HIGHLIGHTS
OF AGRICULTURAL RESEARCH

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Alabama Agricultural Experiment Station Lowell T. Frobish, Director
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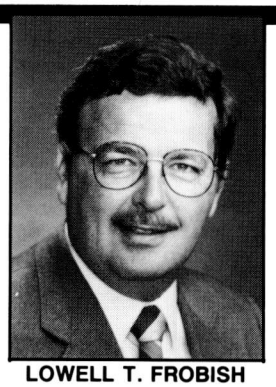
DIRECTORS COMMENTS



LOWELL T. FROBISH

THE IMPLEMENTATION of new technology requires effective communication. Webster defines the word communicate as "to convey knowledge of or information about" and communication as "a process by which information is exchanged between individuals..." *Highlights* is but one means of communicating to you current research of the Alabama Agricultural Experiment Station. To complete the communication cycle, however, we need your thoughts, comments, or concerns.

One goal of our communications is to create a competitive edge for Alabamians and Alabama products. Because of a broader world communication, technology that has allowed Alabama and the United States to develop highly productive agricultural and forest industries is now more readily adopted by other countries than by our producers. This is a major concern.

The future role of U.S. agricultural and forestry industries was effectively communicated by Vernon M. Ruttan in an editorial in the February 21, 1986, issue of SCIENCE magazine, which I quote here to emphasize the critical importance of continuing scientific research:

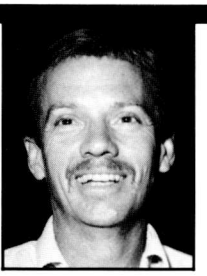
> The capacity of American agriculture to expand its foreign markets and retain its domestic markets depends on continued declines in the real cost of production. American agriculture has achieved its preeminence in the world by substituting knowledge for resources. This knowledge, embodied in more productive biological, chemical, and mechanical technologies and the managerial skills of farm operators, has given the United States a world-class agricultural industry at a time when many sectors of the U.S. economy are losing their preeminent position.

More than ever before producers need the newest technology to maintain their competitive edge. Scientists must be investigating new ideas as well as maintaining the current base of information. Unfortunately, most of our research effort must be directed to just maintaining our current technological base. Little time or funds are available to explore new ideas.

Producers receive information via many different means. It is difficult and sometimes frustrating to sort fact from fiction. Through communications, be it our research and extension reports, scientist and county extension agent meetings, or whatever the means, it is our desire to encourage and develop effective farm management skills in each of you through our research.

For every street running in one direction, another street goes in the opposite direction. Communication is not a one-way street from us to you. We have communicated our research and now we need to hear from you.

MAY WE INTRODUCE



Dr. Robert E. Keith, Associate Professor of Nutrition and Foods. He came to Auburn as Assistant Professor in 1978 from Virginia Polytechnic Institute and State University, where he completed his Ph.D. in human nutrition. Keith, who was promoted to Associate Professor in 1983, also holds a B.S. degree in biology and a master of science degree in human nutrition from Florida State University.

Since coming to Auburn, Keith has gained national and international recognition for his work with the effects of different carbohydrate levels on female athletes. This pioneering research demonstrated some of the mental, as well as physical performance, effects of lowering and raising carbohydrate levels.

Keith also has looked at the effects of different vitamins on different sex and age groups of humans. His report on the effects of vitamin C supplements on elderly women is on page 6 of this issue of *Highlights*.

ON THE COVER. A Red Sunset red maple cultivar exhibits its true colors in a variety test conducted at the Piedmont Substation, Camp Hill. (See story on page 3.)

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EDITOR'S NOTE. Mention of trade names does not indicate endorsement by the Alabama Agricultural Experiment Station or Auburn University of one brand over another. Any use of pesticide rates in excess of labeled amounts in research reported does not constitute recommendation of such rate. Such use is simply part of the scientific investigation necessary to evaluate various materials. No chemical should be used at rates above those permitted by the label. Information contained herein is available to all persons without regard to race, color, sex, or national origin.

D.C. FARE, C.H. GILLIAM, and H.G. PONDER

VARIETY SELECTION IMPORTANT WITH RED MAPLES

EMPHASIS on tree plantings in cities and residential areas has been increasing in recent years, resulting in more and more new species and cultivars being introduced into the ornamental industry. Red maples, because of their brilliant fall colors and handsome canopy shapes, have been popular selections for urban plantings. But a lack of information on red maple varieties has resulted in increased maintenance and removal costs when varieties unsuitable for southern landscapes are planted. As a result, an Alabama Agricultural Experiment Station project was initiated to provide information about fall coloration, shape, and growth rate of red maple varieties.

Red maple plantings of Autumn Flame, Tilford, Scarlet Sentinel, Red Sunset, Gerling, Bowhall, and Armstrong varieties were made in December 1980 at the Piedmont Substation in Camp Hill. Bareroot whips measuring 3 to 4 ft. tall were planted 25 ft. apart within rows and 30 ft. apart between rows. Each year, fall color development was observed and rated based on the date color appeared and peaked and the amount of color present both in individual leaves and on the entire tree. Tree growth also was measured annually and canopy and leaf shape were observed.

Detailed results of color-rating are reported in the table. Autumn Flame had the most consistent fall color development and developed color more rapidly over the entire tree than the other cultivars, thus appearing to have earlier fall color. Consistent color occurred with Tilford since 1985, with 83-100% of the trees exhibiting fall color. Scarlet Sentinel's fall leaf color consisted of mostly yellow and red hues and has been inconsistent, ranging from 100% in 1985 to 25% in 1987. Red Sunset, one of the most widely planted red maples in the Southeast and highly rated in the Ohio Shade Tree Evaluation, exhibited inconsistent color development and only average fall color presentation. Gerling red maple showed consistent fall color formation with all of the trees developing color during the past 4 years. Bowhall showed excellent fall leaf color with hues of yellow, red, and orange. From 1986 to 1988, only 50% of the Armstrong trees had fall color.

Survivability was a problem for Bowhall, which lost 5 of the 9 trees in its planting from bud union incompatibility. Four of the 9 trees in the Scarlet Sentinel planting died from bud union incompatibility (which occurs in grafted trees when the root stock and the grafted stock do not successfully join) and a fifth tree died of winter injury. Two of the 9 Armstrong trees died from bud union incompatibility. No bud union incompatibility was exhibited with Red Sunset in this study. Gerling trees also exhibited good survivability.

The fastest growing cultivar in the study was Scarlet Sentinel, which averaged about 24 in. of growth annually. Tilford was also a fast-growing variety, averaging 22.3 in. height growth annually. Bowhall was a moderate-growing cultivar (21.7 in. per year), while Gerling trees averaged 21.5 in. Autumn Flame was the slowest growing tree in the test, averaging about 16.1 in. of height growth annually.

Scarlet Sentinel exhibited an upright, oval canopy, while Armstrong's canopy tended to be cone shaped and upright. Bowhall, usually attributed with a pyramidal canopy, tended to be upright-oval in form in this study, providing little shade. Autumn Flame trees had round to oval canopy shapes and Gerling tended to be broadly pyramidal and densely branched. Red Sunset cultivar displayed an oval, upright canopy which provides excellent shade.

In this study, Autumn Flame, Tilford, Gerling, and Bowhall varieties exhibited consistent fall coloration. Bud union incompatibility was a problem with Bowhall and Scarlet Sentinel varieties.

Fare is Research Associate and Gilliam and Ponder are Professors of Horticulture.

FALL COLORATION OF 7 CULTIVARS OF RED MAPLE

Measurement	Results, by year			
	1985	1986	1987	1988
Autumn Flame				
Fall leaf color[1]	10/26-11/15	10/15-11/12	10/12-10/30	10/20-11/7
Color[2]	O-R	O-R	O-R	O-R
Trees colored, pct.	100	100	100	100
Tilford				
Fall leaf color	10/19-11/15	10/17-11/19	10/19-11/9	10/17-11/11
Color	O-R	O	O	O-R
Trees colored, pct.	100	100	83	100
Scarlet Sentinel				
Fall leaf color	11/1-11/19	10/20-11/19	10/30-11/8	10/24-11/14
Color	O-R	Y	Y	O
Trees colored, pct.	100	75	25	75
Red Sunset				
Fall leaf color	10/24-11/25	10/30-11/19	None	10/24-11/17
Color	R	R	O	R
Trees colored, pct.	70	100	0	67
Gerling				
Fall leaf color	10/21-11/15	10/19-11/17	11/1-11/21	10/30-11/19
Color	Y-R	Y-R	Y-R	Y-R
Trees colored, pct.	100	100	100	100
Bowhall				
Fall leaf color	10/9-11/15	10/15-11/6	10/16-11/3	10/23-11/9
Color	R-O	R-O	R-O	R-O
Trees colored, pct.	75	100	75	100
Armstrong				
Fall leaf color	10/23-11/15	10/10-11/17	10/19-11/3	10/21-11/9
Color	Y	Y	Y-O	Y-R
Trees colored, pct.	100	50	50	50

[1]Dates reflect when initial fall coloration began and when there was no further coloration.
[2]R = red; Y = yellow; O = orange.

