

Vol. 31, No. 3

Fall 1984

HIGHLIGHTS

of Agricultural Research



ALABAMA AGRICULTURAL EXPERIMENT STATION
GALE A. BUCHANAN, DIRECTOR

AUBURN UNIVERSITY
AUBURN UNIVERSITY, ALABAMA

DIRECTOR'S COMMENTS

PLANNING IS CRUCIAL for the success of any organization, and the Alabama Agricultural Experiment Station is developing a comprehensive, long-range plan for agricultural and forestry research programs.

Planning is nothing new for the Experiment Station, of course. Each department's research program is reviewed in detail every 5 or 6 years by a panel of expert scientists from across the United States. These reviews, like much of the Experiment Station's routine planning, are on a short-term basis and examine the research on a project-by-project basis.

The long-range planning program getting underway will not replace the valuable, short-term, individual project reviews. Instead, it will look considerably farther into the future, focusing on four primary considerations regarding Experiment Station research programs:

1. Missions and goals
2. Organizational structure and functions
3. Personnel
4. Facilities and equipment

The general mission of the Alabama Agricultural Experiment Station, "To conduct both applied and basic scientific research bearing directly and indirectly on the establishment and maintenance of permanent and effective agricultural and forest industries in Alabama," has not changed appreciably in the past 100 years. It is not expected to change in the foreseeable future. Ancillary missions include the improvement of the quality of rural life and protection of vital soil, water, and forest resources. Within the scope of this general mission statement, however, new and promising research thrusts must be identified and addressed while less promising research areas are phased out. This is where long-range planning comes into the picture.

To meet future challenges, we are moving in a deliberate manner to increase emphasis on fundamental or basic research. At the same time, production or applied research is becoming increasingly sophisticated and utilizing high levels of technology.

In order to effectively address the increasingly complex problems in agriculture, there is a greater need for research teams comprised of scientists representing many disciplines. Organizational structures and functions can be improved to facilitate such multiple disciplinary research.

Personnel, both professional and support, is the single most vital component of a successful research organization. New research thrusts will require scientists trained in new areas of research plus highly skilled support personnel to provide technical assistance. Therefore, qualified personnel will be given top priority in all long-range planning.

Many years of less-than-adequate support have made it virtually impossible for the Alabama Agricultural Experiment Station to keep pace with rapid developments in research technology. We lack many items of state-of-the-art research equipment, as well as being years behind in replacing such basic items as vehicles and field equipment. Because this problem demands immediate attention, every effort will be made to expend available resources on the most pressing needs in facilities and equipment. Again, long-range planning is necessary.

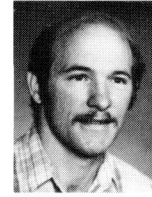
Developing such a long-range research plan is a challenge for all faculty and staff of the Experiment Station. In addition to the efforts by individual scientists, project leaders, and department heads, I look forward to full involvement of major commodity organizations, the Auburn Agricultural Advisory Council, and leading farmers and forest owners.



GALE A. BUCHANAN

may we introduce . . .

Dr. Henry W. Kinnucan, assistant professor, Department of Agricultural Economics and Rural Sociology. A native of Charlottesville, Virginia, Dr. Kinnucan assumed teaching and research responsibilities in agricultural economics in July of 1983.



Dr. Kinnucan came to Auburn after spending 3 years as a research associate at Cornell University, Ithaca, New York. He received M.S. and Ph.D. degrees while serving as research assistant at the University of Minnesota, Saint Paul, 1975-1980. Dr. Kinnucan earned a bachelor's degree at the University of Illinois, Champaign-Urbana, where he made the Dean's List each semester. All of his degrees are in agricultural economics.

Dr. Kinnucan carries on Station research in agricultural marketing and prices and teaches agricultural prices and agricultural marketing courses on both the undergraduate and graduate levels.

A member of Gamma Sigma Delta, Dr. Kinnucan lives in Auburn with his wife Maria, their 3-year-old son, Jaako, and Dr. Kinnucan's brother Charlie.

FALL 1984

VOL. 31, NO. 3

A quarterly report of research published by the Alabama Agricultural Experiment Station, Auburn University.

GALE A. BUCHANAN *Director*
 T.E. CORLEY *Associate Director*
 DAVID H. TEEM *Assistant Director*
 R.E. STEVENSON *Editor*
 STEVE GRENADE *Assistant Editor*
 BARBARA BISCHOFF *Editorial Associate*
 TERESA RODRIGUEZ *Art Designer*



Editorial Committee: GALE A. BUCHANAN; C.E. JOHNSON, *Professor of Agricultural Engineering*; W.A. DOZIER, JR., *Associate Professor of Horticulture*; R.E. MIRARCHI, *Associate Professor of Zoology-Entomology*; J.J. GIAMBRONE, *Associate Professor of Poultry Science*; C.L. WARFIELD, *Associate Professor of Home Economics Research*; G.D. HANSON, *Assistant Professor of Agricultural Economics and Rural Sociology*; W.D. DAVIES, *Professor of Fisheries and Allied Aquacultures*; and R.E. STEVENSON.

Information contained herein is available to all without regard to race, color, sex, or national origin.

ON THE COVER. Quality of small streams in Alabama is improving, as reported in story on page 16.

ALABAMA'S meat processing industry is lacking in both number of plants and capacity of operation. As a result, the State is deficit in red meat production and relies heavily on imports of processed beef and pork. A survey done by the Alabama Agricultural Experiment Station in 1980 indicated that the Alabama slaughter industry was primarily made up of small dual-purpose plants that kill and process both cattle and hogs.

Excess capacity in the nation's meat packing industry has resulted in the closing of existing Alabama plants, and this has retarded expansion of other phases of the livestock industry. The State primarily exports lightweight calves to other regions of the country for fattening, slaughter, and processing for shipment back to Alabama for consumption.

Developments in other regions are having a profound impact on the State's industry. Increased market concentration by a few large meat packing firms is reducing the competitive environment of this industry in the United States. Carcasses are cut into primal cuts to fit into boxes, allowing greater marketing efficiencies in transportation and storage. This technology permits large plants to effectively compete for markets in the meat deficit regions, particularly in Alabama.

For Alabama's meat processing industry to develop to appropriate size, it needs to have either a comparative advantage or offer substitutes for imported red meat. An important strategy is to develop a market niche for the red meat industry where firms can survive even when a neighboring region has a cost advantage. A slaughter plant as large as those that box beef or pork is not currently feasible for Alabama because of the lack of year-round supplies of slaughter animals. The majority of plants in the Southeast are medium-sized market hog slaughter and processing plants (slaughtering approximately 450 head per day) and small sausage plants which slaughter cull sows, cows, and bulls (about 20 sows and 35 cattle per day).

The Alabama Agricultural Experiment Station is currently studying two plants that have a long history of operation, suggesting their ability to survive in a depressed industry. These plants were visited and interviews were conducted to gather detailed information on purchasing, slaughtering, processing, and marketing activities being performed.

Both plants are integrated operations that market meat products under their own private brands. One plant kills and processes only hogs and the other both cattle and hogs. Each plant relies on supplies of live animals from a production area within a 200-mile radius. Plants either contract directly with producers or purchase animals through auction markets.

Innovative Operations needed for State's meat processing industry to compete

H.M. COX and G.M. SULLIVAN

Department of Agricultural Economics and Rural Sociology

The two plants produce an array of processed products in forms and sizes to meet as many requirements as possible for a customer's store. Analysis of each plant using a linear programming model to maximize net returns found that the product mix should be reduced from 15 to 8 products in the smaller plant that kills both cattle and hogs. This would result in an estimated increase of 56% in net returns to the firm. The product mix of the larger plant, which kills only hogs, did not change significantly with the elimination of only one product, smoked sausage. The cost of manufacturing the company's full product line is less than for the smaller plant.

The results indicate that each plant needs to focus on marketing its high priced items, with reduced emphasis on its lower priced items. Each plant markets an array of meat products for both the fresh and processed markets. Marketing a full product line causes a reduction in net return for both plants. In order to maintain a market share, however, a packing plant might need to produce a full product line to provide complete service to customers.

The impact of the optimal operation on each firm's revenues is illustrated in the table. The optimal model for the market hog slaughter and processing plant had a net return of \$7,881 per day, while the model which represented the current situation had a net return of \$7,381 per day—a difference of \$500. The change in net revenue for the sausage processing plant showed a relatively large increase for the optimal model compared to the current situation model. Net returns were \$5,595 per day for the optimal model and \$3,573 per day for the current situation model, a 56% advantage (\$2,022) for the optimal model.

