDITOR



R.E. STEVENSON

MOST STORIES printed in *Highlights* report preliminary results of new research being conducted by the Alabama Agricultural Experiment Station. In fact, reporting on such new research was the stated objective when the quarterly magazine was begun in 1954, and this emphasis has not changed. But there are long-term projects that continue to yield timely and interesting findings. From time to time these types of studies are featured in *Highlights*.

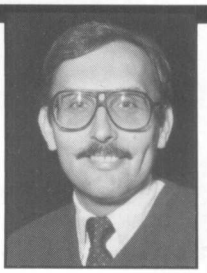
This issue features a story based on the Experiment Station's oldest active project—the "Old Rotation." The story on page 3 reports recent-year findings on how long-term rotations affect cotton yields. Such information is particularly timely because of the growing interest in crop rotations during recent years.

Although this is not covered in the story on page 3, there is much historical interest in the Old Rotation. The project dates back to 1896, just 13 years after the Experiment Station was established. It was begun by Prof. J. F. Duggar, who later served as Station Director (from 1903 until 1921) and whose name is prominent in Experiment Station history. Not only is the Old Rotation Auburn's oldest research project, it is the nation's oldest continuous cotton study and the third oldest continuous field crop experiment in the United States.

The historical significance of the Old Rotation received national recognition in January 1988 when it was placed on the National Register of Historical Places. A plaque designating this listing will be placed at the plots, located on the south side of the campus near the Arboretum's southern border. This site, pictured on the cover, should join other Auburn landmarks in representing Auburn's historical background.

Like all other research projects of the Alabama Agricultural Experiment Station, the Old Rotation study is being conducted only because it continues to yield information that can be of value to Alabama farmers. Nevertheless, its historical significance makes it an important feature in the history of the Alabama Agricultural Experiment Station and in Auburn University's overall history.

MAY WE INTRODUCE



Dr. Joe Molnar, Professor of Agricultural Economics and Rural Sociology. A native of Pennsylvania, Molnar came to Auburn in 1976 as Assistant Professor. He was promoted to Associate Professor in 1982 and to Professor in 1987.

Molnar earned B.S. and M.A. degrees in sociology from Kent State University. He holds the Ph.D. in sociology from Iowa State University, where he worked as a graduate research assistant prior to coming to Auburn.

Since coming to Auburn, Molnar has studied many external factors affecting Alabama's farm industry and rural life. His research interests range from sociological studies of who wants to get into farming today and from where the next generations of farmers will come to the impacts of the Tennessee-Tombigbee Waterway on rural life in southwest Alabama.

On page 6 of this issue of *Highlights* Molnar reports on many of the issues farmers face in handling and disposing of livestock waste.

ON THE COVER. The "Old Rotation" experiment is an important part of Auburn history, but it still yields valuable information, as noted in the story on page 3.

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C.C. Mitchell, Jr.

New Information from Old Rotation

EVEN THOUGH the "Old Rotation" experiment at Auburn has been operating since 1896, the study is still yielding timely findings. In fact, recent interest in rotations and low-input sustainable agriculture makes it an up-to-date study. The value of rotations and legume nitrogen for cotton and corn continues to be demonstrated today, even though farming has changed greatly since World War II.

Basic cropping systems have changed little since the Old Rotation was begun in the early days of the Alabama Agricultural Experiment Station. However, there have been some modifications in crops and fertilizer treatments. The following rotations (with and without nitrogen applications) have been used throughout the last 28 years:

1. Continuous cotton—with and without winter legumes.
2. Two-year rotations of cotton-winter legumes-corn.
3. Three-year rotations of cotton-winter legumes-corn-small grain-soybeans.

The original test included cowpeas as a summer legume following corn. Soybeans replaced cowpeas as the summer legume crop in the 3-year rotation in 1960, and cowpeas have not been used since that time. Vetch or crimson clover, or both, have been used as the winter legume for the 92 years.

Cultural practices have remained basically the same over the years. All plots receive 80 lb. per acre of P_2O_5 and 60 lb. per acre of K_2O per year applied to the summer crop or the winter legume, or split between the summer crop and the winter legume.

Cotton yields have generally increased throughout the life of the test, except during 1900 to 1920, the period when Alabama was invaded by the boll weevil. Researchers of that era suspected that cotton yield was declining because of poor growth of winter legumes, which they thought was due to inadequate phosphorus fertilization. Beginning in 1923, researchers began applying 400 lb. per acre of a 16% superphosphate to vetch in the fall, rather than 160 lb. of a 14% acid phosphate applied to the summer crops. Reports from that time note that the vetch immediately began to make good growth.

Since the 1920's, cotton yields have continued to climb in all treatments except where cotton was grown continuously without benefit of legume nitrogen or fertilizer application. Yields dropped temporarily during the 1970's when DDT, which was highly effective against insects, became unavailable for use. Production has shown some recovery during the last decade as better insecticides and varieties became available.

Clear insights into nitrogen availability and value are revealed in results from the last 10 years reported in the table. These can be summarized as follows:

AVERAGE YIELDS FROM THE OLD ROTATION, 1978-87

Cropping system	Yield/acre: Cotton lint	Yield/acre: Corn
	Lb.	*Bu.*
Continuous cotton		
No legume, no fert. N	214	—
With winter legumes[1]	605	—
No legume, 120 lb. fert. N	624	—
2-year cotton-corn rotation		
With legume N only	674	40
Legumes and fert. N[2]	753	50
3-year rotation		
Cotton (no N)–winter legume-corn (no N)–rye (60 lb. N)–soybeans	744	62

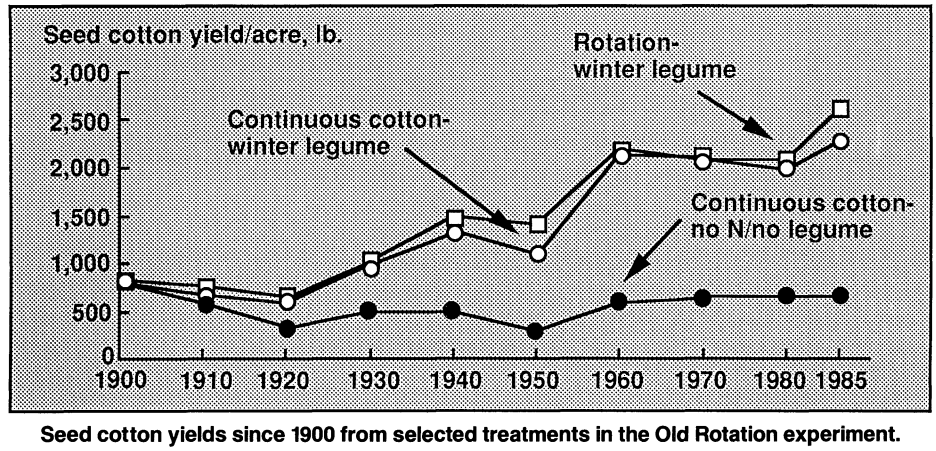
[1]An average of 4,018 lb. per acre of vetch and clover (oven-dry weight) was turned under in early April in plots where a winter legume was planted.

[2]Both corn and cotton received 120 lb. N as ammonium nitrate.

1. Where no legume or fertilizer nitrogen is added to the soil, continuous cotton removes about 13 lb. of N per acre per year in the lint and seed. This is about the amount of nitrogen expected to be available from atmospheric and soil microbial fixation and mineralization.
2. When winter legumes are included in the cropping system, average lint yields are almost tripled. Fertilizer nitrogen alone and legume nitrogen alone had about equal effects on cotton yields.
3. The 2-year cotton-legume-corn rotation increased cotton lint yields 11% over continuous cotton grown with legumes each year. Adding recommended fertilizer nitrogen with the 2-year rotation boosted lint yield 79 lb. per acre over the rotation without fertilizer N.
4. The 3-year rotation without direct N fertilization produced about the same yield of cotton as the 2-year rotation. However, corn grain yields were greater with the 3-year rotation.
5. Corn grown under requirements of this test—planted in late April and not irrigated—is of doubtful profitability because of usual low yields. Soybeans appear more promising in the rotations, however, producing 37 bu. per acre annually when double-cropped with rye.

As demonstrated by results during the last 10 years, the Old Rotation continues to show the value of crop rotations and legume nitrogen in cotton and corn production systems.

Mitchell is Assistant Professor of Agronomy and Soils.



Seed cotton yields since 1900 from selected treatments in the Old Rotation experiment.