S. YALCIN, G.R. McDANIEL, and J. WONG-VALLE

DIFFERENT LIGHT:DARK RATIOS O.K. FOR GOOD BROILER BREEDER PERFORMANCE

GROWING BIRDS on short days and then exposing them to long light periods each day is well known for stimulating onset of egg production. From this basic principle has evolved the standard practice of rearing broiler breeder replacements on a daily light regime of 8 hours light and 16 hours dark from 2 to 20 weeks of age. It is not known, however, if shorter days could be used without reducing the benefits of the controlled light system. Reducing the hours of light would be desirable because this could reduce energy requirements for lighting and thereby lower cost of rearing replacements.

An Alabama Agricultural Experiment Station study was done to determine if different periods of daily light could be used without detrimental effects on broiler breeder replacements.

After 1 week in which all birds were subjected to 23 hours of light and 1 hour of darkness daily, these four light:dark ratios were compared:

4 hours light:20 hours dark
6 hours light:18 hours dark
8 hours light:16 hours dark
10 hours light:14 hours dark

Each treatment involved 300 broiler breeder females and 40 males. They remained on the light treatments (with all other management practices standard for all) until 20 weeks old. They were then moved to a breeder house and subjected to a standard 15 hours of light:9 hours of dark regime for the next 30 weeks. Production was evaluated for the 30-week period to determine effects of light treatment during rearing on reproductive performance of the adult birds.

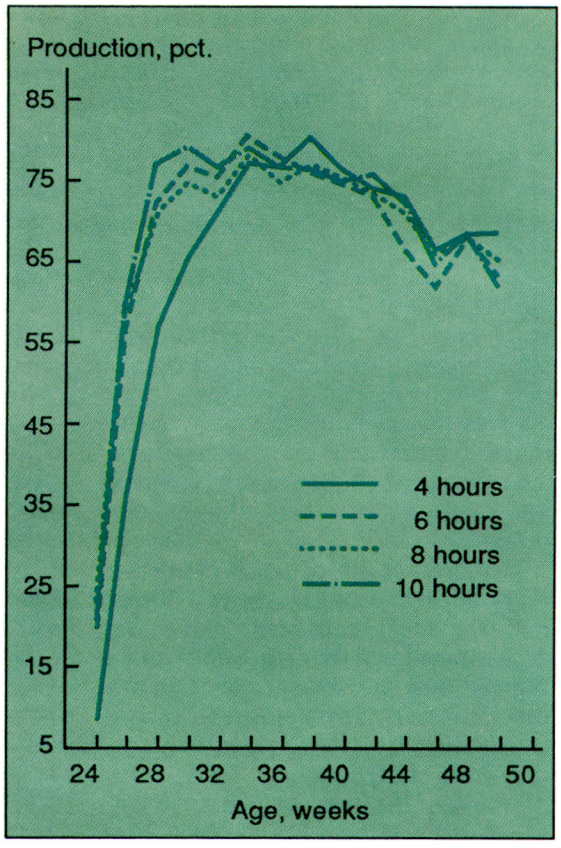
Results show that females grown out with 4 hours of light:20 hours of dark daily matured 11 days later than those raised on 6, 8, or 10 hours of light. As a result, the 4-hour light females (1) reached peak production later than the others, (2) had lower production during weeks 23-30, and (3) had lower total production to 50 weeks of age. In contrast, there was no difference in production to 50 weeks among those raised on 6, 8, or 10 hours of light daily, as listed below:

Light ratio	*Eggs to 50 weeks*
4 light:20 dark . .	123
6 light:18 dark . .	132
8 light:16 dark . .	131
10 light:14 dark .	131

Hen-day egg production was 63.9, 68.4, 67.3, and 67.0%, respectively, for the 4, 6, 8, and 10 hours daily light. Those raised on 6, 8, and 10 hours of light peaked in production (reached approximately 80% lay) by 29 weeks of age. There was no difference in average egg weight, egg specific gravity, and body weight of females as a result of light regimes.

In males, sexual maturity was delayed for 7 days by the 4-hour daily light regime. There were no differences among the 6, 8, and 10 hours daily light groups. Body weight, semen concentration, and semen volume were unaffected by lighting.

Since the results show no differences among the lighting regimes using 6, 8, and 10 hours of light per day, regimes other than the standard 8 light:16 dark can be used for rearing broiler breeder replacements. Where climate-controlled housing is used, the 6 light:18 dark regime offers an opportunity for reducing energy requirements for lower utility costs. For operations using natural light and natural ventilation, the 10 hours light:14 hours darkness regime would be more economical, since there would be less need to close houses and use forced ventilation than would be true with the use of shorter light days.



How different periods of daily light during growing affects egg production to 49 weeks of age is illustrated.

Yalcin is Visiting Professor from Aegean University of Turkey; McDaniel is Professor and Wong-Valle is Graduate Research Assistant of Poultry Science.

D. W. PORCH, C.H. GILLIAM, J.E. BROWN, J.L. ADRIAN, and J.T. EASON

BROILER LITTER VS. COMMERCIAL FERTILIZER PRODUCES EARLIER, LARGER TOMATOES

THE USE of poultry litter as a fertilizer for vegetable crops is becoming more popular due to public concern over the use of inorganic fertilizers and the poultry industry's efforts to find environmentally sound ways to dispose of large amounts of waste. Results of recent Alabama Agricultural Experiment Station research indicate that poultry litter is an ideal fertilizer for vegetable crops. Application of 10 tons per acre of poultry litter produced about 11,629 lb. per acre more tomatoes, and these were harvested earlier than tomatoes grown using commercial fertilizer. In addition to increased yields and earliness, other benefits of using poultry litter on vegetable crops include better water holding capacity, increased aggregation, and improved soil structure. The litter is also a good source of major and minor nutrient elements.

The objectives of the study at the Sand Mountain Substation, Crossville, were to determine the effects of poultry litter rates, compared to commercial fertilizers, on tomato growth and yield. The tests were done on Wynnville sandy loam soil, using Mountain Pride tomatoes (transplants) spaced 15 in. apart in 5-ft. rows.

Poultry litter rates of 10 and 20 tons per acre were applied in the fall. [Analysis indicated the litter contained 3.11% N, 1.17% P, 1.76% K, 1.73% Ca, and 0.40% Mg; minor element concentrations were 2,982 p.p.m. (parts per million) Fe, 292 p.p.m. Cu, 186 p.p.m. Zn, and 42 p.p.m. B]. All plots were tilled to 6-in. depths after litter application, 1 ton per acre of lime was applied, and rye was planted as a winter cover crop. Plots were irrigated to bring the moisture level up to field capacity to ensure rye germination.

The commercial fertilizer treatments consisted of 400 lb. per acre of 13-13-13 (according to soil test recommendations), applied in the spring. Nitrogen sidedressing consisted of 68 lb. of N per acre.

In the spring, plots for all treatments were prepared by applying Gramoxone® (paraquat) at the rate of 0.5 lb. active ingredient (a.i.) per acre and disking. Irrigation was applied to bring soil moisture up to field capacity, and pesticides were applied as needed throughout the study.

Tomato yields in 1988 and 1989 were enhanced by the addition of poultry litter at 10 and 20 tons per acre. Similar yields occurred with each litter treatment. Both broiler litter treatments resulted in about 20% greater tomato yields than from the commercial fertilizer program. In 1989, poor growing conditions prevailed and yields were 40-50% lower than yields given in the table for 1988, which was an excellent growing season.

An evaluation of tomato yield by standard packaging sizes revealed the numbers of 5 x 6 and 6 x 6 packs (large and medium size tomatoes, respectively) were enhanced by application of broiler litter at the 10 tons per acre rate. Application of 20 tons per acre resulted in greater number and weight of all three package sizes.

There were no differences among the three treatments in blossom end rot, cracks, and other problems causing the tomatoes to be unsalable.

Tomatoes in plots receiving broiler litter matured earlier and were heavier than those receiving commercial fertilizer. Those plots receiving broiler litter had their greatest yield on July 26 and August 1, 1988, with no differences between poultry litter rates. Plots fertilized according to commercial standards had their greatest yields in 1988 on August 4 and August 10. Yield data in 1989 were similar to 1988. Earlier harvest in many instances would result in increased profits to commercial producers.

These data reported here show that broiler litter enhanced tomato yield by about 20% compared to standard commercial fertilization practices. In addition, earlier harvest occurred when broiler litter was used as the fertilizer source.