In addition to producing products from slaughter animals, products such as pork

bellies or hams are purchased. Both plants surveyed indicated that they market boxed beef shipped in from outside the State. Processing plants do this mainly to service their retail customers whom they are supplying with their branded products. Boxed beef can be stored at a reasonable cost with only slight additional costs incurred in handling. Both plants also market other food products, such as eggs and butter, which can be delivered to retail stores along with their own products. This arrangement allows cost efficiencies for the store.

Rejuvenation of the meat processing industry will require companies to be more market oriented and selective in their product lines. A firm that can provide many different meat products—fresh, smoked, or processed—can gain a competitive edge in a narrow market area over a large meat packer outside the region who may not desire to export a large variety of products.

Recent population shifts to the Southeast mean that effective demand will increase for processed meat products. Both effects will have a positive impact on local meat processors who can remain competitive in costs, develop a market niche for their products, and remain innovative in product forms and sizes to meet changing consumer demand.

EFFECT OF USING OPTIMAL MODEL ON NET RETURNS

Model	Plant I		Plant II	
	Net return per day	Pct. increase	Net return per day	Pct. increase
Current	\$7,381	--	\$3,573	--
Optimal	\$7,881	6	\$5,595	56

Pruning Ornamentals: Effects on Root and Shoot Growth

C.H. GILLIAM, Department of Horticulture
G.S. COBB, Ornamental Horticulture Substation

PRUNING OF PLANTS involves the selective removal of plant parts to improve the health, landscape effect, or value of the plant. Some common reasons for pruning are to maintain the natural shape of the plant, produce compact growth, improve chances for survival at transplanting time, and develop a particular form such as espalier or hedge.

In commercial nurseries, a common practice is to produce rooted cuttings (liners) during the spring and summer, and then to pot them into larger containers the following year. Stepping-up into larger containers begins during early spring and continues throughout the summer. Most of the stepping-up into larger containers occurs in late spring and summer because of the time requirements associated with shipping orders during early spring. Liners held in small pots become leggy and at potting are normally pruned severely to develop a compact plant.

While the obvious effects of severe shoot pruning are known, information on the effects of severe shoot pruning on root growth has been limited until recent work by Alabama Agricultural Experiment Station researchers.

Uniform liners of *Ilex crenata* "Compacta" in 2-in. pots were transplanted to PVC containers 6 in. in diameter by 12 in. deep with a window cut from one side 4 in. across and 8 in. tall. The window was covered with clear acetate which lined the containers so roots could be observed periodically.

On September 28, 1983, when the plants were potted, three treatments were initiated: no pruning, severe pruning (50% of growth removed), and tip pruning (1-2 in. of terminal shoots removed). One and 2 months later, root and shoot numbers were counted. At the second sample date, dry weight was taken on new shoots and total shoots and fresh root weight was measured. Weekly data were taken on cumulative root and shoot length by marking three roots and three shoots per plant and measuring the length. Eight single plant replicates were maintained in a completely randomized block design.

Shoot pruning at potting reduced root growth 1 and 2 months after potting. Non-pruned plants had 93 and 40% greater root numbers 1 month after potting than severely pruned and tip-pruned plants, table 1. Two months after potting, tip pruning did not

reduce root number or fresh root weight. However, removal of terminal tips did reduce cumulative root growth throughout the study, table 2. Non-pruned plants had 60 and 88% greater cumulative root length than tipped and severely pruned plants, 6 weeks after potting. Tip-pruned plants also had greater root length than severely pruned plants. Non-pruned plants had greater root length than pruned plants, 2 months after potting.

Shoot pruning also affected shoot growth. Shoot numbers were increased by severe shoot pruning. One month after pruning, severely pruned plants had 31 and 57% greater shoot numbers than tip-pruned and non-pruned plants, table 1.

Tip pruning resulted in increased shoot numbers compared to non-pruned plants. Cumulative shoot length was also affected by pruning in that non-pruned and tip-pruned plants generally had greater shoot length

than severely pruned plants, table 2. However, when dry weight of new shoot growth was measured 2 months after potting, growth was similar among treatments, table 1.

These data show that shoot pruning does increase shoot numbers and results in suppressed cumulative shoot length, producing the desired effect of a compact plant. However, when plants are pruned at potting during the summer months, root growth is suppressed during the first 2 months. Furthermore, severely pruned plants tend to have a growth flush during which new shoots emerge simultaneously, evidenced by 41.2 new shoots 1 month after pruning and no additional new shoots 2 months after pruning, table 1. Consequently, suppressed root growth coupled with a vigorous growth flush during a time of the year when environmental conditions are conducive to water stress may adversely affect plant development.

A practical application for homeowners occurs when container-grown plants are transplanted into the landscape during the summer and fall months. Often, homeowners will severely prune these plants at planting to produce the desired compactness. Data indicate that the desirable shoot growth will occur, but at the expense of root establishment. Further research is being conducted in this area by Experiment Station horticulturists.

TABLE 1. EFFECT OF PRUNING ON GROWTH OF JAPANESE HOLLY 1 AND 2 MONTHS AFTER PRUNING¹

Treatment	October 28, 1983		November 28, 1983		Dry wt.		Fresh wt.
	New roots	New shoots	New roots	New shoots	New shoots	Total shoots	New roots
	No.	No.	No.	No.	g	g	g
Non-pruned	14.3	17.6	23.5	25.0	3.2	11.6	8.1
Severely pruned	1.0	41.2	8.8	41.2	4.0	8.7	3.8
Tip-pruned	8.6	28.6	21.1	32.2	3.6	11.3	5.8

¹Plants were pruned at potting on September 28, 1983.

TABLE 2. EFFECTS OF PRUNING ON SHOOT AND ROOT GROWTH OF JAPANESE HOLLY¹

Treatment	Cumulative root length			Cumulative shoot length		
	11-10-83	11-17-83	11-24-83	11-10-83	11-17-83	11-24-84
	In.	In.	In.	In.	In.	In.
Non-pruned	8.0	11.1	15.2	13.6	17.7	23.7
Severely pruned9	1.9	6.2	5.6	5.8	5.9
Tip-pruned	3.1	4.9	8.0	12.5	14.9	17.6

¹Plants were pruned at potting on September 28, 1983.

Effects of severe shoot pruning (left) in comparison with no shoot pruning (right) are noted in root growth differences.



MOURNING DOVE hunting provides a substantial amount of recreational activity for Alabamians each year. Additionally, sizeable revenues (approximately \$200 million annually nationwide) generated from mourning dove hunting trips flow into local economies across the State. Consequently, maintenance of mourning dove populations at harvestable levels makes good sense from recreational and economic perspectives alike.

Some people feel, however, that hunting mourning doves in September results in starvation for numerous dependent nestling and fledgling doves whose parents are harvested. This concern has resulted in considerable research on parent-fledgling interactions being conducted by Alabama Agricultural Experiment Station personnel. Observations indicate that even when both parents are lost, some fledgling doves will survive because of foster parentage. Consequently, the loss of juvenile doves associated with September hunting may be lowered.

Mourning doves lay two eggs per clutch, incubate the eggs for 14 days, and brood the young approximately 15 days before fledglings leave the nest. The nestlings and fledglings are fed by regurgitation. Fledglings are capable of surviving independent of parental care at approximately 21 days of age even though they are fed with some regularity by the male parent until they are 27 days old.

In an Experiment Station study, mourning dove nests were located in east-central Alabama from March through October 1980-81. Thirty-five nestlings were equipped with radio transmitters, and 34 nestmates were marked with colored wing tags. Nestlings-fledglings were located and observed for approximately 2 hours, three times daily, at 12, 15-21, 24, 27, and 30 days of age. The number and duration of feeding interactions between nestling-fledgling doves and parents of both sexes were recorded.

Occasionally, parent mourning doves (primarily males) were observed feeding fledglings that were not their own, see table. Of 417 feeding interactions observed between parents and fledglings, 27 (6.5%) involved unrelated fledglings. Parent birds generally fed their fledglings within 100 ft. of the old nest site. Foster parent feedings were more likely to occur when nest sites of two or more sibling pairs were close to one another or when nest sites were adjacent to areas where juvenile doves gathered to feed themselves.

Most foster parent feedings (81.5%) occurred after fledglings were 21 days old and usually involved a male parent and fledglings that were older than his own. Prior to 21 days of age, fledglings remained under cover, moved little, and did not intermingle with unrelated fledglings. At 21 days of age,



Fledgling Mourning Doves Survive with Help from Foster Parents

R.R. HITCHCOCK and R.E. MIRARCHI, Department of Zoology-Entomology

nestmates often joined other fledglings that were feeding nearby. In addition, 21-day-old fledglings resembled the older fledglings with whom they intermingled because at that age feather development had been completed. Consequently, male parents returning to old nest sites probably could not distinguish their offspring from unrelated juveniles and "mistakenly" fed them all. Feedings involving two nestmates and as many as six unrelated fledglings were observed, see table.