F. Dane, O.L. Chambliss, A.G. Hunter, and L. Wells

Hot Weather Tomatoes

Research Seeks Varieties That Set Fruit Despite High Mid-summer Temperatures

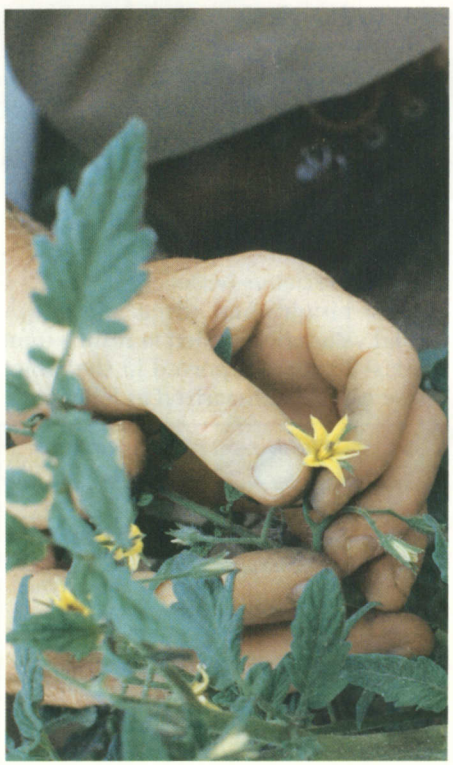
HOT DAYS and nights severely limit mid-summer tomato production in Alabama. Currently available varieties set few fruit during extremely hot periods. Furthermore, quality of the fruit produced is poor. These production constraints basically reflect the effects of high temperature on growth processes of the tomato flower.

Varieties of tomatoes are known to differ in their response to high temperatures, and these differences offer hope for the future. Alabama Agricultural Experiment Station research at the Wiregrass Substation, Headland, identified large differences in heat tolerance among available varieties and breeding lines. Crosses made among varieties and selections with varying heat tolerance levels produced plants with even greater heat tolerance than their parents during first-year ratings.

Plants were transplanted in mid-June at the Wiregrass Substation for evaluation of varieties and breeding lines for their adaptation to mid-summer conditions in Alabama. Daily maximum temperatures ranged from 88 to 102°F and daily minimums were 64 to 74° from mid-June to mid-August. After that, temperatures slowly decreased. Varieties were visually rated on ability to set fruit, and flowers were collected at bi-weekly intervals to determine viability of pollen.

Large fruited commercial varieties, such as Flora-Dade, produced few or no fruit from July to mid-August. In contrast, AVRDC (Asian Vegetable Research and Development Center) selections and small fruited tomatoes such as Red Cherry produced many, but smaller than normal, fruit. Stigma browning and splitting of the anther cone were observed in almost all entries and stigma exsertion in many, which helps explain specific effects of weather.

Lack of fruit formation was attributed in large part to decreases in pollen viability. Flowers collected during the hottest period (early August) showed a pollen viability ranging from 0 to 35% among most varieties. Red Cherry was an exception, maintaining high pollen viability throughout the growing season. Obviously, the small fruited varieties showed the least effect of temperature on pollen viability and subsequent fruit set.



During the winter of 1986-87, crosses were made among several heat-tolerant (AVRDC CL 5915, AVRDC CLN 65, Red Cherry, and Beaverlodge), intermediate (Nagcarlan), and heat-sensitive (Flora-Dade) selections. The resulting F1 hybrids and parent lines were visually rated during the summer of 1987 for their ability to set fruit at the Wiregrass Substation (temperature maximums were 88-100°F and minimums were 60-74°F in July and to mid-August). Flowers were collected bi-weekly and pollen viability determined.

The F1 hybrids showed a higher heat set rating than the average of the parents. Thus, the degree of heat tolerance can probably be improved by developing hybrids. Flowers collected during the hottest part of the summer had lower pollen viability than flowers collected earlier or later in the season.

Crosses in which Nagcarlan was a parent had the highest combination of heat set rating and pollen viability. This variety transmitted its degree of heat tolerance well to its progeny, whereas Flora-Dade combined poorly with other lines.

Several factors were found to be related to poor fruit set at high temperatures. Almost all varieties showed reduced pollen viability, combined with stigma browning and underdeveloped ovaries.

Dane is Research Associate, Chambliss is Professor, and Hunter is Research Associate of Horticulture; Wells is Assistant Superintendent of the Wiregrass Substation.

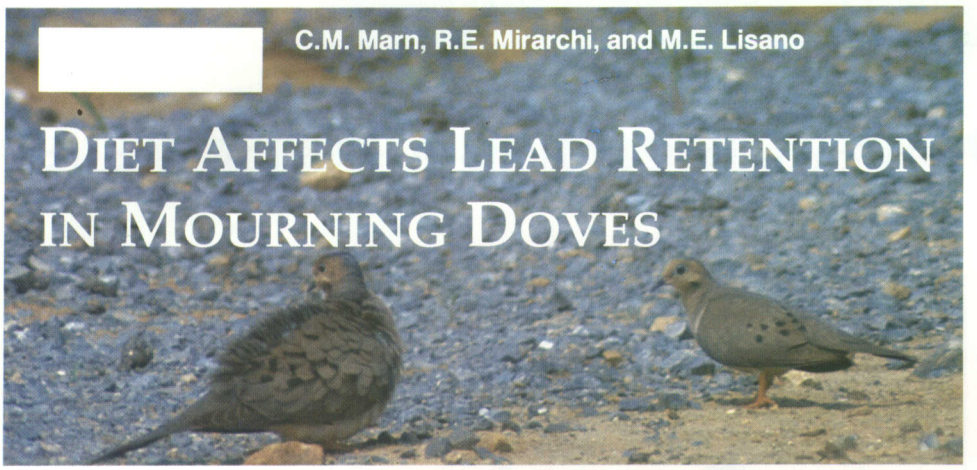
Heat Set Ratings of Tomato Varieties Grown under High Temperature Conditions, 1986

Variety	Heat set rating[1]
AVRDC CL 5915-153	4.5
Red Cherry	4.3
AVRDC CLN 65-349	4.1
AVRDC CLN 95-77	4.1
Beaverlodge-6804	4.0
Karlick	3.5
Nagcarlan	3.0
Saladette	2.9
Fresh Market-9	2.9
Pioneer 2761	2.8
Maliutka	2.7
Severianin	2.6
Chico III	2.4
Small Fry	1.9
Tex Rock	1.8
Hotset	1.7
Anahu	1.0
Monte Carlo	1.0
Flora-Dade	1.0
Floramerica	.8
Floradel	.8
AU-76	.4

[1]Scale of 0-5, with 0 = no fruit to 5 = many fruit.

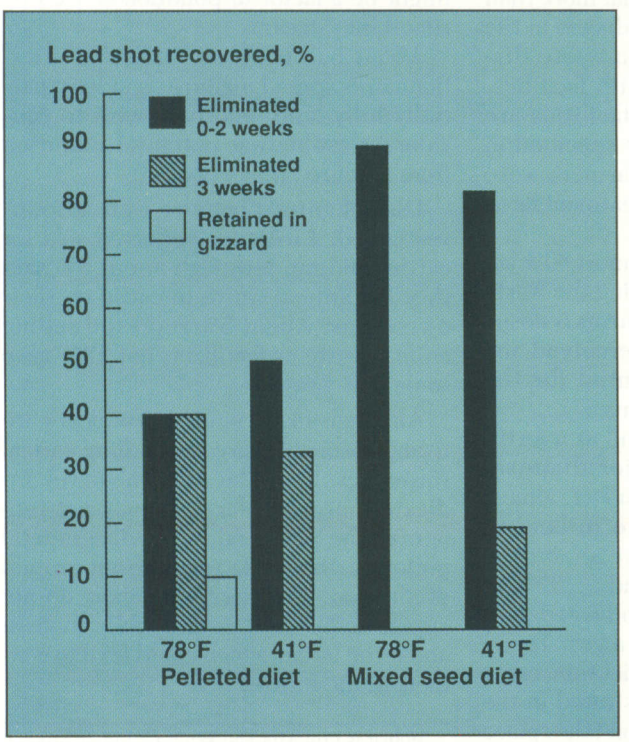
C.M. Marn, R.E. Mirarchi, and M.E. Lisano

Diet Affects Lead Retention in Mourning Doves



WHEN DOVE HUNTS are over and hunters leave the field with their share of the 50 million mourning doves harvested annually in the United States, billions of spent lead pellets are left behind. Hunted dove fields may accumulate up to 1 shot per square foot on, or near, the soil surface. Cultivation displaces the majority of these shot from the surface, but some are ingested by birds who mistake them for food and grit. This can result in mortality from lead toxicosis. Similar lead-induced mortality in waterfowl and bald eagles has resulted in recent federal regulations requiring the mandatory use of nontoxic steel shot for all waterfowl hunting by 1991.