TOMATO YIELD AS AFFECTED BY APPLICATION OF BROILER LITTER, 1988

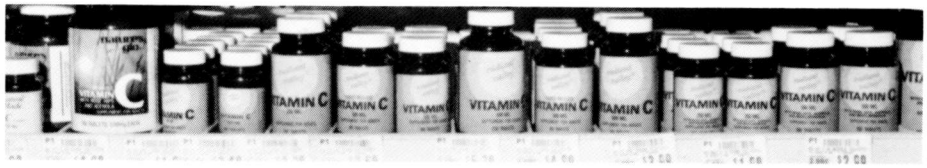
Treatment	Marketable tomato yield/acre, by size[1]			
	5 x 6	6 x 6	6 x 7	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*
Commercial fertilizer	5,838	17,220	23,040	45,165
Broiler litter, 10 tons/acre	11,376	22,428	19,986	56,794
Broiler litter, 20 tons/acre	7,380	22,428	26,748	56,524

[1]5 x 6 has a minimum diameter 2 11/16 in. and maximum diameter 3 3/16, 6 x 6 has minimum 2 8/16 and maximum 2 14/16, and 6 x 7 has minimum 2 4/16 and maximum 2 10/16 in.
[2]Yield based on six harvests per season.

Porch is former Graduate Research Assistant, Gilliam is Professor, and Brown is Assistant Professor of Horticulture; Eason is Superintendent of the Sand Mountain Substation; Adrian is Professor of Agricultural Economics and Rural Sociology.

R. E. KEITH and W. L. McKENZIE

VITAMIN C SUPPLEMENT SHOWS LITTLE EFFECT ON IMMUNITY OF ELDERLY WOMEN



IMMUNITY has been described as the capacity of an organism to identify and reject material that is foreign to itself. It has been suggested that vitamin C supplements increase immunity in humans; however, in recent Alabama Agricultural Experiment Station studies, such supplements had no known effect on immune functions of a group of elderly women.

Vitamin C levels in the body, as well as immune function, are known to decline as the body ages. If part of the immune function decline is due to the reduction in vitamin C status, then perhaps immune function in the elderly could be enhanced by increasing their intake of vitamin C. Therefore, the purpose of the Auburn study was to determine if vitamin C supplementation could enhance immune function in a group of elderly women.

Women chosen for the study were between 67 and 95 years of age, apparently healthy, and living on their own or with relatives. The women were consuming adequate, but not large (less than twice the recommended amount), quantities of vitamin C in their diets.

The women in the study were divided into two groups. One group (seven women) received a vitamin C supplement of 1,000 mg (milligrams) per day for a period of 1 month. The other group (eight women) received a placebo tablet that contained no vitamin C. Neither the study investigators nor the women knew which tablets were given until the study was complete.

Daily dietary intakes were recorded approximately twice per week throughout the study. Blood was drawn initially and at the end of the study and analyzed for vitamin C content and the concentration of immunoglobulin G (IgG) and M (IgM), which are markers of humoral immunity. In addition, delayed cutaneous hypersensitivity (DCH) tests were given at the beginning and end of the study. These are skin-scratch tests in which a small amount of a foreign substance is injected under the skin. The resulting level of redness and swelling can be measured and used as an indicator of cell-mediated immunity.

Results showing the vitamin C intakes and blood concentrations of the subjects can be seen in table 1. Dietary vitamin C intakes were 183% of the Recommended Dietary Allowance in the supplemented group and 143% in the placebo group. Despite the apparently normal vitamin C intakes, both groups' initial blood concentrations of the vitamin were low. [Values below 0.4 mg per 100 ml (milliliters) of blood are considered low.] Vitamin C concentrations analyzed from blood taken at the end of the study remained low in the placebo group. However, the vitamin C supplemented group showed a significant increase in blood vitamin C concentration at the end of the study such that their values were above 0. 4 mg per 100 ml.

IgG and IgM values and the DCH skin test results were within normal limits in both groups of subjects at the beginning of the study. Vitamin C supplementation for 1 month had no effect on the immune system components as measured in the Auburn study. Thus, contrary to some previous studies, vitamin C supplementation did not seem to improve immunity among elderly females in the present study. This lack of immune response was somewhat surprising considering that blood vitamin C concentrations were initially low in the group. However, the immune system is complex. Either the supplements had no real effect on immune function in this group of females or the immune values measured were not sensitive enough to pick up possible changes in immunity.

As a result of supplementation during the study, blood concentrations of vitamin C rose to normal. However, vitamin C supplementation had no effects on immune function.

While vitamin C tablets were given in the current study so that doses could be controlled, it is easy to obtain ample amounts of vitamin C from foods. Examples of foods with their vitamin C content are shown in table 2. Choosing one or two of these foods each day would more than meet normal body needs. In addition to supplying vitamin C, natural foods contain other nutrients and components that are beneficial to health, giving them an obvious advantage over supplemental vitamin C pills.

TABLE 1. DIETARY VITAMIN C INTAKES AND BLOOD VITAMIN C CONCENTRATIONS IN ELDERLY FEMALE SUBJECTS RECEIVING VITAMIN C SUPPLEMENTS OR A PLACEBO[1]

Group	Dietary vit. C, mg/day	Pre-test blood vit. C, mg/100 ml	Post-test blood vit. C, mg/100 ml
Vitamin C	110	0.18	0.52
Placebo...	86	.17	.21

[1]There were seven subjects in the vitamin C group and eight subjects in the placebo group. Blood values below 0.4 mg/100 ml are considered to be low or deficient.

TABLE 2. VITAMIN C CONTENT OF SELECTED FOODS

Food—serving size	Vitamin C content[1]
	mg
Kiwi—1 fruit	265
Broccoli—1 whole stalk	162
Brussel sprouts—8	146
Green peppers—1	94
Cantaloupe—1/2 melon	90
Orange juice—1/2 cup	60
Turnip greens—1/2 cup	50
Strawberries—1/2 cup	44
Tomatoes—1	42
Potato (baked)—1	31
Watermelon—1 slice (small)	30
Sweet potato—1	25

[1]The Recommended Dietary Allowance for vitamin C is 60 mg/day for nonsmokers and 100 mg/day for cigarette smokers.

Keith is Associate Professor and McKenzie is Graduate Student of Nutrition and Foods.

A.G. APPEL and R.C. SPONSLER

GEL AND PASTE BAIT FORMULATIONS EFFECTIVE FOR GERMAN COCKROACH CONTROL

THE GERMAN cockroach is the most prevalent insect pest in apartments, food handling facilities, and hospitals. Since cockroaches can transmit diseases, foul food, and cause allergies, their control is important in both homes and businesses. Insecticidal bait formulations have several advantages over conventional sprays and foggers. Baits allow for precise placement, minimum disruption of the application site, and little odor. While baits available to consumers are usually child resistant, they have disadvantages. Bait containers are large and obvious, and they are difficult to fit into cracks and crevices where cockroaches are likely to hide.

To allow for greater coverage of cockroach harborage areas, several companies have developed gel or paste formulations of their cockroach baits. The effectiveness of these gel and paste bait formulations is being determined in research by the Alabama Agricultural Experiment Station.

The studies were conducted in apartments managed by a public housing authority in both small and moderate size cities in Alabama. The design of these complexes provided one, two, four, six, and eight apartment units. A total of 40 apartments was used in the study.

Sticky traps (Mr. Sticky®) were used to monitor cockroach populations. Two traps were placed in the kitchen of each apartment—one in a rear corner under the sink and the other behind the stove or refrigerator—so they contacted a vertical surface such as a wall or part of an appliance. These traps were left in place for 7 days before the treatments were applied to evaluate cockroach populations. Treatments were applied to individual apartments based on the number of insects caught so the initial cockroach population size and distribution were equivalent among treatments.

Beginning in August of 1988, treatments of Maxforce® gel (containing 2% hydramethylnon) and It Works® and Blue Diamond® pastes (containing 52 and 33% boric acid, respectively) were applied to various apartments. It Works and Blue Diamond are now available for use by pest control operators. Maxforce is currently under evaluation for use by these operators.

Each product was placed in 10 apartments, and 10 apartments were left untreated as a control. Dabs of the treatments were placed in each apartment as directed on the label, using a putty knife or a caulking gun. Each apartment received 11 dabs in the kitchen, 2 dabs in the rear corners under the sink, 2 dabs behind the stove, 2 behind the refrigerator, 2 in upper cabinets, 2 in lower cabinets, and 1 in a pantry or cabinet above the refrigerator. A dab was also placed in each bathroom on the floor behind the toilet. Apartments treated with Maxforce received 0.7 oz. of the bait each, apartments receiving It Works received 5.5 oz. each, and apartments treated with Blue Diamond received a total of 9.5 oz. each.

The results of the field experiment, expressed as the mean number of cockroaches per apartment, displayed no significant differences among the treatments at the beginning of the study, as seen in the table. One week after treatment, Maxforce reduced cockroach trap catch by 50%, while the untreated control apartments showed a 47.6% increase in cockroach numbers.