Unrelated fledglings gained access to areas around former nest sites after male parent doves began incubating at a new nest. Prior to this time, male parents were extremely aggressive and drove adult doves and older juveniles from these areas. Incubation at a new nest site usually began when offspring from the previous clutch were approximately 18 days of age. Thus, declining male parent aggressiveness probably was

partially responsible for the increase in number of foster parent feedings observed as offspring grew older.

The remaining foster parent feedings (18.5%) were done by an adult female who had lost her mate. She fed her own offspring until they were 31 days of age, and in addition fed a fledgling (aged 15 to 19 days) that had been abandoned by its parents. The abandoned fledgling was again adopted at 21 days of age, this time by the male parent of another younger fledgling. The orphan was sustained by foster parent feedings until 30 days of age, at which time it was capable of total independence.

Managing dove habitat for high nesting densities should increase the likelihood of adoption of vulnerable-aged orphans. However, more research is needed to determine if high nesting densities resulting from habitat manipulation are associated with increased rates of predation.

MOURNING DOVE FLEDGLING FEEDING INTERACTIONS WITH PARENTS AND SURROGATE PARENTS, EAST-CENTRAL ALABAMA, 1981-82

Fledgling age-class ¹ (days)	Total feedings observed	Surrogate feeding		
		Observed feedings		Unrelated fledglings involved
	No.	No.	Pct.	No.
15.....	65	1	1.5	1
16.....	71	1	1.4	1
17.....	45	1	2.2	1
18.....	34	2	5.9	1
19.....	55	0	0	0
20.....	35	0	0	0
21.....	46	4	8.7	1
24.....	35	5	14.3	1-2
27.....	26	10	38.5	1-6
30.....	5	3	60.0	1
Total.....	417	27	6.5	1-6

¹Age of radio-instrumented fledgling.

Energy Management System Makes Efficient Use of Combination Solar-Biomass Poultry Brooding System

C.A. FLOOD, JR., and J.L. KOON, Department of Agricultural Engineering
R.N. BREWER, Department of Poultry Science

WHEN DESIGNING a solar heating system, some form of backup energy source must be utilized to handle heating loads during periods of severe cold and extended cloudiness. It is possible to design a solar system large enough to take care of these two cases, but the cost would be prohibitive. A scaled down system could still supply all of the needed heat for a major portion of the year with a backup heater furnishing the remainder during higher demand periods. Auxiliary heat is normally supplied by electricity, oil, or gas. The collected solar energy fulfills the heating requirements until the stored energy is exhausted, at which time the auxiliary heater turns on automatically.

A lower cost alternative to electricity, oil, or gas is a wood burning boiler to satisfy the supplemental heating load. Wood as fuel is less expensive, but requires more management since the boiler must be manually refueled on a 24-hour basis. This management time can be reduced if sufficient energy is generated by burning excess wood during the day to last through the night.

Research on ways to efficiently manage

energy utilization by a combination solar-biomass brooding system for broiler chickens is being conducted at the Alabama Agricultural Experiment Station. A mathematical model is being developed to assist the grower in deciding when the biomass burner must be operated and when adequate solar energy will be available. To carry out needed calculations, a small microprocessor system will be required.

Calculation of the expected heating load can be accomplished with a microcomputer furnished with the appropriate inputs. These inputs consist of the expected temperature differences between inside and outside air, building thermal characteristics, ventilation rate, and age of birds. The hourly outdoor air temperature can be accurately predicted from the forecasted high and low temperatures furnished by the National Weather Service, figure 1. Using these hourly temperatures, the total heat loss by conduction through the building shell and heat loss in the ventilation air can be predicted.

The expected solar energy gain can be predicted for a given system using the out-

door air temperature and the forecasted hours of sunshine furnished by the National Weather Service.

The difference between the expected heat loss and heat gain must be supplied from the storage system. If the available energy in storage at the time the heat balance calculations are made is adequate to heat the house over the forecast period, no additional heat would be required. If, however, the storage energy is below the amount required, then the biomass system would be used to provide the additional amount in advance of the time it was needed.

Results of preliminary work indicate that the mathematical model being developed at Auburn can predict the expected heat loss and heat requirements with reasonable accuracy from 1- to 3-day weather forecasts. Figure 2 shows an example of actual energy usage and that calculated using the model for one trial. Work is continuing to improve the accuracy of calculations. Some problems in predicting hourly temperatures, and thus expected heat loss, occurred with rapidly moving cold fronts. However, the results were satisfactory for most applications.

A microprocessor system such as would be required for this system can be installed for under \$200 with a video readout and tape input. The microprocessor can be utilized for many more functions other than simply predicting energy requirements. Small microprocessor units are now being field tested as temperature controllers and as "intelligent" fan control systems.

The decreasing cost of microprocessors has opened many areas for their applications. By improving the heating system efficiency, the efficiency of the entire poultry producing operation can be increased, thereby reducing operating costs. Also, efficient utilization of farm labor means that time management must be continually improved. Hopefully, the system described here will aid in these areas.

FIG. 1. Actual and calculated hourly temperatures.

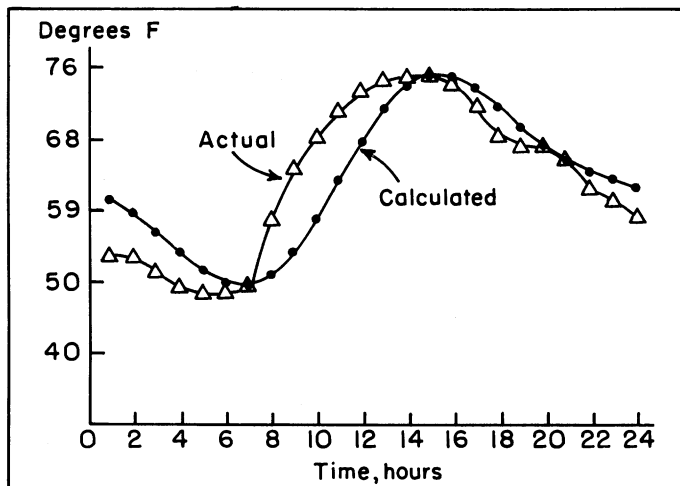
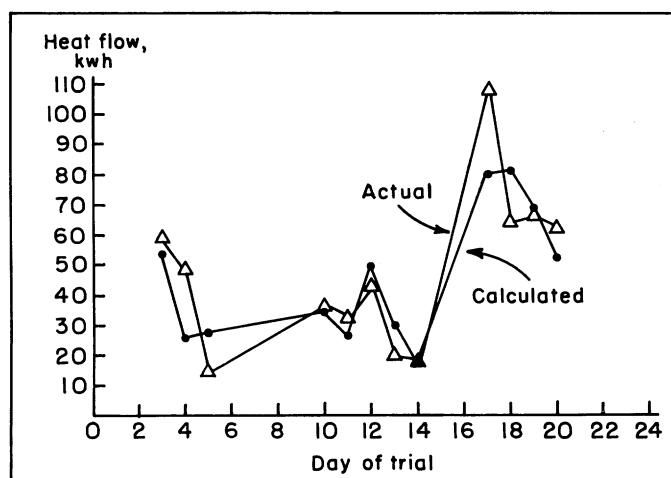


FIG. 2. Actual and calculated energy usage.





Nematode Resistant Soybean Varieties Sought for Infested Alabama Fields

D.B. WEAVER, Department of Agronomy and Soils

R. RODRIGUEZ-KABANA and D.G. ROBERTSON, Department of Botany, Plant Pathology, and Microbiology

SOYBEANS are subject to attack by several nematode species, with the root-knot nematode and soybean cyst nematode causing the most economic damage in Alabama and the Southeast. Recent Alabama Agricultural Experiment Station surveys indicate that 28.6% of the soybean fields in Alabama are infested with cyst nematodes, 23.3% with root-knot nematodes, and 9.7% have mixtures of both species.

In the past, soybean producers have relied mainly on nematicides to control nematodes. The most effective nematicides were the fumigants DBCP and EDB. These chemicals were easy to apply and provided good nematode control at a moderate cost. However, use of DBCP and more recently EDB as fumigants has been prohibited by U.S. Environmental Protection Agency regulatory action, leaving no economical and effective nematicide available for nematode control in severely infested fields. With the exception of growing nonhost crops in rotations, use of varieties with genetic resistance or tolerance remains the only economical control measure. Thus, there is a critical need for resistant varieties to assure profitable yields in the absence of effective nematicides.