Little information is available on the incidence or effects of lead poisoning in upland game birds. Of these birds, mourning doves are perhaps the most vulnerable to ingesting spent lead shot because they feed in fields in which they are hunted. Researchers have found that from 1% to 6% of mourning dove gizzards examined contained lead shot. As reported in a previous *Highlights* article, Alabama Agricultural Experiment Station researchers found that mourning doves dosed with lead shot suffered higher mortality than control birds. Also, lower hatchability occurred in eggs produced by lead-treated doves. Because these results appeared to be influenced by diet and cold temperatures, further studies investigated the effects of these factors on captive female mourning doves dosed with lead shot.



Rate of elimination of lead shot by female mourning doves.

From December 12, 1985, to January 2, 1986, 96 female mourning doves were housed indoors in cages at two temperature treatments (78°F or 41°F). Doves assigned to the cold treatment were placed in an environmental chamber that controlled the ambient temperature. Half of the doves in each temperature group were fed a commercial pelleted diet, while the others were kept on a mixed seed and corn diet. Half the doves (divided equally between temperature and diet treatments) were force fed 1 No. 8 shot which contained approximately 70 mg of lead, while the remaining 48 doves received a browntop millet seed. After dosing, the temperature in the environmental chamber was reduced from 78°F to 41°F for the cold-treated doves.

No mortality occurred during the 3-week study. Doves appeared in good condition at the end of the experiment except for one lead-treated dove (cold exposed, mixed seed diet) which had tremors. Elimination of lead pellets through the digestive tract apparently reduced the effects of ingested lead. Partially eroded lead pellets were recovered in the feces of 89% of the lead-treated doves. Of these recoveries, 73% were eliminated within the first 2 weeks after dosing. Doves on soft pelleted diets retained the lead shot longer, see graph, and eroded more of the lead shot in their gizzards than did the doves on the mixed seed diet. The harder mixed seed diet may have increased elimination of the lead shot because of greater gizzard activity.

As expected, lead-dosed doves had higher lead levels in their tissues than control birds. There were no differences in kidney, liver, or bone lead concentrations due to temperature treatment. Tissue lead levels were higher in lead-treated doves on the mixed seed diet although lead-dosed doves on the pelleted diet had eroded more of the lead shot. Apparently, nutritional differences between the diets affected lead metabolism. The more nutritionally complete pelleted diet (particularly higher protein and calcium) apparently offered more protection against the effects of ingested lead.

Diet appeared to be the important factor affecting lead retention in female mourning doves. The physical nature of the diet influenced retention of lead pellets and the nutritional composition of the diet affected lead concentrations in the body tissues. Thus, wild mourning doves may be more, or less, susceptible to lead poisoning according to the composition and nutritional content of their diet. Additional field studies are needed to determine if lead shot in the environment is adversely affecting mourning dove populations.

Marn is former Graduate Research Assistant, Mirarchi is Professor, and Lisano is Associate Professor of Zoology and Wildlife Science.

J.J. Molnar and L.S. Wu

Animal Waste Disposal Becoming a Public Issue

THE PUBLIC is becoming increasingly concerned about potential environmental pollution from farming. Thus, agriculture can expect to be under close scrutiny in the future as the environmental consequences of present-day farm practices are recognized and evaluated.

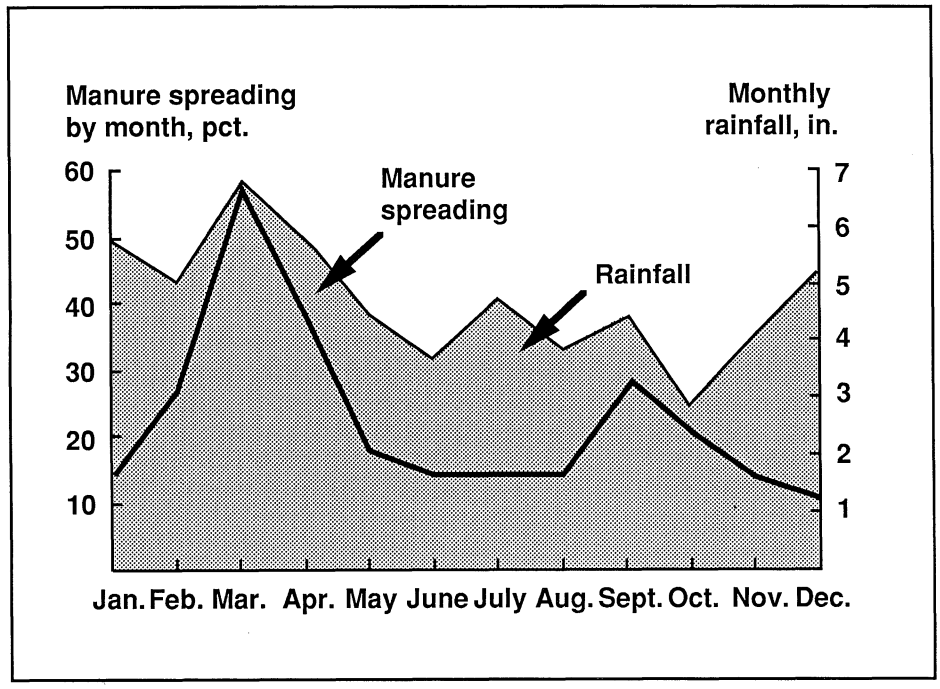
The treatment and disposal of animal waste is likely to be among the greatest public concerns. Just as nonagricultural industries must exercise caution in the way their activities affect groundwater, rivers, streams, and aesthetic experiences, animal producers also must be careful about the practices used for disposing of animal waste.

To provide information about current practices and attitudes of farmers about waste handling, a mail survey was conducted in 1988 by the Alabama Agricultural Experiment Station. The questionnaire went to 680 animal producers in two north Alabama counties. One of the counties is a national leader in broiler production. Both have many small beef cattle herds, and dairy and hog producers were also included in the survey. Data from the 354 returned questionnaires (52% return rate) were used to assess animal waste disposal practices.

How Farmers Handle Their Animal Waste, 354 Respondents, 1988

Item	Percent reporting*
Treatment facilities	
Have no waste treatment facilities	77
Facilities are over capacity	8
Perceive some or more pollution potential from facilities	8
Understand the next step to improve animal waste facilities	59
Land application	
Apply animal manure to land	79
Apply animal manure three or more times a year	10
Apply to at least partly hilly land	49
Use of animal waste	
Sold for cattle feeding	1
Sold for fertilizer	5
Fed to cattle	7
Spread on cropland	8
Given away	12
Spread on pasture or hayland	64

*Percentages do not sum to 100 due to multiple response and selective presentation.



Monthly distribution of rainfall as related to timing of manure spreading. (Rainfall data from Roger Getz, Southeast Agriculture Weather Service Center.)

Data in the table reveal that more than three-fourths of animal producers in the surveyed counties have no waste disposal facilities. Of those with facilities, about 8% reported their facilities are over capacity. Although not specified in the table, dairy and hog farmers were most likely to have waste treatment facilities.

Of all the respondents, almost 60% accepted the fact that improving the waste handling facilities on their farms is desirable. However, only 8% perceived any degree of pollution potential for the waste facilities on their farms.

Spreading manure on land as a fertilizer material is the major disposal method for most farmers. In fact, almost 80% apply animal manure to land in some fashion. The largest amount is spread on pasture or hayland.

Although respondents indicated that applying manure to land is a year-round activity, most of the application takes place in the spring. As illustrated in the graph, this spring application takes place during a season of high rainfall. This might be a factor in pollution caused by runoff into streams.

About half of those returning questionnaires spread manure on at least partially hilly land, another factor to consider in evaluating potential pollution from manure application.

Uses of animal manure were also investigated. Little was reported sold for cattle feeding, although about 5% said they fed animal waste to cattle on their own farms. About 5% reported selling animal waste as fertilizer, but 12% gave some of it away.

Although many animal producers are using reasonable care in handling animal waste, results of the Auburn survey indicate that many farmers may not recognize the potential for environmental pollution that may result from animal production. Furthermore, many do not appear to be sensitive to public concern about the issue, which could lead to conflicts in the future.

Molnar is Professor and Wu is Graduate Student of Agricultural Economics and Rural Sociology.