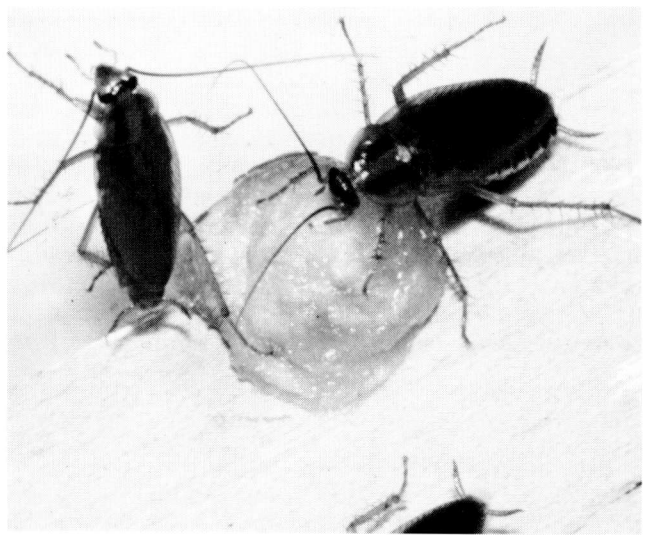
At 2 weeks, there were no differences between Maxforce and the boric acid paste treatments, but all three treatments had fewer cockroaches than the control, a trend that continued at 4 weeks. Maxforce displayed the greatest reduction in cockroach numbers (75.2%) at 4 weeks. Apartments treated with Blue Diamond bait had the fewest cockroaches at 8 weeks, with a 75.1% reduction. The number of cockroaches in the Maxforce treatments began to increase after the fourth week to only 51.1%. Examination of these treatments revealed that all of the Maxforce gel had been consumed by the cockroaches. It Works performed poorly throughout the study, with no more than a 41.5% reduction in cockroaches after 4 weeks.

Results revealed significant reductions in German cockroach populations during the entire period of the field study from use of Maxforce and Blue Diamond treatments. While these formulations are not available to homeowners, they are available or should soon be available to professional pest control operators and may provide a new way to effectively use baits for cockroach control.

Appel is Assistant Professor and Sponsler is Laboratory Technician III of Entomology.

NUMBER OF COCKROACHES AFTER BAIT TREATMENTS

Treatment	Precount	Mean number of cockroaches after treatment			
		1 week	2 weeks	4 weeks	8 weeks
Maxforce	134	67	79	33	66
It Works	117	112	79	68	69
Blue Diamond	104	91	56	46	26
Control	113	117	150	188	128



D. TAVE, R.T. LOVELL, R.O. SMITHERMAN, and M.A. REZK

GOLD TILAPIA MORE MARKETABLE DUE TO LIGHTER FLESH COLOR

Flesh color differences evident in (from top) gold, bronze, and black tilapia.

TILAPIA are among the most popular farmed food fish in the world, with total production of 600-700 million lb. annually. Though commercial production in the United States is only about 2 million lb. annually, it could jump to 33-44 million lb. by the year 2000—if production and marketing problems of tilapia can be overcome.

Normal skin color of tilapia is dark, with melanin (black) being the predominant pigment. When tilapia are marketed whole or as skin-on fillets, the dark skin color can be a marketing liability in the United States and other areas where consumers prefer lightly colored fish. Research in the Alabama Agricultural Experiment Station indicates recently developed "all" gold tilapia may eliminate this black pigmentation.

Recent Experiment Station research determined the genetics of three body colors (gold, bronze, and black) in *Tilapia mossambica*. Body color is determined by a single autosomal gene, making it possible to develop and produce a true-breeding gold population (see *Highlights,* Vol.36, No. 1, Spring 1989). Gold tilapia have virtually no melanin in their skin. If melanin production in gold tilapia also is reduced internally, their fillets could be lighter than those from black tilapia. This would make the gold tilapia more marketable, even when sold as skinless fillets.

An internal reduction in melanin production also could change pigmentation of the peritoneal (abdominal cavity) lining. The peritoneal lining of black *T. mossambica* is black and often must be removed during processing to make this fish more appealing to consumers. If gold tilapia produce less melanin in their peritoneal lining, they would be easier to process and sell.

In the Auburn test, flesh color of fillets of gold, bronze, and black tilapia was evaluated visually by 10 judges who assigned a numerical score to fillets on the basis of lightness. The scoring system was: 10 = very light; 8 = medium light; 6 = medium; 4 = medium dark; 2 = very dark. Pigmentation of the peritoneal lining was evaluated by removing the abdominal wall.

Flesh of black and bronze tilapia fillets was white with a grayish tint, as shown in photo. Microscopic examination of the flesh revealed that some of the grayish color was due to melanophores (black pigment cells) associated with blood vessels. However, flesh that was free of blood vessels still had a grayish tint. Remnants of the dermis that remained on the flesh after skinning were a silver-gray. The red muscle, which runs along the side of the fish between the upper and lower muscle masses, was a brownish-tan color in both bronze and black fish.

Flesh color in gold tilapia was much lighter than in bronze and black tilapia, as evidenced by a mean flesh score of 8.9. Bronze and black tilapia were 5.1 and 5.0, respectively. Gold tilapia had white flesh with few to no melanophores associated with blood vessels. Remnants of the dermis left on the flesh after skinning were silver-white. The red muscle in gold tilapia was pink.

Pigmentation of the peritoneal lining was strikingly different among the three tilapia phenotypes. Black tilapia had uniformly black peritoneal linings, compared to shiny white peritoneal linings in gold tilapia which gave a silver-white appearance.

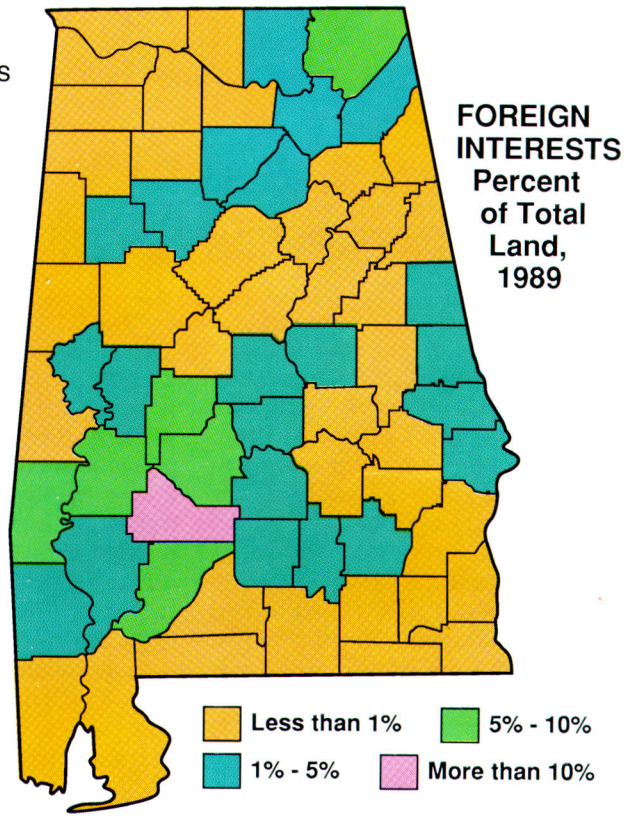
Peritoneal lining of bronze tilapia exhibited a broad range of color variation. The basic color was white, but all individuals had some melanistic areas. Some fish had large black patches that covered almost half the lining. Others were spotted; the sizes and shapes of the spots and the degree of spotting varied greatly. There was no pigment symmetry between the right and left sides. Some bronze tilapia had small areas of iridescent greenish spots on the lining adjacent to the ribs.

Results from this study indicate that flesh color of gold *T. mossambica* is significantly lighter than that of normal pigmented fish and should have greater consumer appeal. Additionally, the white peritoneal lining means that gold tilapia will be easier to process, because the lining does not have to be removed.

Tave is a former Visiting Scientist, Lovell and Smitherman are Professors, and Rezk is Graduate Student of Fisheries and Allied Aquacultures.

J.L. ADRIAN, N.A.D. THOMPSON, and A.M. MIMS

FOREIGN OWNERSHIP OF ALABAMA LAND LITTLE REASON FOR CONCERN



FOREIGN OWNERSHIP of America's agricultural land has been the subject of concern in recent years. Since such concerns are shared by many Alabamians, the Alabama Agricultural Experiment Station regularly compiles information from compliance forms required by the 1978 Foreign Investment Disclosure Act (AFIDA). Periodic analyses of these data are conducted to determine (1) ownership (both full and partial) and (2) other foreign interests that include both ownership and other activity, such as long-term timber management and cutting contracts.

Based on an analysis through January 1989, only about 1% (316,000 acres) of Alabama's land is owned by foreign entities. About twice this much (626,000 acres) is involved with foreign interests.

Foreign entities own agricultural land in 51 Alabama counties and have interests in 55 counties. Wilcox, Choctaw, Perry, Monroe, and Jackson counties account for 45% of the acreage involving foreign interests and about 38% of the ownership.

In terms of land area involved in foreign interests, Wilcox County accounts for 15.5%, Perry 9.8%, Choctaw 9.3%, Monroe 7.7%, and Jackson 5.6%. Monroe County leads in foreign ownership, with 5.8% of the acreage, followed by Jackson (5.6%), Wilcox (4.6%), Russell (4.5%), and Chambers (3.2%).