Soybean cyst nematodes can be adequately controlled in most situations through use of a resistant variety. With high populations of root-knot nematodes or mixtures of root-knot and cyst nematodes, however, even resistant varieties suffer large yield losses.

Several new public and private soybean varieties have recently been released that are purported to be resistant to root-knot and/or soybean cyst nematodes. Several of these varieties were evaluated in Experiment Station tests in a nematode-infested field near Elberta in Baldwin County.

Two experiments were conducted, each with the seven varieties listed in the table.

One group of varieties was evaluated during both 1982 and 1983 and a second group only during 1983. The predominant nematode species in the field was the cotton or Southern root-knot nematode (*Meloidogyne incognita*). Soybean cyst nematodes (*Heterodera glycines*) were also present but in much lower numbers. With the exception of Coker 317, Ransom, and Johnston, varieties evaluated are purported to have resistance to the cotton root-knot nematode. Coker 317, RA 701, Foster, and Kirby have resistance to soybean cyst nematodes.

Each variety was grown with and without the application of 2 gal. per acre of EDB. Yield response to EDB was an indication of each variety's nematode resistance. Low response to EDB indicated a resistant variety, while high response indicated susceptibility to the nematodes.

Yields were severely depressed in the untreated plots in 1982, the result of a combination of nematode feeding and dry weather. Under these conditions, genetic resistance of the varieties was not enough to prevent severe yield loss. Nematicide treatment caused large increases. In the untreated plots, Foster and Braxton had the

most resistance as indicated by their higher yields.

Growing conditions, particularly moisture availability, were more favorable in 1983, resulting in higher yields. The public varieties Foster, Kirby, and Braxton had the best performance in the untreated plots. Proprietary varieties RA 701 (Ring Around Seed Co.), A7372 (Asgrow Seed Co.), and Agratech 67 (Goldkist) were generally inferior to the public varieties in untreated plots both years.

Nematode resistance or tolerance was measured by calculating the percent increase in yield due to nematode treatment. Foster, Braxton, and Kirby showed smaller yield increases with nematicide than the other varieties, thus were more nematode resistant.

These experiments demonstrate that nematodes can be partially controlled through use of resistant varieties. Therefore, proper varietal selection can be a valuable tool in an overall nematode control management program that includes crop rotations and other good management practices.

PERFORMANCE OF SOYBEAN VARIETIES GROWN WITH AND WITHOUT NEMATICIDE TREATMENT IN NEMATODE-INFESTED SOIL

Variety	1982			1983			1983		
	Yield		Response to nematicide	Yield		Response to nematicide	Yield		Response to nematicide
	C ¹	F		C	F		C	F	
	Bu.	Bu.	Pct.	Bu.	Bu.	Pct.	Bu.	Bu.	Pct.
A7372	5.8	27.5	374	16.5	38.2	131	--	--	--
Coker 317	1.1	33.6	2,954	18.7	54.7	193	19.0	49.8	162
Agratech 67	5.7	28.1	393	14.8	38.2	158	--	--	--
RA 701	7.9	30.1	281	20.3	51.0	151	--	--	--
Braxton	8.3	33.8	307	22.4	42.7	91	21.4	45.9	115
Foster	12.1	37.3	208	30.0	56.6	89	26.1	51.1	96
Ransom	4.8	36.5	660	16.1	45.3	181	14.5	41.5	186
Cobb	--	--	--	--	--	--	8.5	37.5	341
Johnston	--	--	--	--	--	--	8.5	40.1	372
Kirby	--	--	--	--	--	--	35.4	55.6	57

¹C = no nematicide, F = 2 gal. per acre EDB.



Promising Dogwood Cultivars for the Southeast Identified in Piedmont Substation Comparison

D.C. FARE, C.H. GILLIAM, and H.G. PONDER, Department of Horticulture
W.A. GRIFFEY and H.E. BURGESS, Piedmont Substation

THE NEED for a comprehensive evaluation of traditional and new introductions of shade and ornamental trees for the Southeast has long been recognized by horticulturists, nurserymen, and landscape designers. While most introductions are evaluated by the producer or in arboretums, little effort had been made to develop a comparative evaluation in a single location.

Increased emphasis on tree plantings in cities, residential districts, and along streets and highways has accelerated the selection and introduction of new species and cultivars for use in these landscape areas. Limited data have led to the selection of some trees that are poorly suited to many sites, resulting in high maintenance and removal costs. Because of this need, research was begun at the Alabama Agricultural Experiment Station to provide information about the characteristics and adaptability of species and cultivars of shade and ornamental trees.

This project is in its fourth year and has

approximately 225 species or cultivars of trees. Trees are being evaluated on their growth rate, fruiting and flowering characteristics, and adaptability to the Southeast.

One large group of trees in the study is dogwoods. Trees were planted in the study during December 1980 as 1-year-old plants at the Piedmont Substation, Camp Hill.

A dogwood native to the Eastern United States, *Cornus florida*, has been planted extensively as an understory tree in many landscapes. It works well as a specimen tree and in groupings. Flowering dogwoods have a four-season landscape value. In spring, it is the flowers; during summer and fall, the leaf texture and fruit color; and in winter the unique branching habit and bark. True flowers are greenish yellow and unimportant as a landscape feature. The showy parts of the bloom are the bracts, which are narrow at the end or notched, and appear from April to May.

Many cultivars of *C. florida* are available in the nursery trade that have white, pink, or red blooms. Those included in the Piedmont Substation test plantings are described here:

American dogwood (*Cornus stolonifera*).

Barton White blooms when young, and the blooms have large white bracts. This variety had some sporadic blooming during the fourth study year, but profuse blooming occurred during early April of the fifth year.

Bay Beauty, a double white flowering dogwood, bloomed prolifically during the third, fourth, and fifth growing seasons, usually peaking during early April.

Cloud Nine had sporadic blooms during mid-April in the fourth and fifth years.

Cherokee Princess, known to be a prolific bloomer with large white bracts, is in its fifth growing season and has not flowered.

First Lady, a white flowering dogwood with variegated leaves of yellow and green, has also not flowered in the study.

Springtime bloomed during early April of the fifth growing season with large white bracts up to 4 in. in diameter.

Cherokee Chief, Pink, Purple Glory, Reddy Red, Rubra, Sweetwater Red, and Welsh's Jr. Miss are the red flowering dogwoods in the study. Welsh's Jr. Miss and Reddy Red had a few sporadic blooms during April of the fourth year. All of the red-flowering cultivars bloomed during the fifth growing season, but only sporadically.

Bay Beauty, Springtime, and Welsh's Jr. Miss are the fastest growing dogwoods, averaging about 20 in. in height each year. Cloud Nine and First Lady are showing slower growth rates at 10 in. a year in height, while all others are averaging 15 in. a year. At present, the red flowering dogwoods have not shown a tendency to grow slower than white flowering dogwoods as has been previously reported.

Another interesting native dogwood is American dogwood (*C. stolonifera*). This species has been trained into a single trunk tree in this study and bloomed profusely from mid-May to mid-June the third, fourth, and fifth growing years. Other prominent features are blue fruit, early fall leaf color, and reddish brown twigs that are noticeable during winter months. American dogwood is averaging 20 in. a year in height growth.

Korean dogwood (*C. kousa*) is one of the few trees in bloom during June, usually 3 weeks after *C. florida*. Bracts are white, tapered at the end, and can last up to 6 weeks. Only a few sporadic blooms occurred during the fourth growing season, but blooms were prolific during the fifth year. With age, the bark is scaling, leaving mottled colors of gray, tan, and brown. The Korean dogwood is averaging 15 in. a year in height growth.

In summary, the white flowering dogwoods have bloomed more prolifically than the red flowering cultivars. The American dogwood and *C. florida* Bay Beauty have bloomed prolifically as young trees and have had the fastest growth among the dogwoods tested.

IN 1983, more than 50% of softwood plywood in the United States was manufactured from southern yellow pine. Although growth yield of southern yellow pines is able to satisfy present demands for pulp and paper, lumber, and plywood, the average diameter of harvested southern pine trees is decreasing while demands for lumber and plywood in housing are increasing.

Part of the additional plywood needed for sheathing may be manufactured either entirely from sweetgum or a combination of southern pine and sweetgum. Sweetgum represents 12% of all growing hardwood stock in the South. Density, gluability, strength, and physical properties of sweetgum are comparable to loblolly pine, according to research at the Alabama Agricultural Experiment Station. Sweetgum peels easily into veneer and produces relatively smooth veneer surfaces.