J.L. Stallings

IMPORTED FEED GRAINS DOMINATE STATE'S GRAIN MARKETING SYSTEM

ALABAMA'S GRAIN marketing system has undergone significant changes since 1960, but one thing remains the same: more than half of the feed grains handled are produced out of state. Of the 190 million bu. handled each year, only about 67 million bu. come from Alabama farms.

The big change in the system has been the shift from family-owned country elevators and feed mills to collection stations and feed manufacturers. These larger units serve the vertically integrated poultry industry and other livestock operations.

Two developments have been largely responsible for increased grain imports in recent years: (1) location of two large soybean processing plants in northern Alabama to provide protein for poultry feeds, and (2) establishment of a corn processing plant in Decatur.

Even without these new plants, however, Alabama has been a deficit state for feed grains for many years. Alabama Agricultural Experiment Station research findings indicate that Alabama has produced less than 30% of the grains needed over the past 20-30 years.

Corn continues to lead in size of deficit, with 1985 data showing that State production accounted for only 24 million bu., while imports were nearly 73 million bu. Alabama soybeans and oats almost equaled imports that year, while most grain sorghum and over half of wheat came from within the State.

The Public Grain Elevator in Mobile, owned by the State, plays a part in the Alabama grain marketing system. However, it has mostly exported grain coming in from outside Alabama. Alabama grain exported through Mobile mostly comes from the southern half of the State. The northern half of Alabama typically exports little grain through Mobile and requires even more import of grains for its poultry industry and the soybean and corn processing plants located there. So far, the newly completed Tennessee-Tombigbee Waterway has had little impact on the grain marketing system of Alabama or in the volume of grain business through the port of Mobile.

Most of the out-of-state grain coming into Alabama over the last 20-30 years has come from Illinois and Indiana in the Corn Belt and from Tennessee and Kentucky in the South. In 1985, 67.1 million bu. (54.5% of the total of five out-of-state grains coming to Alabama) came from Illinois and Indiana. Corn comprised 54.7 million bu., or 81.5%, of this total. Soybeans were the primary import from the surrounding states of Mississippi, Tennessee, Kentucky, and Georgia, accounting for 19.7 million bu. (62.3%) of the 31.6 million bu. of soybeans imported.

Firm-to-firm transfers of grain within Alabama and receipts from Alabama farmers by firms were virtually all by truck. Grain coming from out-of-state was generally equally distributed between rail and water, with trucks accounting for 92.7% of the receipts from the surrounding states of Georgia, Florida, Mississippi, and Tennessee.

Rail and water receipts mostly came to northern Alabama; water shipments came by way of the Tennessee River to firms in either Decatur or Guntersville. About 93.6% of the rail and water receipts from the Corn Belt States of Illinois, Indiana, Iowa, Minnesota, Missouri, Wisconsin, and Ohio were to these northern Alabama firms.

Most shipments of grain within Alabama were of two types: (1) transfer to the parent institution by satellite country elevators after collection from farmers, primarily to feed manufacturing firms, poultry operations, and the soybean and corn processing plants; and (2) the importation of out-of-state grains by terminal elevators and the subsequent transfer to various users within Alabama. Firm-to-firm transfers within Alabama represented 45.5 million bu. in 1985, mostly by truck.

Shipments of grains by Alabama firms to ports for export overseas totaled only 17.2 million bu. in 1985 (10.2 million of soybeans, 3.4 million of wheat, 3.1 million of corn, and less than 0.5 million bu. of grain sorghum). This compares with domestic use of 162.8 million bu.

As with shipments to ports, the out-of-state shipments of 10.9 million bu. also represented a relatively small amount compared with domestic use. These shipments were almost exclusively to surrounding states, unlike out-of-state receipts which were frequently from several states away.

Alabama was a deficit state in corn, soybeans, wheat, and oats in 1985, and it is expected to continue to be a deficit state in the near future. A 72.9% deficit in corn is largely the result of the poultry industry's feed grains needs and the requirements of one large corn products processing plant. A 33.8% deficit in soybeans is largely due to the needs of two soybean processing plants in northern Alabama.

Stallings is Associate Professor of Agricultural Economics and Rural Sociology.

GRAIN RECEIPTS BY ALABAMA FIRMS, BY KIND OF GRAIN AND ORIGIN, 1985

Origin	Receipts, thousands of bushels					
	Corn	Soybeans	Wheat	Grain sorghum	Oats	Total
Firm to firm transfers						
South Alabama	2,399	12,561	697	864	—	16,521
North Alabama	5,762	583	647	319	182	7,493
Total	8,161	13,144	1,344	1,183	182	24,014
Receipts from farmers						
South Alabama	8,352	16,474	5,981	1,675	12	32,494
North Alabama	12,110	11,692	3,981	6,849	—	34,632
Total	20,462	28,166	9,962	8,524	12	67,126
From out of state	72,947	31,560	8,180	8,582	1,873	123,142
TOTAL	93,409	59,726	18,142	17,106	1,885	190,268

S.L. Brown, J.E. Brown, and M.C. Osborn

Thrips Not Attracted by Reflective Mulches

THRIPS are commonly found on most food crops in Alabama, but only since 1986, when tomato spotted wilt virus (TSWV) was first found in State tomato plantings, has the tiny insect been considered a problem. Thrips vector TSWV, and since there is no cure for the virus, the only protection against the disease in tomatoes is controlling the insect vector.

Alabama Agricultural Experiment Station research on thrips control in tomatoes has evaluated several different colored plastic mulches to determine the effect on thrips. At the same time, effectiveness of several insecticides has been measured. Because thrips are known to avoid light and prefer certain colors, plastic mulches might affect population build-up of the pests.

Results indicate that insecticides commonly used to control thrips actually have little effect on populations of the pest. The most commonly used plastic mulches, black and white, were found to attract thrips to a greater degree than bare soil, but highly reflective mulches attracted fewer of the insects.

In calm air, thrips are capable of orientation toward a preferred host and are known to respond to different colors. Different species vary in their color preference, but light colors are generally more attractive. Highly reflective surfaces tend to repel most thrips, although information is limited on this subject. The Auburn study was designed to test the effect of white and black plastic mulches and black plastic sprayed with chrome aluminum paint, compared to a bare ground treatment with three different insecticide treatments. Insecticides used included Cygon (0.5 lb. active ingredient per acre), Asana (0.05 lb. active ingredient per acre), and Orthene (0.5 lb. active ingredient per acre). Although Orthene is used for thrips control, it is not registered for use on tomatoes.

Plots consisted of 10 Mountain Pride variety tomato transplants set out April 27, 1988, at the E.V. Smith Research Center in Shorter. Plants were staked and tied as done in most commercial production areas. In plots getting insecticidal treatments, weekly applications began on May 3 and ended June 14. Weekly bloom samples were taken by randomly picking five blooms per plot and placing them in a small jar of alcohol. Thrips were extracted from the bloom samples by pulling apart each flower, releasing thrips from deep inside blooms into the alcohol.

Tomatoes grown on white plastic mulch attracted thrips.

On four of six sampling dates, thrips populations on tomatoes grown on white plastic were significantly higher than those on the control (untreated tomatoes on bare ground). On black plastic, numbers were higher than the control on three of six sampling dates. Aluminum plastic resulted in no significant differences from the control. None of the insecticides significantly reduced thrips populations; in fact, all resulted in significantly higher populations on at least one sampling date. This was apparently due to the elimination of beneficial insects which feed on thrips.

Overall, thrips populations steadily increased throughout the sampling period. Composite samplings of thrips indicated that western flower thrips was the dominant species on the first five sample dates. Eastern flower thrips were the most common on the last date. Even though thrips populations were high (over 20 per bloom in some plots), only four plants showed visible TSWV symptoms. This was consistent with the situation seen throughout the State during 1988. Since disease incidence was low, differences in thrips populations had no effect on yields.

Tomato growth response to aluminum plastic mulch was positive, apparently due to greater light intensity. The highest tomato yield was produced on aluminum-painted plastic.

There are approximately 3,000 acres of commercial tomatoes grown in Alabama, most grown using plastic mulch. The advantages of plastic mulch have been well documented, but results of this test indicate that both of the commonly used colors (black and white) of plastic mulch can attract thrips, while the aluminum mulch neither repelled nor attracted thrips.

Steve Brown is Extension Entomologist; James Brown is Assistant Professor and Osborn is Research Associate of Horticulture.