Changes in foreign activity patterns between 1984 and 1989 were also noted in the analyses. Declines of more than 15,000 acres were noted in Baldwin, Choctaw, Clarke, Conecuh, Covington, Escambia, and Monroe counties. During the same period, Chilton, Shelby, and Talladega counties had large increases in foreign interest. These changes reflected long-term timber management and cutting contracts established by one firm in Shelby and Chilton counties and the purchase of three tracts by another firm in Talladega County. No foreign activity in either 1984 or 1989 was reported for Calhoun, Clay, Elmore, Franklin, Geneva, Henry, Houston, Lamar, Lauderdale, and Montgomery counties.

There were 597 entities reporting foreign ownership in 1989. Most of these (451) reported single (whole-fee) ownership. Tract size of whole-fee ownerships averaged 698 acres. Among those reporting partial ownership (partial-fee interest), interest ranged from 6% to 50%, and tract size averaged 2,275 acres.

Long-term timber leasing, cutting, and management contracts accounted for most of the foreign interests in Alabama's agricultural land. In fact, forestry or timber activities accounted for two-thirds of the total acreage involving foreign interests. Nonagricultural uses accounted for 29% of foreign land usage, with traditional crop production using only about 0.5% of the total.

Organizations, primarily corporations, were the dominant foreign entities involved with Alabama's agricultural land. Average size of tracts reported by corporations was 1,267 acres.

Individual owners accounted for less than 1% of acreage owned by foreigners. Citizens of Canada, the United Kingdom, and West Germany made up three-fourths of the individual owners. A large portion of individual purchases were pecan groves in Macon and Bullock counties.

Although the analyses showed a 29% decline in foreign activity of Alabama agricultural land, much of this adjustment simply reflected a change in definition. (Formerly, only 5% foreign ownership was required to define the interest as "foreign," but the new definition required 10% ownership to meet the foreign classification.) Changing status of two firms accounted for 23% of the adjustment noted. One firm with large State interest had its foreign ownership component purchased by domestic interests, while another was deleted from the foreign list because its interest was more than 5% but less than 10%. Without the change in definition, the extent of foreign interest was largely unchanged (a 6% decrease) between 1984 and 1989, rather than the 29% decline resulting from the new definition.

Based on the ongoing Auburn study, there seems to be little reason for concern about foreign activity with Alabama agricultural land. Much of the activity is by firms that have been traditional entities in the State. Since most of the acreage involves the forest and timber sector, there is little effect on traditional production agriculture. About half of the activity is by lease rather than ownership, and many activities involve large domestic interests along with foreign owners.

Adrian is Professor of Agricultural Economics and Rural Sociology; Thompson is Extension Data Analyst; Mims is Extension Specialist-Microcomputer.

D.H. SUMMERFORD, J.E. DUNKELBERGER, D.L. HUFFMAN, and W.R. EGBERT

NEW LEAN GROUND BEEF GETS HIGH CONSUMER RATING

GROUND BEEF has been a popular American meat product for a long time. Tastiness, ease of preparation, versatility, and value are several of the positive attributes consumers like about ground beef. In recent years, however, American consumers have given increased attention to their eating habits, especially with respect to the fat content of foods. This change in consumer preference has created a challenge for the red meat industry because removing fat from ground beef results in a product that tends to be dry and flavorless. Motivated by consumer demand, research at the Alabama Agricultural Experiment Station has developed a lean ground beef product that contains less than 10% fat while maintaining comparable quality with currently marketed ground beef products containing approximately 20% fat.

In 1989 and 1990, household taste and attitudinal surveys were conducted to determine consumer acceptability of this newly developed product. Some 90 households representative of all racial and income segments found in a medium- size Alabama city were selected and randomly assigned to one of three independent test groups.

Three ground beef products were included in the taste test: Product A, the current market product containing 20% or more fat; Product B, a very lean product containing less than 10% fat; and Product C, the developed test product containing less than 10% fat. Product C, the developed product, consists of the same beef materials as the two comparative products plus nonmeat ingredients to improve juiciness, flavor, and texture of the product (water, salt, hydrolyzed vegetable protein, and carrageenan).

The three ground beef products were home-delivered in different sequences to each household for 3 weeks with a separate evaluation completed for each week's product. A fourth week involved delivery to all households of only the developed test product.

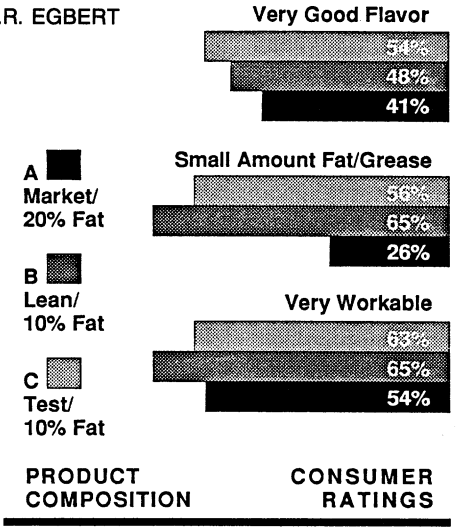
Each week the household food preparer rated the ground beef products according to a variety of observable traits. These involved the sensory and physical characteristics of the three products at three distinct consumption stages: (1) preparation, (2) cooking, and (3) eating.

Preparation traits are those noticeable prior to the actual cooking of the product, such as overall product appearance, leanness, color, aroma, and workability. The cooking stage evaluation focused on such traits as the amount of grease, shrinkage, and overall appearance of the product as it cooked. Finally, the eating stage centered on the qualities of flavorfulness, tenderness, and juiciness.

The figure shows a comparison of the three products on the basis of one attribute from each stage: workability, amount of grease, and flavorfulness. The developed test product (Product C) was rated better than the current market ground beef product (Product A) on all attributes. Product B (the 10%-fat product) and Product C were rated good to very good at all stages. Product A (the 20%-fat product) was rated considerably lower than the very lean product or the developed test product at all stages except the eating stage where the ratings were about the same for the three products.

The lean products, B and C, were rated similarly for general likability, with Product C receiving a rating of "very much liked" slightly more often than Product B.

When choosing a ground beef product, leanness, tenderness, and freshness were concerns most often mentioned by participants in the taste test. Only a few indicated low cost was a concern. In a separate follow-up questionnaire, the household couples (food preparer and spouse, if married) were asked to give their feelings concerning their nutrition and dietary habits. Most (54%) said they had reduced or completely eliminated particular fatty foods. In addition, nearly 70% of the household food preparers and 50% of spouses indicated a desire to lose weight. Among household couples, 86% said they served ground beef at least once a week. However, approximately 20% indicated they were eating less ground beef now compared to 1 year ago, primarily because of health and nutritional concerns.



Consumers' rankings of various attributes in three ground beef products.

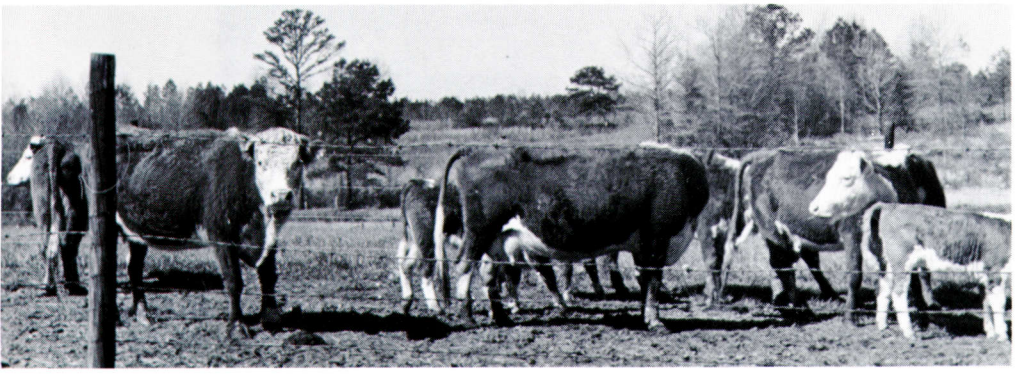
The survey showed that the majority of these households were more concerned about nutritional factors in their meat consumption than about the cost of the meat. Some 40% of the participants indicated that nutritional value was highly important and another 55% said it was somewhat important. Only 5% said nutritional value was of no concern when purchasing ground beef. More than half of the household food preparers indicated that they regularly purchased ground chuck, a product generally rated leaner but more expensive than regular ground beef.

Current buying practices indicate consumers' willingness to purchase a leaner ground beef product when desired quality factors are present. The developed test product (Product C), which has less than 10% fat, possesses sensory and physical qualities rated superior to the current market product containing 20% or more fat.

Summerford is Graduate Research Assistant and Dunkelberger is Professor of Agricultural Economics and Rural Sociology; Huffman is Professor and Egbert is Research Associate of Animal and Dairy Sciences.

J.C. WRIGHT, S.D. BECKETT, and J.G. FLOYD

MANAGEMENT DEFICIENCIES, HEALTH PROBLEMS LIMIT BEEF PRODUCTION IN ALABAMA



THE NEED for improved management on Alabama beef farms was emphasized in results from a 1989 survey of cattlemen and veterinarians. The objective of the Alabama Agricultural Experiment Station survey was to identify health problems as perceived by cattlemen and veterinarians. While the survey was successful in identifying specific health problems, the most striking information concerned management practices used. The high percentage using year-round calving and the failure of most to check bulls for breeding soundness point out areas of improvement that could boost productivity.