Mechanical properties of commercially produced CDX¹ southern pine plywood were compared to those of sweetgum plywood and plywood made from southern pine veneer faces and sweetgum core in the Auburn tests. Five commercial CDX southern yellow pine plywood panels (4 ft. by 8 ft.) were randomly selected in a plywood mill from each of the following three constructions: 3-ply, 1/2-in.; 4-ply, 1/2-in.; and 5-ply, 5/8-in. All veneers of 4-ply and 5-ply were 1/8-in. thick, while all veneers of the 3-ply were 1/6-in. thick. For comparison, five each of the following experimental plywood panels were constructed in the same mill: 4-ply, 1/2-in. with all-sweetgum C grade faces, D grade backs, and C-D grade cores; 4-ply, 1/2-in. with southern pine C grade faces and D grade backs, and sweetgum C-D cores; 5-ply, 5/8-in. with southern pine C grade faces and D grade backs, and sweetgum C-D grade crossbands

¹CDX designates plywood constructed with C grade veneer face, D grade veneer back, bonded with an exterior type X glue.

Sheathing-Grade Plywood from Sweetgum Suitable for Structural Purposes

E.J. BIBLIS
Department of Forestry

and center. All veneers were rotary cut and 1/8-in. thick.

All CDX southern pine and sweetgum plywood panels were fabricated with a commercial extended phenolic resin. All panels were pre-pressed at room temperature with 160 p.s.i. for approximately 3 minutes, then hot-pressed with 200 p.s.i. at 305°F for 3.5 minutes for 3-ply, 1/2 in.; 4 minutes for 4-ply, 1/2 in.; and 5 minutes for 5-ply, 5/8 in.

Three of the five panels of each of the six plywood groups were randomly selected to obtain specimens for evaluating the following properties: bending in the orientation of the grain of face veneer, shear stiffness, shear strength, and glue line shear strength. All testing was performed according to applicable ASTM standards for testing plywood.

The experimental test results of certain important mechanical properties of commercial CDX southern pine plywood, of all-sweetgum plywood, and of plywood with southern pine faces and sweetgum cores are presented in the table. The experimental results indicate that the mechanical properties of all-sweetgum CDX plywood are better than properties of all-southern pine CDX plywood. Results also indicate that proper-

ties of plywood with southern pine veneer faces and sweetgum cores were higher than those of all 5/8-in. pine plywood and lower in 1/2-in. pine plywood.

In general, the results suggest that all-sweetgum plywood, bonded with phenolic resin, can perform structurally as well as CDX all-southern pine plywood sheathing in house construction.

As expected, the 3-ply all-pine 1/2-in. plywood was approximately 16% stiffer and stronger in bending (oriented to face grain) than 4-ply all-pine 1/2-in. plywood of equal veneer quality. Wet-dry cycled specimens retained at least 86% of the original binding values. Bending specimens tested after 48-hour soak retained 63% to 70% of their original stiffness and between 48% and 76% of their original strength.

It is strongly recommended that the American Plywood Association perform tests according to its performance based standards on all-sweetgum plywood panels to verify and certify that such panels meet APA criteria for sheathing and flooring.

The significance of this study is that existing forest resources of sweetgum can be used for manufacturing structural plywood for housing.

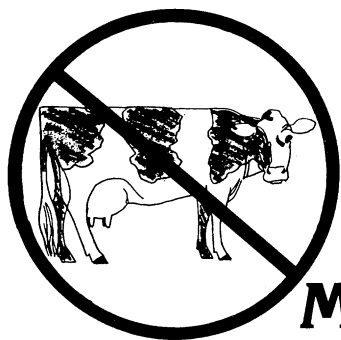
BENDING AND SHEAR PROPERTIES OF COMMERCIAL CDX PLYWOOD WITH ALL-VENEER PLIES, SOUTHERN PINE, SWEETGUM, AND WITH SOUTHERN PINE FACES AND SWEETGUM CROSSBANDS¹

Face and core species	No. of plies	Moisture content	Density ³	Bending properties ²		Shear stiffness	Shear strength	Glue line	
				Stiffness	Strength			Shear strength	Wood failure
		Pct.		1,000 p.s.i.	p.s.i.	1,000 p.s.i.	p.s.i.	p.s.i.	Pct.
All veneers southern pine	3	10.1	0.53	1,450	7,170	61.7	660	190	70
All veneers southern pine	4	9.8	.61	1,295	6,550	81.6	970	240	85
Faces southern pine; core									
sweetgum	4	10.1	.55	1,035	5,170	73.8	820	240	95
All veneers sweetgum	4	10.0	.59	1,554	10,030	87.0	1,000	220	90
All veneers southern pine	5	9.8	.58	1,059	5,200	76.1	900	255	85
Faces southern pine; core									
and crossbands sweetgum	5	10.4	.56	1,373	8,390	82.0	950	225	95

¹Each value represents the mean of 12 specimens.

²Specimens were 6 in. wide; 1/2-in. thick specimens were tested over 24-in. span and 5/8-in. thick over 30-in. span, with veneer grain orientation.

³Weight divided by volume (oven-dry basis).



Milk Diversion Program May Lead to Higher Milk Prices

L.E. WILSON
Department of Agricultural
Economics and Rural Sociology

AFTER MONTHS OF DEBATE, Congress enacted the Dairy and Tobacco Adjustment Act in late 1983. Dairy provisions were designed to encourage the adjustment of milk production to meet the national demand for milk products. The Act was passed following 13 years of production increases that had brought record surplus build-up and growing public concern about excessive program costs.

The 1983 dairy legislation provides for reductions in the support price, an assessment paid by dairy farmers of 50¢ per 100 lb. of milk marketed, and a 15¢ dairy promotion allowance, plus the program's centerpiece—a \$10 per hundredweight optional payment to dairy farmers not to produce milk. This provision, referred to as the Milk Diversion Program, allowed farmers in

January 1984 to contract with USDA for reduced milk marketings from 5% to 30% below their base level (1982 marketings or 1981-82 average marketings). The contract was set for 15 months, from January 1984 through March 1985.

In an Alabama Agricultural Experiment Station study of effects of the program, it was found that about 38,000 dairy farmers (20% of all U.S. commercial dairymen) signed contracts to reduce milk marketings. They contracted to divert 7.5 billion lb. in 1984, which was 22.9% of the participants' bases.

Production cutbacks were to be made mainly through heavier culling and adjustments in feeding programs. However, many producers were eligible for program payments because of reductions they had made in 1983 before the act was passed. This probably accounted for about one-third of the contract diversions. Thus, actual diversions in 1984 as a result of the program amount to only about 5 billion lb.

Impact of the diversion program was found to vary among regions. In the major milk production states, where the surplus problem originated, dairymen did not participate at the expected levels. The greatest sign-up occurred in the Southeast where milk supplies were already short. In Alabama, Florida, Georgia, Louisiana, Mississippi, and South Carolina, 1,466 dairy farmers signed contracts to divert 737 million lb. in 1984, 11.4% of 1983 production. Diversion was only 2.0% of 1983 production in the Northeast, 3.2% in the Lake States, and 3.5% in the Pacific West.

Wisconsin dairy farmers, who produce 17% of U.S. output, diverted only 3.5% of their 1983 production. Through June 1984, total milk production in the five leading dairy states (California, Minnesota, New York, Pennsylvania, and Wisconsin) was essentially unchanged from 1983. Production in the Southeast was down about 6%.

Participation in Alabama was among the highest in the nation, with 42% (172 producers) of commercial dairymen signing contracts for diversion. These farmers agreed to

divert 63.1 million lb. in 1984 (80 million lb. during the 15-month program). These diversions amount to 26.2% of the producers' bases and 11% of total Alabama production in 1983.

Dairy farmers who had either reduced or maintained milk production since the base period found the diversion program to be financially attractive. The cost of complying by these farmers was less than the diversion payments. In contrast, producers who had increased marketings substantially since the base period likely could not justify the cost of participation. For farmers who had increased production, the reductions required to participate would include the elimination of their increased production plus the diversion level chosen. With these two potential situations, a high sign-up was predictable in Alabama where production had been declining before 1984.

Alabama dairy farmers will be paid about \$8 million for milk diversion over the 15-month period. Most participants diverted 27% or 30% of their bases. Those diverting less than 30% may overship their contracted volumes up to 3% and remain within the contract limits.

The average participant had an annual base of about 1.4 million lb. and diverted 372,000 lb. Thus, average diversion payments will be approximately \$46,500 for the 15-month program period. Farmers diverting a higher percentage of base (25-30%) tended to have the large bases, see table.

Average number of cows milked by participants declined from 102 to 93 from the first to last quarter of 1983. This 9% decline accounted for some of the adjustments made by farmers prior to signing diversion contracts.