P.B. Abney, R.H. Walker, and D.R. Wyatt

Herbicide-stunted Sicklepod Competes Less with Soybeans

SICKLEPOD, because it reduces yield and quality and makes harvesting difficult, is one of the most troublesome weeds in soybeans in the Southeast. Tolerance of this weed to many commonly used herbicides and its adaptability to a wide range of soil fertility and pH conditions have contributed to its spread in the South, especially in Alabama.

Though acreage has dropped from a high of 2 million acres in 1981 to 500,000 in 1987, soybeans are still an important crop in Alabama. Much of this decrease in acreage can be attributed to low market prices that occurred while production costs remained high.

The cost of weed control has not decreased, but results of recent Alabama Agricultural Experiment Station research indicate a potential for reducing this expense. A single application of the herbicides Classic® or Scepter® was found to stunt sicklepod and other weeds enough that growers may be able to produce maximum yields at reduced herbicide cost.

Both Classic and Scepter provide acceptable sicklepod control with two applications—one soil plus one foliar application. Unfortunately, soybean injury has been unacceptable at times and two applications are expensive. However, a single foliar application of either product usually stunts sicklepod, so research was designed to determine how competitive these stunted weeds are with soybeans.

Field experiments were established at the Prattville Experiment Field to evaluate the competitiveness of sicklepod with soybeans. Variables include two herbicides, Classic and Scepter, and five sicklepod densities (0, 2, 4, 6, and 8 plants per 3 ft. of row). Weed densities were established within 4 in. of the drill on the center row of a three-row plot planted on 36-in. row spacings. Classic at 0.008 and Scepter at 0.125 lb. active ingredient (a.i.) per acre were applied 16 days after planting the soybeans, at which time the sicklepod plants were approximately 1-4 in. tall.

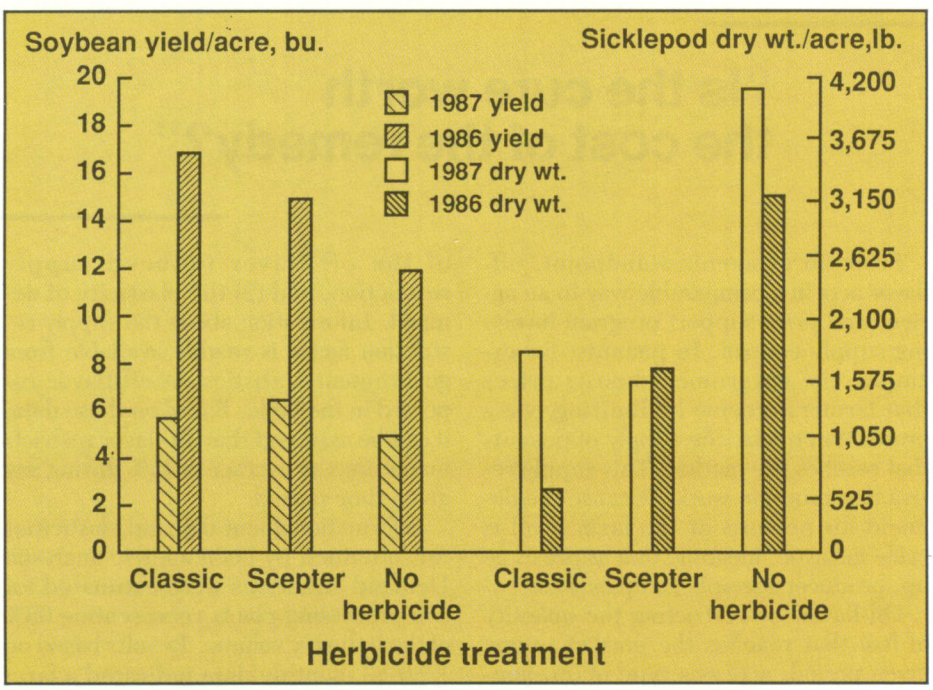
Sicklepod dry weight was affected by both densities and herbicides. Classic (averaged over densities) reduced sicklepod dry weight by 81% in 1986 and 54% in 1987, while Scepter produced a reduction of 48% in 1986 and 61% in 1987.

Soybean seed yield decreased as sicklepod density increased up to six plants per 3 ft. of row. Compared with the no-herbicide treatment, soybean yields were increased 43% with the use of Classic and 26% with the use of Scepter in 1986. The next year, however, Classic increased yield only 15% while Scepter increased yields 23%. The reduced effectiveness of Classic in 1987 was probably due to the severe drought conditions at the time of application.

When either Classic or Scepter was applied once at recommended rate to simply stunt the sicklepod, in lieu of complete control, the sicklepod plants were rendered much less competitive than weeds in no-herbicide plots. Fewer seed pods were produced by the stunted plants, thus fewer seeds were returned to the soil. In 1987, Classic reduced the number of seed pods per plant by 33% and Scepter reduced the number by 48%.

Planting soybeans in narrower row spacing may offer opportunities for further reducing competition of stunted sicklepod. It is anticipated that these practices will eliminate the need for a second herbicide application.

Abney is a Graduate Research Assistant, Walker is Professor, and Wyatt is a Graduate Research Assistant of Agronomy and Soils.



Sicklepod dry weight and soybean yields as affected by Scepter and Classic herbicides.

H.W. Kinnucan, S. Sindelar, D. Wineholt, and L.U. Hatch

RESEARCH ON CATFISH OFF-FLAVOR

Valuable to Both Producers and Consumers of Farm-raised Catfish

OFF-FLAVOR, a term used to describe catfish that are unmarketable because of undesirable flavor, is the most serious problem facing the fledgling catfish industry. Off-flavor is serious because it affects, depending on the season, up to 45% of the foodsize fish held in farm ponds, delays harvesting up to 8 months, undermines consumer confidence in the retail product, and currently cannot be controlled cost-effectively. The problem never entirely disappears, but as shown by data in the table, is present in varying degrees throughout the year.

INCIDENCE OF OFF-FLAVOR IN FARM-RAISED CATFISH, MISSISSIPPI, 1985-86 SEASONAL AVERAGE

Item	Extent of off-flavor, by month			
	January	April	July	October
	Mil. Lb.	*Mil. Lb.*	*Mil. Lb.*	*Mil. Lb.*
Inventory of foodsize fish	85	48	68	134
Quantity off-flavor	11	5	10	60
On-flavor inventory	74	43	58	74
Incidence of off-flavor %	*13*	*10*	*15*	*45*

Source: Mississippi Crop and Livestock Reporting Service.

Though solving off-flavor in catfish has obvious benefits, it could have a negative impact on farm revenue. Thus, the question becomes, "Is the cure worth the cost of the remedy?" Economic research recently completed at the Alabama Agricultural Experiment Station indicates that, while the catfish industry benefits from elimination of off-flavor, most of the benefits will accrue to individuals beyond the farm gate, mainly processors and consumers.

"Is the cure worth the cost of the remedy?"

From an economic standpoint, off-flavor acts in a comparable way to an agricultural price support program involving supply control. In peanuts, for example, the government boosts prices that farmers receive by limiting, via a production quota, the supply of peanuts that reaches the market. This supply restriction program works because the demand for peanuts at the farm level is price inelastic, meaning that as prices go up, producer receipts go up as well.

Off-flavor, by restricting the quantity of fish that reaches the market in any given period, acts as a type of (involuntary) supply control program. Whether the reduced supply of fish enhances the total value of the catfish crop depends on the demand for catfish at the farm level. If demand is price inelastic, meaning that processor purchases of live fish are relatively insensitive to price, then the off-flavor induced reduction in marketings actually increases the value of the crop. If, on the other hand, demand is price elastic, meaning that processor purchases of live fish are sensitive to price, then reduced marketings caused by off-flavor cause the total value of the catfish crop to fall.

Two factors largely determine the societal cost of off-flavor: (1) the magnitude of the off-flavor induced supply restriction, and (2) the elasticity of demand. Information about the supply restriction factor is readily available from government statistics on off-flavor reported in the table. Based on these data, it can be assumed that off-flavor restricts marketings an average of 15% during any given time period.

Information about demand elasticities was obtained by econometric analysis. Demand equations were estimated for five processing plants representing 93% of the industry volume. Results based on 1980-83 monthly data indicated a farm level demand elasticity for catfish of -.37. Because this coefficient is less than 1.00 in absolute value, indicating an inelastic demand, elimination of off-flavor will reduce aggregate farm revenues. Thus, most of the benefits from solving off-flavor will go to nonfarmers.