Of the 372 producers who returned questionnaires (790 sent), 47% had a herd size of fewer than 50 animals. Only 11% reported having more than 200 animals. Most respondents (68%) owned cow-calf operations. Only 18% raised purebred cattle. Those reporting feedlot, stocker calf, and backgrounding operations totaled 4%, 7%, and 3%, respectively, of the total returned. Angus (18%) and Hereford (13%) were the breeds most often reported.

Responses concerning management practices revealed that 71% obtained their bulls through private purchase, and 58% never evaluated their bulls for breeding soundness. Only 12% of the respondents evaluated their bulls before the breeding season, while 18% evaluated them before sale or after purchase and 6% if they had noted fertility problems.

Surprisingly, 49% reported a year-round breeding season. Twenty-eight percent reported a breeding season of 2 to 4 months and 19% a 4- to 6-month season. Nearly half (43%) indicated that most of their calves were born in the spring. Estrous synchronization was reported by 31% of those responding to the survey. Artificial insemination and embryo transfer were used infrequently, by 17% and 4%, respectively.

Most of the producers said they used a veterinarian, with 45% reporting service every 6-12 months. Only 7% never employed a veterinarian.

Foot lameness was the leading problem among 25 disease and health problems from which producers selected the most prevalent, table 1. Skin conditions ranked second, while diarrhea in calves, pinkeye, pneumonia in calves, intestinal parasites, cancer eye, grass tetany, dystocia, and fescue toxicity also were reported to occur frequently.

Foot disease was also the leading problem reported by the 68 responding veterinarians (out of 113 receiving questionnaires). Rounding out their list of the five most important disease and health problems encountered in their practice were respiratory disease, reproductive disease, intestinal parasites, and dystocia, table 2.

The veterinarians, 85% of whom reported less than half of their practice to involve beef cattle, also were questioned about their impressions of the most important causes of beef production shortfalls in Alabama. Reasons, ranked in order of importance, were management (63%), nutrition (48%), reproductive programs (34%), parasites (25%), and genetics (18%).

Although responses to the surveys are not directly comparable because of different disease and health problem classifications between the two groups, similar problems were noted by producers and veterinarians. Foot disease, respiratory disease, intestinal parasites, and dystocia were reported with high frequency by both groups. The veterinarians' assessment of management problems as a limiting factor obviously related to the management practices reported by the producers. Following better management procedures clearly offers opportunities for improving productivity of Alabama beef herds.

TABLE 1. DISEASE AND HEALTH CONDITIONS MOST FREQUENLY REPORTED BY 268 ALABAMA BEEF CATTLE PRODUCERS RESPONDING TO A MAILED SURVEY

Disease/condition	Prevalence reported	
	Number	Percent
Foot lameness	110	41
Skin conditions	104	39
Diarrhea in calves	77	29
Pinkeye	75	78
Pneumonia in calves	68	25
Intestinal parasites	68	25
Cancer eye	66	24
Grass tetany	64	24
Dystocia	52	19
Fescue toxicity	40	15

TABLE 2. DISEASE AND HEALTH CONDITIONS MOST FREQUENTLY REPORTED BY THE 68 ALABAMA VETERINARIANS RESPONDING TO A MAILED SURVEY

Disease/condition	Prevalence reported	
	Number	Percent
Foot disease	40	59
Respiratory disease	39	57
Reproductive disease	36	53
Intestinal parasites	34	50
Dystocia	33	48

Wright is Associate Professor of Pathobiology; Beckett is Associate Dean of Veterinary Medicine; Floyd is Extension Veterinarian.

Steers eating hay in fall, despite ample high-quality pasture.

A Little Hay May Go A Long Way

D.I. BRANSBY, S.E. SLADDEN, and W.H. GREGORY

FEEDING HAY to cattle grazing lush winter pastures appears illogical, since such pastures are thought to provide the best possible nutrition. The general belief is that cattle grazing lush winter pastures would not eat hay if it were offered.

Both these ideas are disputed by early results of Alabama Agricultural Experiment Station tests in which hay supplements were used on winter pastures. Despite an abundance of lush pastures, steers regularly consumed hay, and the hay feeding increased rate of gain, especially at high stocking rates.

In the fall of 1988 and 1989, pastures at the E.V. Smith Research Center were planted with 90 lb. per acre of Wintergrazer 70 rye and 25 lb. per acre of Marshall ryegrass. Because of differing planting depth requirements, these two species were planted in separate passes over the experimental paddocks to develop a mixed pasture. Nitrogen was applied as ammonium nitrate at a rate of 100 lb. per acre at planting and 60 lb. per acre in late February and P and K were applied according to soil test at planting.

Grazing commenced when pastures were about 6 to 8 in. tall. This occurred on November 9, 1988, and on December 5, 1989. The delayed start in 1989 was due to late planting caused by low rainfall in the fall. A mixed group of fall- and spring-born Angus x Hereford x Gelbvieh steers grazed 2-acre pastures continuously for 140 days in 1988-89 and 169 days in 1989-90. In 1988, steers were not in good condition and averaged 495 lb. at the start of grazing, while in 1989 they were in better condition and averaged 597 lb. Steers were weighed and pasture height was measured every 28 days.

The experiment involved grazing pastures with and without bermudagrass hay available to animals. Each of these treatments was applied at four stocking rates: 1.0, 1.3, 1.7, and 2.0 steers per acre. Large round bales of hay were provided free choice on the supplement treatment from the day that grazing began. The hay contained approximately 10% protein and was about 50% digestible. Animals remained on pasture throughout the winter with or without hay. This differs from traditional grazing on pastures in fall, removing animals for feeding in mid-winter, and returning them to pasture in spring.

Gains in 1989-90 were lower than in 1988-89. This was probably because animals were thin when grazing began in 1988, resulting in some compensatory growth, and because the late planting in 1989 resulted in less pasture growth in fall and winter.

Steers with hay supplements started eating hay from the first day of grazing, despite excess availability of the high quality pasture. Hay consumption continued throughout the experimental period, although it reached a peak in mid-winter when pastures were short, especially at heavy stocking rates. On average, hay consumption was 5-9 lb. per head per day, depending on stocking rate.

Hay supplementation provided the greatest advantage in average daily gain at the high stocking rate: 2.8 vs. 1.9 lb., or a 47% increase in 1988-89, and 1.4 vs. 0.2 lb., or a seven-fold increase in 1989-90, see table. This is probably due to animals substituting hay for pasture, resulting in greater forage availability and consumption associated with slightly taller pastures (especially in winter).

Gain per acre was highest at the high stocking rate in both years for the hay supplement treatment. However, for the no-hay treatment, gain per acre was highest at the high stocking rate in 1988-89, but was highest at the low stocking rate in 1989-90. The highest gain per acre for the hay supplement treatment was 47% and 40% higher than that for the no-hay treatment in 1988-89 and 1989-90 treatments, respectively.

In this experiment, supplementation of stockers with hay was extremely effective in extending winter annual pastures to carry more animals at increased gains, and removing animals from pasture in mid-winter was not necessary. However, it proved critical to provide the hay from the day grazing started in fall. In the Auburn test, animals usually ate the hay because they appeared to crave dry matter, even while grazing high-moisture pasture.

Bransby is Associate Professor and Sladden is Research Assistant of Agronomy and Soils; Gregory is Superintendent of the Beef Unit, E.V. Smith Research Center.

Average Daily Gain, Gain Per Acre, and Pasture Height for Steers Grazing Winter Pasture With and Without Hay at Four Stocking Rates

Treatment	Result, by number of steers/acre							
	1988/89				1989/90			
	1.0	1.3	1.7	2.0	1.0	1.3	1.7	2.0
	Average daily gain, lb.							
Hay supplement	3.2	3.1	2.9	2.8	2.2	1.9	1.6	1.4
No hay	2.9	2.6	2.2	1.9	2.0	1.5	.7	.2
	Gain per acre, lb.							
Hay supplement	448	564	690	784	372	417	460	473
No hay	406	473	524	532	338	330	201	68
	Pasture height, in.							
Hay supplement	5.3	4.5	4.7	3.4	4.3	3.0	2.9	2.8
No hay	7.4	4.4	3.3	2.7	4.3	2.6	2.4	2.3

J.D. HOUGH, D.R. MULVANEY, and J.L. HOLIMAN

ULTRASOUND ACCURATE IN PREDICTING CARCASS COMPOSITION OF LIVE CATTLE

THE USE of ultrasound technology is proving to be an accurate tool for predicting carcass traits of live cattle. This was demonstrated in an Alabama Agricultural Experiment Station test in which ultrasound readings for fat thickness, ribeye area, and yield grade from live animals were within 0.05 in., 0.69 sq. in., and 0.25 unit, respectively, of actual readings after the animals were slaughtered.