With high diversion in the South, the spring milk flush did not create the normal seasonal surplus problems in 1984. In Florida, for example, the large cutback in production resulted in doubled importation of raw milk. In early summer, out-of-state milk needs for the Florida markets have exceeded total Alabama Grade A milk marketings. Greatest needs in the Southeast generally occur with the beginning of school in late August.

With Southern dairymen cutting back on production as they comply with diversion contracts, cooperatives and milk processors will be forced to acquire a greater proportion of their raw milk supplies from more distant sources at higher costs. This extra supply cost will result in either (1) higher consumer prices for milk, or (2) cooperatives, who are usually the major suppliers, passing these costs on to producer members in the form of lower net prices for their production. Thus, great pressure will be on the Southern milk industry to seek higher fluid milk prices to increase returns to dairy farmers and avoid greater shortages in the region.

MILK DIVERSION PROGRAM PARTICIPATION IN ALABAMA, JANUARY 1984-MARCH 1985

Diversion percentage	Producers participating	Amount for 15-month period				Cows milked	
		Total base	Total diversion	Average base	Average diversion	1st qtr. 1983	4th qtr. 1983
		Thou. lb.	Thou. lb.	Thou. lb.	Thou. lb.	No.	No.
8	1	1,748	140	1,748	140	115	105
10	9	15,399	1,540	1,711	171	90	88
15	8	14,742	2,211	1,843	276	106	98
17	1	1,259	214	1,259	214	84	75
20	11	16,881	3,376	1,535	307	88	89
21	1	2,762	580	2,762	580	158	145
22	1	1,180	260	1,180	260	70	70
23	2	2,347	540	1,174	270	71	69
25	8	22,753	5,689	2,844	711	160	144
27	42	83,138	22,477	1,979	535	112	104
30	88	143,114	42,935	1,626	488	95	85
TOTAL	172	305,323	79,931	1,775	465	102	93

Source: USDA, ASCS.

THE CONVENTIONALLY BUILT, single-family, detached house is the predominant housing type in the United States. However, there are many alternatives that may help to protect the nation's natural resources and offer an economic advantage to the consumer.

Housing that is factory built is usually less costly to construct and may use fewer materials. Multi-family housing, such as town-houses and apartments, uses less land and usually has lower land development costs. Recent developments in energy saving construction (passive solar, active solar, earth sheltered, and retrofitted houses) promise to conserve fossil fuels and reduce heating and/or cooling expenses.

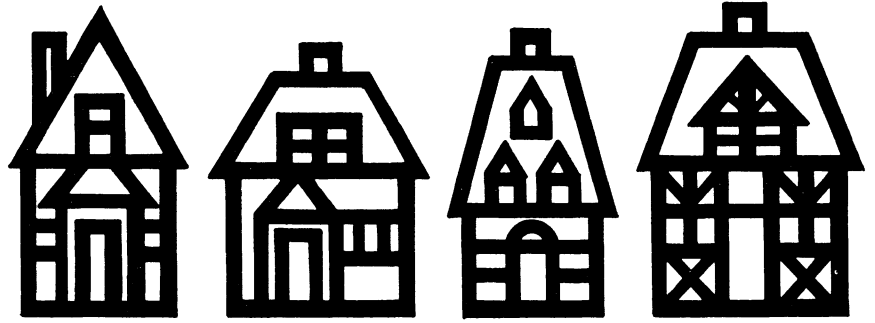
Although these alternatives offer certain advantages, they have not been readily accepted by housing consumers. A recent survey of Alabama households, conducted by the Alabama Agricultural Experiment Station as part of a regional project, sought to identify consumers' awareness of these alternatives as well as their perceptions of these housing options.

Households for this study were randomly selected from property tax listings in four Alabama counties. The counties were selected by a stratification process based on median household income and number of non-farm households. A total of 216 households was personally interviewed in Crenshaw, Dallas, Clay, and Lee counties during 1981.

The respondents were primarily white females between the ages of 25 and 64; most were employed either full- or part-time. Over 70% of the households had two to four members and over 50% had incomes of \$15,000 or more. Ninety-four percent of the households lived in conventional houses and 87% of the houses were owned. Over 65% of the housing units in the sample had 1,401 or more sq. ft. of floor space.

The level of consumers' awareness of housing alternatives is reported in the accompanying table. Respondents were asked if they had heard about, read about, seen, or lived in the following: manufactured housing (mobile homes), multi-family housing (apartments), passive solar housing (using design, construction, and natural convection to collect and transfer solar energy), active solar housing (using mechanical devices to collect and transfer solar energy), retrofitted

PERCEPTIONS OF ALTERNATIVE HOUSING AMONG ALABAMA CONSUMERS



J.O. BEAMISH, Department of Home Economics Research

housing (energy efficient additions made), and earth sheltered housing (partially or completely covered by earth).

Over 90% of the respondents had heard about manufactured and multi-family housing. The respondents were not as familiar with the energy saving alternatives, with only 49% having heard about retrofitted housing. While one-third of the respondents had lived in multi-family housing and one-fourth had lived in manufactured housing, none of the respondents had lived in active solar or earth sheltered houses and only a few had lived in passive solar or retrofitted houses.

Once the respondents' level of awareness was determined, the various alternatives were defined and respondents were asked if they would consider living in these alternatives if they were to move or change residences. Over 50% of the respondents indicated they would definitely or probably consider living in the passive solar, active solar, and retrofitted housing types. Most of the respondents would definitely not or probably not consider living in manufactured housing, multi-family housing, or earth sheltered houses. There was, however, a substantial proportion of respondents (36%) who stated they would consider living in an earth sheltered house.

Respondents' perceptions of these housing options provide some insight into their

willingness to live in alternative housing. Energy efficiency was the most frequently reported reason why respondents would like living in passive solar, active solar, and retrofitted houses. The safety of manufactured housing, the privacy and location of multi-family housing, and the confinement of the earth sheltered house were frequently cited as undesirable features. On the other hand, the cost of manufactured housing, the limited amount of maintenance associated with multi-family housing, and the energy efficiency and safety of the earth sheltered house were seen as being advantages of these house types.

Finally, the respondents were asked to rank the housing alternatives from best liked to least liked. The conventionally built house was included in this list and was the first choice of 67% of the sample. The earth sheltered house was both the most frequently cited second choice and the last choice, indicating that the respondents were divided in their positive and negative perceptions of this housing type. The passive solar and active solar house types were most frequently ranked in the middle; and manufactured housing, multi-family housing, and retrofitted houses were most frequently ranked close to the bottom.

Preliminary findings indicate that Alabama consumers may have fairly positive perceptions about housing alternatives offering energy efficiency, although earth sheltered housing evoked both positive and negative responses. Consumers were not positive about manufactured and multi-family housing. Further analysis of the relationship between household characteristics (income, age, education, etc.) and these perceptions may offer a better understanding of the choices that different types of consumers might consider as well as provide insight into the housing types that should be offered by the housing industry.

ALABAMA RESPONDENTS WHO HAD HEARD ABOUT, READ ABOUT, SEEN, OR LIVED IN HOUSING ALTERNATIVES

	Manufactured housing	Multi-family housing	Passive solar	Active solar	Retrofitted	Earth sheltered
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Heard about.....	95.4	92.1	67.1	63.4	48.8	88.0
Read about.....	27.0	25.1	27.8	31.9	21.4	34.3
Seen.....	84.7	81.4	14.8	11.6	9.3	16.2
Lived in.....	26.5	34.9	1.6	.0	.5	.0

Note: Multiple responses do not add to 100.



BED FARMING ON CLAY SOILS

C.E. JOHNSON, Department of Agricultural Engineering
 C.B. ELKINS, Department of Agronomy and Soils - U.S.D.A.
 R.L. SCHAEFER, U.S.D.A. National Tillage Machinery Laboratory

PART OF THE WEST-CENTRAL area of Alabama contains clay soils that are tough when dry, yet weak, very sticky, and plastic when wet. These soils, containing 46 to 66% 2:1 expanding-type clay minerals, swell and shrink when they are alternately wetted and dried. The soil surface will tend to aggregate if it experiences four or more wetting and drying cycles.

Conventional tillage practices on this soil often create a rough surface composed of large clods which require considerable secondary tillage to create aggregation for even a suboptimum seedbed. Unfortunately, these practices coupled with climatic conditions and lack of wetting and drying cycles do not allow time for the natural forces of shrinking and swelling to produce desirable surface aggregation.

Additionally, the topography often creates surface drainage problems, and extended periods of soil surface wetness can compound the timeliness problem associated with spring tillage operations needed for seedbed preparation. Also, this wetness can prohibit traffic through the field to accomplish necessary operations.