The estimated demand elasticity of -.37 and the supply restriction estimate of 15% were inserted into an economic model to compute the cost of off-flavor to society (consumers and producers alike). Results indicated that, in any given year, off-flavor incurs a social cost equal to 12% of farm revenues. For example, in 1983 catfish producers received revenues of $83.7 million, implying a cost to society of $10.0 million due to the higher prices and production costs caused by off-flavor. If research could develop new technology to eliminate off-flavor, societal benefits would be equivalent to 12% of the annual revenue received by catfish producers.

Research indicates that off-flavor entails significant costs not only to catfish producers but to consumers. These findings suggest, moreover, that off-flavor research is justifiable on economic grounds and funds expended for such research could yield a positive net benefit to society. Although elimination of off-flavor will reduce aggregate farm revenue, production costs will decline as well. The net benefit to producers from elimination of off-flavor depends on the relative size of this cost decline.

Kinnucan is Assistant Professor, Sindelar and Wineholt are former Graduate Research Assistants, and Hatch is Assistant Professor of Agricultural Economics and Rural Sociology.

G.J. Keever, G.S. Cobb, and J.C. Stephenson

LANDSCAPE PLANTS O.K. FOR INDOORS

TEMPERATE ZONE woody landscape plants have the potential of offering a new and varied source of plant materials for interior landscapes. In addition to their desirable aesthetic qualities, temperate zone species are generally more tolerant than tropical or semitropical species of cooler interior conditions. Thus, they may be suited for homes or other buildings with low temperatures due to energy-conserving measures or for placement near building entrances where drafts of cold air frequently enter.

Successful indoor performance of temperate landscape plants will vary among different species depending on their ability to adjust to low light conditions. Suitable species must be able to remain vigorous without experiencing a natural dormancy environmentally induced by shorter days and cooler temperatures. Research conducted by the Alabama Agricultural Experiment Station evaluated selected temperate woody and herbaceous species typically used in exterior landscaping. Most of the species tested responded well when placed in the interior environment.

One phase of the study involved uniform liners of spreading lilyturf, Southern magnolia, mondo grass, and cleyera which were potted in March 1985 in 6-in. containers. A 100% milled pine bark growth medium was amended with dolomitic limestone, gypsum, and Micromax® micronutrient fertilizer. Plants were topdressed monthly during production with 1 tsp. 12-6-6 fertilizer. Plants of each species were divided into three groups of 10 plants and grown under three light conditions: (1) full sun; (2) 47% shade; and (3) 64% shade. Growth measurements were taken prior to transferring plants to an interior environment with fluorescent lamps (50 footcandles), 12-hour photoperiod (6 a.m. to 6 p.m.), 70°F, and 80% relative humidity. After 15 weeks, growth measurements, leaf color, leaf drop, and plant quality were determined.

In a second experiment, uniform liners of dwarf gold-dust plant, variegated waxleaf privet, and Wood's Dwarf nandina were potted in 6-in. containers and wintercreeper euonymus were potted in 4½-in. containers in April 1986. Cultural methods were the same as in the first experiment, except plants were transferred to an interior environment in September 1986.

Overall plant quality was generally poorer with plants grown in full sun. Almost all of the plants grown in full sun were more compact and denser than the shade-grown plants. They had smaller, lighter green leaves and marginal leaf necrosis was found on a number of plants. Only magnolia and cleyera were of similar quality under all light regimes.

Once moved to the interior environment, all species continued to produce new growth. While production size for some plants grown in full sun was smaller when first placed indoors, plant size was similar among light treatments after 15 weeks indoors. Foliar color ratings were higher for shade-grown plants of lilyturf, magnolia, and euonymus compared to ratings of sun- grown plants. Ratings were similar for other species, regardless of light treatments. These ratings indicate an improvement in leaf color of full-sun grown plants during the interior period.

Shade treatments appeared to influence leaf drop on some plants, while others performed well regardless of production light levels.

At the end of the interior period, the quality of lilyturf, magnolia, mondo grass, cleyera, and privet was good to excellent regardless of light treatment, though some performed better under specific treatments. Euonymus grown in full sun displayed a high mortality rate.

Results show that temperate zone landscape plants can be successfully used in the interior environment. Varying light levels during production influenced the performance of some plants. Quality was generally higher for shade-grown plants, though some did well in other light levels too.

RESPONSE OF TEMPERATE ZONE LANDSCAPE PLANTS GROWN UNDER THREE LIGHT CONDITIONS TO AN INTERIOR ENVIROMENT

Cultivar and production light level	Growth index[1] After production	Growth index[1] After use in interior	Quality rating[2]
Spreading lilyturf			
Full sun	35.5	35.6	3.7
47% shade	40.8	41.1	4.8
64% shade	41.4	41.7	4.8
Southern magnolia			
Full sun	37.4	44.6	4.6
47% shade	48.3	52.6	4.8
64% shade	51.8	53.5	4.8
Mondo grass			
Full sun	19.1	19.7	5.0
47% shade	19.4	19.8	5.0
64% shade	18.3	19.8	5.0
Cleyera			
Full sun	48.8	49.2	5.0
47% shade	53.9	54.8	5.0
64% shade	56.3	56.5	5.0
Waxleaf privet			
Full sun	20.5	21.3	3.6
47% shade	25.5	27.1	4.7
64% shade	27.3	28.7	4.8
Dwarf gold-dust plant			
Full sun	16.2	17.9	1.6
47% shade	24.8	26.4	4.8
64% shade	24.3	26.1	4.8
Wood's Dwarf nandina			
Full sun	35.7	38.6	1.9
47% shade	40.0	42.7	4.2
64% shade	39.6	42.6	4.6
Wintergreen euonymus			
Full sun	21.0	19.4	1.0
47% shade	25.0	25.8	2.8
64% shade	22.9	24.3	4.0

[1]Index = height + width + width ÷ 3 (measured in centimeters).
[2]Rating: 1 = poor (not saleable); 3 = good (saleable); 5 = excellent.

Keever is Associate Professor of Horticulture; Cobb is former Superintendent and Stephenson is Associate Superintendent of the Ornamental Horticulture Substation.

D.I. Bransby, S.P. Schmidt, W. Griffey, and J.T. Eason

Heavy Grazing is Best for Infected Fescue

HIGH STOCKING rates may help overcome the effects of fungus infection of Kentucky 31 tall fescue pastures. Close grazing of fescue that was highly infected with the fungal endophyte, *Acremonium coenophialum*, resulted in higher gains per acre than with moderate or light stocking rates. High-fungus fescue also yielded higher gain per acre than low-fungus fescue at both moderate and high stocking rates. These unexpected results were obtained in two separate experiments at different locations within the Alabama Agricultural Experiment Station System.

The research was conducted over an 84-day period in the spring of 1988 at the Piedmont Substation in Camp Hill and at the Sand Mountain Substation in Crossville. At Camp Hill, Simmental-Hereford-Angus crossbred steers that averaged 804 lb. at the beginning of the experimental period grazed high- and low-fungus fescue at stocking rates of 1.2, 1.8, and 2.4 animals per acre. Steers in the Sand Mountain experiment were Angus-Hereford crosses with an initial weight of 685 lb. These steers, at stocking rates of up to 2.5 per acre, grazed highly infected fescue only.

High-fungus fescue at both locations had over 70% of the plants infected, while the low-fungus fescue at the Piedmont Substation had less than 15% of the plants infected. Pastures stocked at the high rate were grazed down to about 2 in., but those at the low stocking rate were underutilized and grew tall.

Normally, average daily gain (ADG) is high at low stocking rates and low at high stocking rates. On average, this trend was observed for the low-fungus fescue pastures at the Piedmont Substation, as shown by data in the table. ADG ranged from 1.85 lb. per day at the low stocking rate to 1.04 lb. per day at the high stocking rate. However, on the highly infected fescue at the Piedmont Substation, ADG was comparable at all stocking rates: 1.35, 1.31, and 1.28 lb. per day for light, moderate, and heavy grazing, respectively.

Gain of Stocker Cattle Grazing High- and Low-Fungus Fescue at Two Locations, 84-day Period, Spring 1988

Fungus level-location	Grazing gain, by stocking rate					
	Average daily gain			Gain per acre		
	1.2/ acre	1.8/ acre	2.4/ acre	1.2/ acre	1.8/ acre	2.4/ acre
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Low-fungus—Piedmont	1.85	1.44	1.04	187	218	209
High-fungus—Piedmont	1.35	1.31	1.28	136	198	258
High-fungus—Sand Mountain	1.35	1.46	1.56	136	220	314

At the Sand Mountain Substation, where all fescue pastures were highly infected, ADG for the high stocking rate (1.56 lb. per day) on high-fungus fescue was higher than for the low stocking rate (1.35 lb. per day). Animals stocked at the low rate also had rougher coats than those at the heavy stocking rate, suggesting that they suffered more from fescue toxicosis. On average, the ADG data in the table show (1) at the low stocking rate ADG was higher on low-fungus fescue than on high-fungus fescue, (2) there was little difference in ADG at the moderate stocking rate, and (3) at the high stocking rate, ADG was higher on the high-fungus fescue.