Ultrasound technology has been utilized for several years in the medical profession. The ultrasound machine used in AAES beef cattle research is similar to those used by many obstetricians to view fetuses of pregnant women. With ultrasound, a transducer continuously emits high frequency (16,000 cycles per second) sound waves. The sound waves are reflected differently off tissues of different densities. Reflected sound waves are captured by the transducer and converted into a video image which can then be measured. Recent technological advances have made it practical to measure cattle in normal production environments.

In tests at the Black Belt Substation, Marion Junction, ultrasound measurements of fat thickness and ribeye area were taken 2 or 3 days prior to slaughter on 152 Angus and Charolais animals. After slaughter, actual fat thickness and ribeye measurements were recorded. In addition, carcass weight and kidney, pelvic, and heart (KPH) fat percentage were recorded to calculate yield grade. Cattle were slaughtered when ultrasound fat thickness measurements averaged 0.4 in. Average weight of the cattle was 1,057 lb. and the average age was 442 days.

Ultrasound technology has proven effective in predicting carcass composition of live cattle.

Correlation between ultrasound and actual carcass values is a way of measuring the accuracy of live animal ultrasound measurements. Correlations range from -1 to +1, where a correlation of 0 indicates no relation between two measurements and a correlation close to 1 indicates two measurements are nearly the same. The correlation between live animal ultrasound fat thickness and carcass fat thickness was .70, while correlation in ribeye area was much higher at .93.

An important factor in pricing slaughter cattle is yield grade, which is a function of fat thickness, ribeye area, carcass weight, and KPH fat percentage. When replacing actual carcass fat thickness and ribeye area with ultrasound measurements, the correlation between ultrasound and actual yield grade was .79. Even though the correlations were high, a perfect correlation of 1 is not expected because differences exist in the shape and dimension of ribeye and fat thickness between the live animal in an upright standing position as it is monitored by ultrasound and the carcass hanging on the rail.

Shown in the table are the minimum, maximum, and average slaughter and ultrasound measurements for fat thickness, ribeye area, and yield grade. Also given are the ultrasound error values, which are the absolute values of the differences between actual carcass measurements of each slaughtered animal and the ultrasound measurements taken prior to slaughter. On average for fat thickness, the ultrasound measurements were within 0.05 in. of actual carcass fat. For ribeye area, ultrasound estimates were within 0.69 sq. in. of carcass measurements on average and yield grade estimates were within 0.25 unit on average.

Based on these preliminary findings, the future of ultrasound use by beef cattle producers appears to be promising. Never before in the livestock industry has there been a way to evaluate carcass merit with the objectivity and accuracy that ultrasound technology provides.

MINIMUM, MAXIMUM, AND AVERAGE VALUES ASSOCIATED WITH ACTUAL CARCASS AND ULTRASOUND MEASUREMENTS AND DIFFERENCES BETWEEN ULTRASOUND AND CARCASS MEASUREMENTS

Measurement	Minimum	Maximum	Av.
Carcass measurements			
Fat thickness, in.	0.10	0.53	0.38
Ribeye area, sq. in.	7.90	19.50	12.30
Yield grade, score	.49	3.40	2.31
Ultrasound measurements			
Fat thickness, in.	.20	.59	.41
Ribeye area, sq. in.	8.20	18.56	12.34
Yield grade, score	.88	3.34	2.36
Ultrasound error[1]			
Fat thickness, in.	.00	.19	.05
Ribeye area, sq. in.	.01	2.35	.69
Yield grade, score	0.00	1.00	.25

[1]Absolute value of the difference between actual carcass and ultrasound measurements.

Hough and Mulvaney are Assistant Professors of Animal and Dairy Sciences; Holliman is Superintendent of the Black Belt Substation.

J.L. ADRIAN, T.E. JOHNSON, and B.K. BEHE

RETAIL NURSERIES AND GARDEN CENTERS IMPORTANT TO ORNAMENTALS INDUSTRY

THE ORNAMENTALS industry has become an important contributor to Alabama's economy, with producer revenues amounting to $162 million in 1988, an 18% increase from 1987 and an 80% increase from 1980. The industry is comprised of numerous sizes and types of business operations. An important component of the total system is retail nurseries and garden centers which facilitate distribution of ornamental products.

To provide information about the nature and status of retail nursery firms in Alabama, the Alabama Agricultural Experiment Station contacted 56 operations in the State. Detailed information concerning the nature of firms, sources and types of plants marketed, operational practices, and problems encountered was received from 31 of these firms. The data were summarized to provide a base of information for use by managers of existing and potential retail firms and nursery managers who might wish to better serve these outlets for their products.

Responding retail nursery and garden centers had been in operation an average of 13 years (from 1 to 60) and the average time of involvement with some aspect of the nursery business was 15 years. About half of the firms classified their locations as being in the suburbs, while a fourth noted location outside city limits. Suburban operations accounted for 61% of the total business volume reported, while firms outside city limits had 24% and businesses in downtown areas had 15%.

Average sales per firm in 1987 were $334,000, a 20% increase over 1982. Fifty-four percent of the sales revenues was generated by plants and plant materials, while 46% came from services and nonplant sales. Woody ornamentals (19%) and bedding and vegetable plants (9%) were dominant items in the former grouping, with the balance being about equally distributed among foliage plants, potted flowering plants, seeds and bulbs, sod, hanging baskets, fruit trees, roses, and perennials.

For services and nonplant sales, landscape design and installation (11%), fertilizer and soil conditioners (10%), insecticides, herbicides, and fungicides (8%), plant containers (8%), and mulches (6%) were major components contributing to sales. Firms which provided landscaping service indicated that 47% of their sales came from landscaping-related activities.

Three-fourths of the firms accepted credit cards for payment, accounting for about 10% of their sales. Sixty-two percent provided in-store credit, and this accounted for about 12% of their total sales. Three firms reported collection problems and 18 firms reported difficulties with bad checks and uncollectible accounts. However, losses amounted to 1% or less of sales for three-fourths of the firms reporting such losses.

The average estimated value of retail facilities was $339,000, with 80% of the total representing sales facilities and the balance production facilities. On average, 2.12 acres of retail display was devoted to plant materials. Two-thirds of the firms had heated greenhouses while 40% had unheated greenhouses. These were used for retail display, production, and winter protection of plants.

Forty-five percent of the firms grew all or some of the greenhouse crops they marketed and 13% produced some of the woody ornamentals sold (primarily 1-gal. and larger hollies). Reasons offered for production of plants were to guarantee availability of better quality plants, lower costs, and promote more efficient utilization of labor.

Firms sold a wide variety of plants from several source areas. Of the azaleas purchased for resale, 58% of those smaller than 1-gal. and 41% of the 1-gal. size were from Alabama; all of the 2-gal. size were from Alabama; and all of 7- and 14-gal. sizes came from Louisiana. All of the 1-gal. or smaller camellias came from Georgia. Over 90% of the 1-gal. or larger hollies came from Alabama, while the smaller than 1-gal. hollies came from Georgia. Ninety-one percent of the junipers purchased for resale were from Alabama operations. All of the larger than 3-gal. roses were from Alabama, while the smaller sizes came from Georgia, Texas, and Oregon.

Of the field-grown shade trees, 38% were from Alabama, 29% were from Tennessee, and 24% were from Georgia. Three-fourths of the fruit trees came from Tennessee.

Woody plants generating the most sales included all sizes of container-grown azaleas, hollies, junipers, maples, dogwoods, and roses. One-gal., container-grown photinias and golden euonymous were also highly demanded, as were 2-gal. dwarf nandina and crimson pygmy barberries.

Plants that were identified as being demanded by consumers but not readily available included 2- to 3-gal. field-grown azaleas, camellias, and hollies. Shade trees, including 1 1/2-in. caliper and larger dogwoods, were difficult to locate and purchase, as were ferns, hydrangeas, and rhododendrons.

Several firm managers noted that low quality of delivery services and variable quality of plants were problems. Other important problems identified by managers were difficulty in hiring skilled employees (35%), seasonality of business (23%), management of a variable cash flow (19%), competition from mass-merchandising retail firms (19%), bookkeeping (16%), and weather (16%).

The ornamentals industry is an increasingly important component of the State's economy. Improved information and coordination among segments of the industry can enhance efficiency of the industry and further promote the State's economy.

Adrian is Professor and Johnson is former Graduate Research Assistant of Agricultural Economics and Rural Sociology; Behe is Assistant Professor of Horticulture.