Since creation of a seedbed and machinery mobility are major problems in row-crop

production on these soils, researchers at the Alabama Agricultural Experiment Station and the U.S.D.A. Agricultural Research Service have concentrated on the development of techniques and equipment for timely planting in these clay soils. The specifications for planting were (1) to attain sufficient soil moisture and aggregation in the top 1 to 2 in. of soil for planting in the row area as early in the crop season as soil temperatures would allow, and (2) to attain timely machine mobility and operation.

Specifications were met by creating beds during the mid-fall period (October-November) and creating and maintaining permanent, raised traffic ways. This allowed time for the top of the beds to experience sufficient wetting and drying cycles for natural aggregation. The beds were constructed on 0.5 to 0.6% grade to relieve the surface drainage problem and to enhance drying on the beds to promote shrinking and swelling and subsequent natural aggregation in the seed zone.

Before this prescription could be carried out, two implements had to be developed. The first was a lubricated bedder for operation in adhesive soils. The current concept consists of right-hand and left-hand moldboard bottoms facing each other. One plow

A machine was developed to plant seed on each side of bed.

bottom is approximately 6 in. ahead of the other so the soil slice cut by the front bottom is inverted and partially covered by the soil slice cut by the rear one. Both plow bottoms were lubricated with a liquid polymer lubricant to alleviate soil sticking.

The second implement developed was a planter. The beds were not wide enough to allow planting of two rows on the top, and the interior of the beds was too wet at planting time to consider any tillage operation to level the beds for conventional planters. A machine was developed to plant seed on each side of a bed.

These two implements have been used successfully for 4 crop years. The specification of timely early planting into a well-aggregated seedbed at the correct soil moisture was achieved. The specification of machine mobility was achieved on the elevated traffic paths, which are 72 in. apart, when tractor operation in a conventional field would have been impossible.

Results have shown that emergence and seedling vigor are greater with the bed culture than with conventional cultural practices. In crop year 1983, the bed system allowed planting corn and sunflowers on March 11; it was 7 weeks later before the conventional plots could be planted. This timeliness, coupled with climatic and agronomic factors, resulted in a 53% increase in corn yields and a 59% increase in sunflower yields compared with conventional tillage and planting practices, see table. Although the difference in planting date does not always result in a yield difference, it does provide the potential for double-cropping.

This method of farming the expanding-type clay soils in Alabama is a concept in its infancy. The total machinery system would require that all machines have a standardized tread width to match the traffic path spacing. Wider spacing between traffic ways would allow machinery tread width to be matched more easily. Research is being continued to determine if a wider bed to accommodate three rows and traffic ways 90 in. apart will function similar to the former narrow bed and traffic ways 72 in. apart.

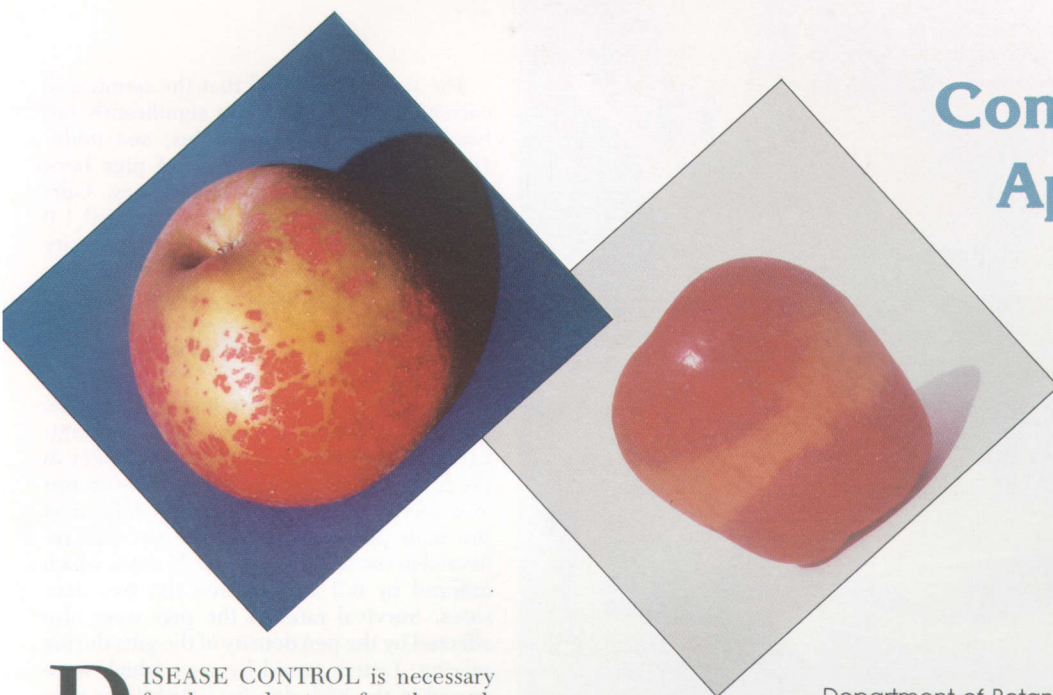
AVERAGE YIELDS OF CORN AND SUNFLOWERS FOR 3 YEARS USING CONVENTIONAL CULTURAL AND BED CULTURAL PRACTICES

Year	Yield/acre by cultural method			
	Conventional		Beds	
	Corn	Sunflowers	Corn	Sunflowers
	Bu.	Lb.	Bu.	Lb.
1981.....	95	1,593	84	1,743
1982.....	130	1,038	126	1,254
1983.....	81	1,322	124	2,102

Controlling Apple Diseases without Fungicide- Induced Russetting

A.J. LATHAM

Department of Botany, Plant Pathology, and Microbiology
M.H. HOLLINGSWORTH
North Alabama Horticulture Substation



DISEASE CONTROL is necessary for the production of apples with the high quality required for the commercial market. Use of fungicides for disease control, however, may contribute to another problem—the development of russet on the fruit. Russeted apples have a rough, leathery surface and golden skin color affecting part or all of the fruit surface, figure 1.

Cool, damp weather during early stages of fruit development is related to russetting. When fungicides are applied under such conditions, leaves may be injured and russetting of fruit may result. Low temperatures and frost during the early part of the growing season may cause injury even without fungicide applications. This usually shows up as a band of russet around the apple, figure 2.

Fungicide-induced russet results from the use of unsuitable chemicals or improper application. Thus, Alabama Agricultural Experiment Station apple disease control research considers both disease control and russetting when evaluating fungicidal treatments.

FIG. 1 (left). Russet due to fungicide toxicity to skin of apple. FIG. 2 (right). Russet due to low temperature. Russet band may occur anywhere on fruit.

Long-term evaluations of fungicides for controlling sooty blotch and flyspeck had earlier identified Difolatan® as the most effective material. When a single application of Difolatan is applied at the silver-tip to green-tip stage of growth, followed by appropriate cover sprays as recommended by the manufacturer, only a trace amount of sooty blotch and flyspeck develop. However, applications later in the season caused russetting.

Newer research at the Alabama Agricultural Experiment Station has found that even better results are possible. Benlate® plus Manzate 200® treatments gave better control of sooty blotch, flyspeck, and scab

than other fungicides tried, and russetting was not a problem.

In the 1981-82 test at the North Alabama Horticulture Substation, Cullman, fungicide evaluations were made on a 10- to 14-day application schedule on three-tree plots of Red Spur Delicious apple trees. All treatments were repeated (replicated) four times. Fifty apples of each replicate were selected randomly and examined for disease incidence and russet severity on August 12, 1981, and August 16, 1982. The apples were then placed in clean, half-bushel baskets and stored at 78°F for post-harvest rot incidence determinations 14 days later.

Differences in fungicidal control of rots during 1981 and 1982, shown in the table, probably reflect weather differences and natural inoculum levels of pathogenic fungi.

Good control of apple diseases was obtained with Difolatan applied at the silver tip stage of bud growth. When applications were made during the blooming period, an average of 86% of the fruit surface was blemished by russet. The blooming-stage application of Difolatan was not repeated in 1982 since the 1981 finding confirmed results of earlier work.

Treatments with Benlate plus Manzate 200 gave better control of sooty blotch, flyspeck, and scab than other fungicides used singly or in combinations. Other results show that similar control can be obtained with either Dithane M-45® or Dithane FZ® substituted for Manzate in the combination spray. The fact that russetting was not induced by Benlate plus Manzate 200 represents an important advantage for this treatment.