Gain per acre was highest at the moderate stocking rate for low-fungus fescue; at the high stocking rate, however, it was highest where fungus infection was high.

Cattle on high-fungus fescue: Top—stocked at 2.4 per acre are in good condition; bottom—stocked at 1.2 per acre show typical signs of fescue toxicosis.

Furthermore, maximum gain per acre was higher for high-fungus fescue (258 and 314 lb. per acre, respectively, at the Piedmont and Sand Mountain substations) than for low-fungus fescue (218 lb. per acre).

A possible explanation for poor gains at the low stocking rate on high-fungus fescue is that this light utilization led to more stem and seedhead production by fescue plants. Stems and seedheads, known to contain higher concentrations of fungus than the leaves, were selectively grazed by the cattle when stocking rate was low. On the heavily stocked fescue there was little seedhead production. Cattle therefore consumed mainly leafy forage and appeared to suffer less from fescue toxicosis.

Results from the first year of these experiments suggest that management which prevents seed formation on infected fescue will provide the best gains. Consequently, moderate or heavy continuous grazing is likely to be favorable, and rotational grazing is likely to be detrimental because it would lead to more seedhead production. In addition, it appears that high-fungus fescue provides higher gains than low-fungus fescue when grazed heavily.

It must be emphasized that these unexpected results may have been influenced by drought conditions which prevailed in the spring of 1988 at both test sites. Thus, the findings should be viewed with caution until the experiments are repeated.

Bransby is Associate Professor of Agronomy and Soils; Schmidt is Associate Professor of Animal and Dairy Sciences; Griffey is Superintendent, Piedmont Substation; Eason is Superintendent, Sand Mountain Substation

A.G. Appel, G.R. Strother, R.C. Sponsler, and D.A. Estridge

New Sprays Provide Limited Control of Cockroaches

These cockroaches were found behind a wall clock in an infested apartment.

GERMAN COCKROACHES are the most important insect pests in homes, restaurants, and animal rearing facilities. These cockroaches infest food, cabinets, and appliances where they may spread disease and cause allergies. Additionally, German cockroach populations may rapidly increase and become difficult to control. Rather than attempting their own pest control, many people prefer the services of professional pest control operators. These professionals are licensed and trained in the use of insecticides not generally available to homeowners. Such insecticides are often applied by sprayers equipped with flat fan nozzles or by crack and crevice methods using compressed air sprayers.

Formulation is frequently as important to insecticide performance as the active ingredient. Most indoor professional-use insecticides are available in emulsifiable concentrate, microencapsulate, or wettable powder formulations. Each formulation has its advantages and disadvantages.

Emulsifiable concentrates are easily mixed with water and do not leave a noticeable residue; however, they tend to be absorbed into some surfaces, like unpainted wood, removing the insecticide from the treated surface where it would be contacted by cockroaches. Both microencapsulate and wettable formulations remain available for contact atop treated surfaces. These formulations are more difficult to apply because they must be agitated frequently to maintain a consistent mixture and they can leave white or grey powdery residues. Since the most recently introduced professional-use formulations are microencapsulates and wettable powders, the Alabama Agricultural Experiment Station evaluated the performance of four of the newest materials (two of each formulation).

Initial populations of German cockroaches were sampled in 43 infested apartments using two "Mr. Sticky" traps. One trap was placed beneath the kitchen sink and the other was placed behind the stove. Traps were left in place for 1 week. Population numbers ranged from 10 to 237 cockroaches per apartment.

After initial counts were made, treatments (listed in the table) were assigned to apartments. The maximum, or clean-out, label rate was used for all formulations. Sprays of Tempo®, Demon®, Knox Out®, and Dursban® were applied with a 1-gal. compressed air sprayer pressurized to approximately 30 p.s.i. A wide fan spray nozzle was used to evenly apply the sprays. About 1 qt. of finished spray was applied to each treated apartment.

Kitchen cabinets were emptied and sprayed as were areas around the stove, refrigerator, and other appliances, and all cracks and crevices. In the bathroom, the areas around the toilet and shower and under the sink were treated.

All units were sampled at 1, 2, 4, and 8 weeks following treatment. Traps were placed in the same locations where the initial samplings were made.

The minimum acceptable level of insecticide performance against German cockroaches is a 50% or greater reduction in population numbers. Tempo provided the best results, reducing the population by 62.3% at 1 week and 53.8% at 2 weeks after treatment. Performance of Tempo decreased at 4 weeks and cockroach populations had returned to near their pretreatment numbers after 12 weeks. Demon reduced populations 30.5% at 1 week, 39.6% at 2 weeks, and 57.8% at 4 weeks. At 8 weeks, population size had increased. None of the other treatments significantly reduced German cockroach populations.

The untreated control apartments had generally increasing cockroach populations. Populations had increased nearly 42% after 4 weeks, so these apartments were treated with an insecticide.

Demon and Tempo (wettable powder formulations) clearly performed better than Knox Out and Dursban ME (microencapsulated formulations). However, Demon and Tempo belong to the more toxic synthetic pyrethroid class of insecticidal compounds, whereas Knox Out and Dursban ME are less toxic organophosphate compounds. Performance of the organophosphate formulations may also have been affected by insecticide resistance induced by previous exposure.

Appel is Assistant Professor, Strother is Associate Professor, Sponsler is a Graduate Research Assistant, and Estridge is a Laboratory Technician of Entomology.

Performance of Professional-use Insecticide Formulations Against German Cockroaches in Apartments

Treatment[1]	Av. number of cockroaches/apartment				
	Pretreatment	1 week	2 weeks	4 weeks	8 weeks
Control	148.3	161.6	136.6	209.6	—
Demon WP (0.2%)	97.4	67.7	58.8	41.1	65.1
Dursban ME (0.5%)	97.4	123.1	94.3	102.4	74.9
Knox Out 2FM (1.0%)	95.7	101.4	93.9	113.4	121.0
Tempo WP (0.1%)	116.6	44.0	53.9	81.4	120.1

[1]Eight to 10 apartments in each treatment.

J.H. Yeager

Farm Investment Down, Equity Position Improved

FARM INVESTMENT represents the resources that a farmer has to produce income. In terms of a balance sheet, it is a picture of his/her financial position at a given time. Because of the problems in agriculture in the 1980s, farmers, agribusinesses, farm creditors, and others have kept a close eye on farm investment trends. Research conducted through the Alabama Agricultural Experiment Station over the past 3 years has helped provide this much needed information. Results now suggest improvement in the farm economy.

As shown in the table, a farmer's investment includes real estate, machinery and equipment, livestock and poultry, and stored or growing crops. To provide a more complete overall farm investment picture, information on these factors and others was obtained through the USDA Economic Research Service. Also included in the study were such factors as investment in household items, deposits, bonds, and investments in cooperatives. Debts, or claims against the farm, are reported as real estate and nonreal estate debt. Equity is the difference in assets and debt, or what the farmer would retain after all debts were paid.

Average investment in Alabama farm real estate per farm declined about 11% from 1982 to 1986, considerably less than the 56% decline in Corn Belt States such as Iowa. Alabama farmers' investment in machinery and crops showed some decline from 1982 to 1986, while livestock and poultry investments per farm remained the same.

Farm real estate is a significant part of total investment. If household items, deposits, currency, and bonds are omitted as part of the total farm investment, real estate accounts for more than three-fourths of the total. A major part of the financing of agriculture is tied to real estate. Thus, the concern among farmers, lenders, and others is apparent when farm real estate values decline.

Balance Sheet of Alabama Farms (Including Operator Households) 1982 and 1986

Item	Average value/farm	
	1982	1986
Assets		
Real estate	$177,200	$157,700
Machinery	25,900	21,800
Livestock and poultry	12,100	12,100
Crops	3,600	2,200
Household items	9,300	15,000
Deposits and currency	4,900	7,500
U.S. savings bonds	600	800
Inv. in cooperatives	4,800	6,500
Total	$238,400	$223,600
Debt		
Real estate	$ 25,400	$ 21,600
Nonreal estate	20,800	16,300
Total	$ 46,200	$ 37,900
Equity	$192,200	185,700
Ratios		
Equity/assets	80.6%	83.0%
Debt/equity	24.0%	20.4%
Debt/assets	19.4%	16.9%
Net farm income/debt	19.3%	33.4%
Number of farms	*55,000*	*51,000*

Source: ERS, USDA, Economic Indicators of the Farm Sector, ECIFS 6-14, February 1988.