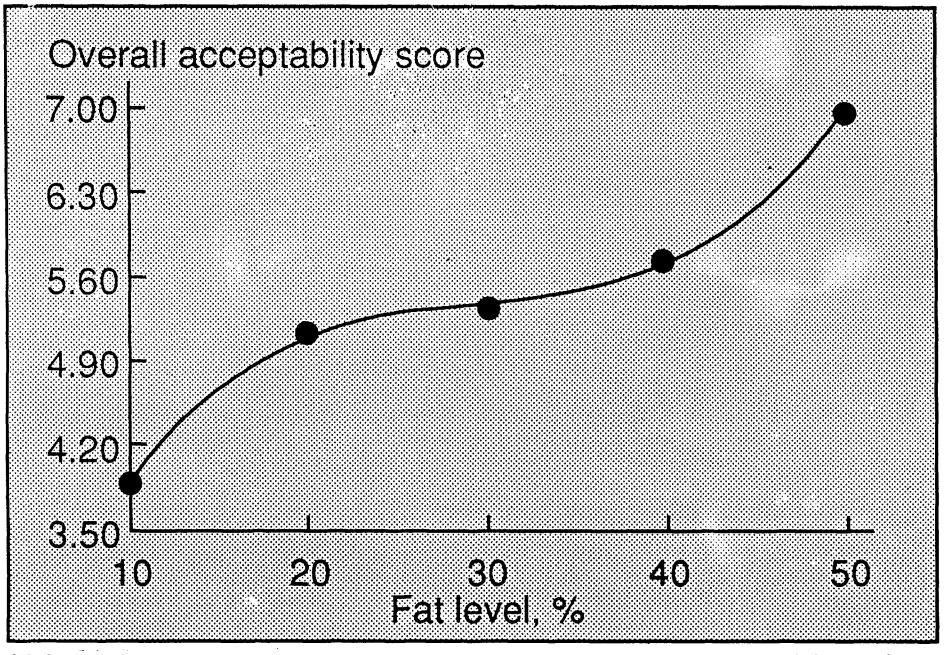
W.R. EGBERT, D.L. HUFFMAN, and J.C. REEVES

FAT CONTENT IS MAJOR FACTOR IN ACCEPTABILITY OF FRESH PORK SAUSAGE

THE NUTRITIONAL quality and safety of the food supply has emerged as a major concern of today's consumers and hence food processors. The relationship between dietary fat and the development of coronary heart disease exemplifies this concern. Meat products and other animal food products have been attacked for their possible role in the atherogenic process. The American Cancer Society and the American Heart Association have recommended that calories from fat account for no more than 30% of total caloric intake. In light of these trends, commodity support organizations have identified the assurance of the nutritional role and safety of animal food products as a high priority area for food animal research.

Traditionally, fresh pork sausage has been a high-fat product, but an economical and highly accepted meat selection. High fat content not only lowers the cost of the product, but also increases palatability and decreases the time required for cooking. USDA standards for fresh pork sausage allow it to contain 50% fat (raw basis) which, when cooked by the consumer, can contain more than 340 calories per 3-oz. serving on an "as eaten" basis. As the American public becomes increasingly concerned about the healthfulness of the foods they eat, it is imperative that the meat industry develop low-fat sausage products tailored to meet the needs of today's diet-conscious consumers.

A study conducted at the Alabama Agricultural Experiment Station evaluated the influence of fat level on the overall acceptability of fresh pork sausage. Fresh pork sausage patties were formulated to contain 10, 20, 30, 40, or 50% fat using closely trimmed boneless pork leg and backfat. Frozen sausage patties were griddle broiled and evaluated by a 50-member untrained, consumer-type panel. Panelists were instructed to evaluate the sausage products for overall acceptability on a 10-number descriptive analysis scale (0 = dislike extremely and 10 = like extremely). Moisture and fat content of raw sausage patties were determined. Commercial fresh pork sausage products from 10 different manufacturers were obtained and moisture and fat content determined.



Higher fat content in fresh pork sausage increases consumer acceptability of the product.

Fat level had a significant effect on the overall acceptability of fresh pork sausage patties, as shown in the figure. Sausage patties with 10% fat were rated as being least acceptable by consumer panelists. Panelists found patties with 20, 30, and 40% fat to be similar for overall acceptability and to have a greater overall acceptability than patties with 10% fat. Consumer panelists found sausage patties with 50% fat to be most acceptable.

Actual fat content of the sausage patties as determined by petroleum-ether extraction were 9, 18, 28, 37, and 47% (formulated at 10, 20, 30, 40, and 50%, respectively). Moisture content was inversely related to fat content with values of 69, 63, 55, 48, and 40% (corresponding to 10, 20, 30, 40, and 50% fat patties, respectively).

The raw composition of fresh pork sausage products from various meat processing companies was also determined. Fat content of the commercial sausage products ranged from 35 to 50%, with average fat content of 41%. Moisture content ranged from 38 to 50%, with an average of 45%.

As today's consumers become increasingly concerned about the nutritional quality of the food they eat, commercial sausage products like those in the test (average of 41% fat) may not be included in their diets. Therefore, the development of reduced-fat, fresh sausage products tailored to the needs of the diet conscious consumer must be the priority of the meat industry.

It is evident from the results reported that the acceptability of fresh pork sausage is highly related to the amount of fat it contains. Based on consumer ratings, fresh pork sausage with 50% fat could be used as the consumer acceptability standard in the development of fresh pork sausage products with reduced fat levels.

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J.W. EVEREST, M.G. PATTERSON, R. DUFFIELD, and C.H. GILLIAM

HERBICIDES REDUCE NUTSEDGE POPULATIONS AHEAD OF PLANTING ORNAMENTALS

Zorial treatments (right and left) flank untreated plot of nutsedge.

NUTSEDGE is considered one of the world's worst weeds, and Alabama has its share of the pest. Although it is a problem in many crops, nutsedge is especially troublesome in fields planted to ornamentals. Its ability to reproduce by both tubers ("nuts") and seed contributes to its fast spreading ability.

Control measures for nutsedge are both costly and generally unsuccessful. For ornamental crops, the big need is to reduce the nutsedge population prior to planting in areas known to be infested. Soil fumigants are expensive options and are only effective to the depth of tillage. Use of nonselective herbicides offers opportunities for control if treated land can be fallowed for 1-2 years.

The potential for successful control with nonselective herbicides is apparent from results of field experiments during 1987-89 at the E. V. Smith Research Center, Shorter. Several control programs were evaluated on a Norfolk sandy loam soil that was heavily infested with both purple and yellow nutsedge (200 shoots per square yard). The test plots (10 ft. by 30 ft.) received the same treatment in both 1987 and 1988.

Treatments included preplant incorporated (PPI) and postemergence over-the-top (POT) herbicide applications—alone, in combination, and along with diskings, as listed in the table. PPI treatments were applied in May 1987 and May 1988. Postemergence herbicide applications and diskings were staggered to obtain maximum effectiveness in combined programs. One program consisted of three diskings alone timed approximately 6 weeks apart during each growing season.

Good to excellent nutsedge control was obtained both years from all herbicidal treatments except Zorial® alone and Zorial or Scepter® plus three diskings in 1987. Disking alone gave poor control during both growing seasons.

To determine if there was herbicidal carryover after 2 years of treatments, forsythia, Foster's holly, Compacta Japanese holly, and althea were planted in Zorial and Scepter plots in May 1989. There was no reduction in plant height or dry matter of any ornamental species, except althea was reduced in height by the annual Scepter treatments.

Some measure of control was achieved with all treatments over the 2-year period, as indicated by data in the table. However, the primary goal was to reduce nutsedge populations. Success of this attempt is indicated by the column showing nutsedge shoots in September 1989 following the two treatment years.

Zorial treatments, either alone or supplemented with either disking, MSMA, or Roundup®, reduced nutsedge populations to the point of elimination. In contrast, control programs involving Scepter PPI treatments or POT applications of either MSMA or Roundup allowed substantial numbers of nutsedge plants to remain in the treated plots.

Yearly herbicide and application cost ranged from $48 to $135 per acre for the effective treatments. The combination of one PPI Zorial plus three POT MSMA applications virtually eliminated nutsedge for a cost of $65.50 per acre per year ($131.00 over the 2 years).

Everest is Associate Professor and Patterson is Assistant Professor of Agronomy and Soils; Duffield is Superintendent of the Field Crops Unit, E.V. Smith Research Center; Gilliam is Professor of Horticulture.

SUCCESS AND COST OF NUTSEDGE CONTROL PROGRAMS

Treatment[1]	Nutsedge control 10/87	Nutsedge control 10/88	Nutsedge shoots/sq. yd., 9/89	Herbicide + labor cost/acre
	Pct.	*Pct.*	*No.*	*Dol.*
Zorial (PPI)—1 app.	30	88	1	48.00
Scepter (PPI)—1 app. + 3 diskings	71	87	26	100.00
Zorial (PPI)—1 app. + 3 diskings	67	94	2	59.00
Zorial (PPI)—1 app. + MSMA (POT)—3 app.	82	97	0	65.50
Zorial (PPI)—1 app. + Roundup (POT)—3 app.	98	99	1	135.00
Roundup (POT)—3 app. + 3 diskings	95	95	20	94.50
MSMA (POT)—3 app. + 3 diskings	90	83	27	24.75
3 diskings	26	20	126	11.25
Control	0	0	126	0

[1]Herbicide rates: Zorial 80DF, 5 lb./acre; Scepter 1.5E, 2.2 qt./acre; Roundup, 2 qt./acre/application; MSMA, 1.2 qt./acre/application.

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