The data available from USDA indicate that Alabama farmers had an increase in value of household items, deposits, and currency, as well as U.S. savings bonds, on hand from 1982 to 1986. This was associated with the increase in net farm income of Alabama farmers from 1982 to 1986 as well as some increase in off-farm income. The off-farm income of Alabama farmers in 1982 and 1986 was greater than their net farm income.

Both real estate and nonreal estate debt per farm declined from 1982 to 1986. The decline in debt was greater than the decline in total asset values, indicating strengthening of the farmers' financial position. The proportion of real estate debt changed very little between 1982 and 1986.

Financial ratios provide useful insights to the farm financial picture. The ratios given in the table generally show that some improvement occurred in Alabama's farm financial picture from 1982 to 1986. Farmers' equity relative to assets increased from 80.6% to 83.0%. The debt-to-equity and debt-to-asset ratios declined somewhat. Net farm income-to-debt ratio was more favorable in 1986 than in 1982. Also, these ratios were generally more favorable for Alabama farmers than for those in Corn Belt States.

In summary, the total investment in Alabama farms declined from 1982 to 1986. A major part of the decline was in farm real estate and farm machinery including motor vehicles. Real estate and nonreal estate debt were reduced more than the decline in total assets. Therefore, the farmer's equity position improved although the dollar value of his equity was reduced. Similar financial data for more recent years are not available at this time to determine if improvements in the financial structure of Alabama's farms continued.

Yeager is Head of Agricultural Economics and Rural Sociology.

M.R. Bradbard

Many Factors Affect Farm Women's Life Satisfaction

THE MAJORITY of women today face the challenge of combining the roles of homemaker, spouse, and parent with a job outside the home. For farm women the challenge may be even greater since an increasing number of them have two jobs, being employed off the farm as well as having on-farm work responsibilities.

Each of the roles women assume requires a commitment of time and energy and carries with it a set of specific role expectations. Further, each of these roles and responsibilities must be prioritized and balanced against one another. Given the multiplicity of roles in which farm women typically engage, a reasonable question researchers might ask is "How satisfied are farm women with their lives?"

To answer this question, Alabama Agricultural Experiment Station surveys were mailed to a random sample of Alabama farm women. A total of 130 questionnaires was returned, representing a response rate of 33%. More than half (53%) of the women were between the ages of 46 and 65, while 22% were younger than 46 and the remainder were older than 65. All were married or widowed, had been married for an average of 32 years, and almost all had one or more grown children.

Most of the respondents were well educated. Slightly more than half had attended or completed college, a fourth had high school diplomas, and the remainder had completed fewer than 12 years of school. While all the respondents were involved in farming operations, only 74% stated that farming was the family's major occupation. The average family income was $20,000 to $25,000 in 1987, with the wife contributing approximately half of the income. The majority of these women indicated that their family income had remained about the same over the last 5 years.

The respondents were juggling a variety of roles and responsibilities and lead full, active, and well-balanced lives. On the average, the women worked nearly 31 hours per week in their on- and off-farm jobs combined, as shown in the table. They spent 39 hours per week on meal preparation, home maintenance, and housework and nearly 21 hours each week sustaining marital and other social relationships with family and friends.

To determine the level of satisfaction felt by these working farm women, the questionnaire included reliable measures of life satisfaction, as well as of marital adjustment, family adaptability (the family members ability to adjust to change and stress), and family cohesion (the emotional bonding among family members). Questions also were asked about job-related supports, including benefits received at the workplace, flexibility to change the daily work schedule, and family income.

The results indicated that these women were moderately satisfied with their lives. On a scale in which 1 represents very dissatisfied and 7 signifies very satisfied, these women received a score of 4.3. Seven variables, listed here in order of importance, contributed significantly to the level of satisfaction expressed by the respondents. More satisfaction was expressed by women who: (1) had better marriages; (2) were younger (less than age 56); (3) received more job-related benefits (insurance, retirement and pension plans, and paid leave time), usually from off-farm jobs; (4) had higher levels of education; (5) had higher family income; (6) had greater flexibility to alter their daily work schedules; and (7) perceived their family members to be more flexible and adaptable to change and stress.

These results illustrate the need to examine a complex array of factors representing the marital, family, and work roles of farm women to understand why some women are more satisfied with their lives than others. When a woman holds an off-farm job and also works on the farm with her husband, and sometimes with her children, portions of work relationships are interwoven with close interpersonal relationships. This mingling of business and personal relationships can result in both positive and negative consequences that are unique to farm women.

Bradbard is Associate Professor of Family and Child Development.

Average Number of Hours per Week Farm Women Spend on Tasks

Off-the farm employment	20.8
Farm work	10.1
Meals	20.7
Home maintenance/housework	18.5
Child care	5.3
Marital relations	12.7
Other social relations (family, friends)	8.1
Leisure/self-improvement	14.6
Other(shopping, paying bills, volunteering, church)	12.7

R.R. Dute, R. Dickens, and J. Baird

VIRGINIA BUTTONWEED IS A TOUGH PEST

Mass Reproductive Potential Makes Control Difficult

VIRGINIA buttonweed has become the most talked about weed in turf during the past few years, because of its tenacity and rate of spread. Control of this pest in commercial operations, using either cultural techniques or herbicides, has not been acceptable. Alabama Agricultural Experiment Station research indicates underground seed and flower formation by this weed may be key factors in making it difficult to control by methods that successfully control other weeds.

Studies were recently completed on the anatomy and reproductive habits of Virginia buttonweed which have added greatly to the understanding of how the plant grows and reproduces. Anatomical investigations involved direct inspection of fresh plant material and observing and photographing of specially prepared plant material with both light and scanning electron microscopes.

Virginia buttonweed is a plant with massive reproductive potential. The aerial portions of the plant consist of creeping stems supporting opposite leaves which often bear small white flowers in their axials, figure 1. Lateral buds at the point of leaf attachment can form new roots and shoots when a stem segment is separated from the parent plant, figure 2. Numerous extra (adventitious) buds form plants along the hypocotyl (lower stem); these grow into new leafy shoots when the upper stem is cut off or killed.

Virginia buttonweed has an extensive network of fleshy roots that also play an important part in its survival and reproduction. Numerous adventitious buds occur singly or in clusters along the lengths of older roots, figure 3. These buds, which can also produce aerial shoots, have been observed on roots growing 3 ft. below the soil surface. Energy necessary for germination and growth of these buds is supplied from starch stored in the fleshy roots.

Not only does this weed reproduce vegetatively, but it is also a prolific seed producer. Virginia buttonweed, like most other species, produces seed above ground from fertilized ovules within the small white flowers on the stems. However, unlike most other plants, this pest also forms flowers below ground. Shown in figure 4 are some of these subterranean flowers (FL) formed on the adventitious buds (AS) that grow on the roots (R). These buds, with their flowers, often occur on smaller lateral roots (LR). The petals (P) of these flowers never open, but self pollination occurs and fruits and seeds are formed.

These seeds formed by the underground flowers may represent a source of dormant, viable propagules in the soil below the reach of many herbicides and they could be an important source of new plants when the soil is disturbed by tillage treatments such as coring. Therefore, any program for control of this species may require consideration of the varied methods of seed production as well as its great reproductive potential by conventional seed and vegetative means.

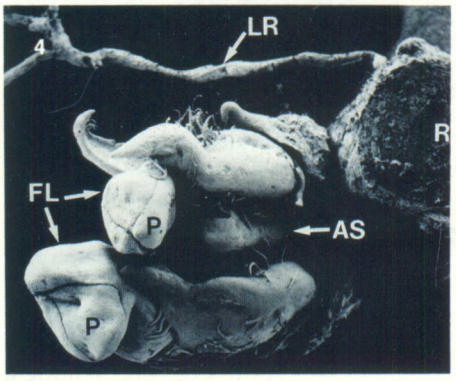


FIG. 1—small white flowers characteristic of Virginia buttonweed; FIG. 2—new roots and shoots from lateral buds; FIG. 3—adventitious buds on older roots; FIG. 4—subterranean flowers of Virginia buttonweed.

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