EFFECT OF SELECTED FUNGICIDES ON APPLE DISEASE INCIDENCE AND RUSSET DEVELOPMENT, NORTH ALABAMA HORTICULTURE SUBSTATION, 1981-82

Treatment—fungicide and rate/100 gal.	Incidence, by year								Russet, 1981 Pct.
	Sooty blotch		Flyspeck		Scab		Rot ¹		
	1981 Pct.	1982 Pct.	1981 Pct.	1982 Pct.	1981 Pct.	1982 Pct.	1981 Pct.	1982 Pct.	
Benlate 50W (2 oz.) plus Manzate 200 80W (12 oz.) ² . . .	1.0	3.2	1.3	38.4	0.3	0	0.5	14.4	0
Difolatan 4F (3 qt.) ² plus Captan 50W (2 lb.)	6.0	39.1	15.0	78.9	2.3	1.0	.7	13.8	.7
Difolatan 4F (3 qt.) ³ plus Captan 50W (2 lb.)	12.0	--	25.3	--	.3	--	.7	--	86.0
Check (no fungicide)	96.3	100.0	95.3	99.8	74.7	98.0	2.3	45.5	0

¹Combination of summer rots caused by *Botryosphaeria dothidea*, *B. obtusa*, and *Glomerella cingulata*.

²Applied at silver tip stage of bud growth, Captan later as cover spray.

³Applied at full bloom stage, Captan later as cover spray.



Crowded Conditions for Gilts May Improve Reproductive Performance

D.L. KUHLERS, S.B. JUNGST, D.N. MARPLE, and C.H. RAHE
Department of Animal and Dairy Sciences

THE AMOUNT of floor space available to pigs during the growing-finishing period has been studied to determine its effect on growth and feed efficiency. Based on the results from these studies, it has been concluded that the minimum amount of floor space needed for pigs weighing 120 to 220 lb. is 11.5 sq. ft. per animal for pens with solid floors and 8 sq. ft. per animal for pens with slotted floors.

The recommendations made for the amount of floor space required do not take into consideration other traits of importance to the swine industry. Little research work has been done to determine if the amount of floor space per pig during the growing-finishing period would influence a gilt's subsequent reproductive and maternal performance.

A study recently completed by the Alabama Agricultural Experiment Station sought to determine if the amount of floor space and/or the number of pigs per pen during the growing-finishing period would influence gilts' subsequent ovulation rates, number of pigs per litter at birth and at 21 days, and litter weights at birth and at 21 days.

Reproductive and maternal productivity of 109 crossbred gilts of Duroc and Landrace breeding that had been reared in a low (eight

pigs per pen) or high (16 pigs per pen) density during the growing-finishing period were studied. Pigs in pens of eight were allowed 11.4 sq. ft. per animal from 65 to 145 lb. and 13.5 sq. ft. per animal from 145 to 220 lb. Pigs in pens of 16 were allowed one-half as much floor area, that is 5.7 and 6.7 sq. ft. per animal during the two weight periods. All pens were equipped with nipple waterers and one self-feeder hole for every four pigs. After attaining an average weight of 220 lb., the gilts were moved together to unimproved pastures. Gilts were bred when they were 9 months of age and maintained on pasture until 110 days of gestation at which time they were moved to a central farrowing house.

Traits evaluated were number of corpora lutea (an indicator of how many eggs were ovulated), total pigs born, pigs born alive, total litter birth weight, number of pigs in each litter alive at 21 days, litter weight at 21 days, and the percentage of pigs alive in the litter at the beginning of the lactation period that survived to 21 days. The 21-day litter sizes and litter weight data were statistically adjusted so all sows started with the same number of pigs at the beginning of the lactation period. Surgery to determine the number of corpora lutea was done to only 42 of the 109 gilts.

The results indicated that the number of corpora lutea did not differ significantly between the two pen densities, see table. However, the total number of pigs born differed between the two densities. Gilts from the pen density of eight farrowed 1.0 pig more per litter than gilts from the density of 16. The difference between the two densities was a nonsignificant 0.7 pig per litter for the number of pigs born alive. Litter birth weights did not differ significantly between the two densities.

When the number of pigs alive at the beginning of lactation was held constant, 21-day litter size was found to be greater in the high than in the low pen density groups (8.9 versus 8.2). This difference in favor of the high pen density groups was also reflected in the litter weights at 21 days, which differed by 6.9 lb. between the two densities. Survival rates of the pigs were also affected by the pen density of the gilts during rearing. Litters raised by sows which were reared in the high density (16 pigs per pen) had 7% higher survival rates at 21 days than did those of sows which were reared in a low density (8 pigs per pen).

Why low pen density during rearing (less social competition and/or more rearing space) allowed larger litters to be born, but led to decreased 21-day litter sizes, litter weights, and survival rates, remains a question.

Previous work at the Alabama Agricultural Experiment Station using some of the same animals indicated that growth rates and backfat thicknesses did not differ significantly between the two pen densities. Therefore, these factors are unlikely to have influenced the reproductive and maternal traits examined in this study.

This work suggests that gilts to be kept as replacement females should be raised in higher pen densities to increase the number of pigs surviving to 21 days. Since all replacement females must go through the stress of farrowing and lactation, it appears that conditioning gilts to stress during the growing-finishing period may be desirable.

AVERAGES AND DIFFERENCES BETWEEN PEN DENSITIES FOR REPRODUCTIVE AND MATERNAL TRAITS OF CROSSBRED GILTS

Trait	Gilts/pen		Difference
	8	16	
Number of corpora lutea	16.6	15.6	1.0
Total number born	10.8	9.8	1.0
Number born alive	10.0	9.3	.7
Litter birth weight, lb.	34.5	32.7	1.8
Number alive at 21 days	8.2	8.9	-.7
Litter weight at 21 days, lb.	86.3	93.2	-6.9
Survival rate, pct.	84	91	-7

OF THE FOUR major animal waste types—swine, beef, dairy, and poultry—swine waste has demonstrated superior methane production properties. The high concentrate ration fed swine production herds provides a waste that is approximately 30% more productive on a dry matter basis than any of the other waste types.

The liquid flushing systems commonly found in Alabama's swine production facilities allow frequent waste removal, providing a fresh substrate for methane production. However, the addition of flushing liquid to the raw waste results in excessive dilution of the waste material, so some method of reconcentrating the flushed waste must be employed before use in an anaerobic digester for methane production.

One of the simplest methods of reconcentrating the flushed waste is mechanical separation using either a stationary or vibrating screen. Studies conducted by the Alabama Agricultural Experiment Station examining reconcentration with vibrating screens have shown that by using various screen mesh sizes and flow rates, a waste feedstock that is ideal for methane fermentation can be produced.

The optimum solids level for anaerobic digestion is approximately 5% total solids, which can be produced using a 60-mesh screen (60 openings per in.) and a flow rate of 17 gal. per minute per sq. ft. Because most of the ammonia contained in the flushed swine waste is not captured in the reconcentrated solids fraction, the possibility of digester "upset" due to high ammonia levels is greatly reduced. Thus, both process stability and overall methane production are enhanced using reconcentrated waste as the methane substrate.

During the screening process, all dissolved solids and a major portion of the fine particulate solids remain in the liquid fraction. Since the solids fraction is used as the digestion feedstock, all solids that remain in the liquid fraction are not available for methane production. The loss of these solids, should it be severe, can seriously reduce methane production when the screened waste is compared to the original flushed waste.

To evaluate these losses, studies were conducted using a 2,000-gal. pilot-scale digester at the Experiment Station's Swine Research Unit in Auburn. Flushed swine waste was reconcentrated using an 18-in. vibrating screen separator with a mesh size of 60 and a 17-gal. per minute per sq. ft. flow rate. The potential methane loss in this system has been determined to be in the 35 to 40% range. This loss does not appear to be economically prohibitive for methane production, and using a liquid waste transport system employing a reconcentrating step

actually appears to enhance the total energy production of the system.

Because a major portion (70%) of the ammonia (one of the most inhibitory constituents of the raw waste) has been removed from the feedstock, digester loading rates can be greatly increased when compared to whole waste. This reduces the size of the digester required to process equal amounts of waste, and therefore reduces capital costs, which are a major factor in determining economic feasibility of methane production systems.

Data collected during the study relating to digester performance using the reconcentrated flushed waste follow. Except for the initial loss of material due to screening, the separated waste is an excellent methane feedstock.

The characteristics of the screened waste showed a total solids fraction of 5%, made up of material that is 10% ash. The remainder of the solids fraction (90%) was organic material capable of being converted to methane. The ammonia level of the screened waste was 554 milligrams per liter, which is well below the level required to produce inhibition of methane fermentation. The screening process, in addition to reconcentrating the waste, actually increases the fraction of biodegradable material from about 80% in whole waste to 90% in the screened waste, while reducing the ash content from about 20% to 10%.

The economics of on-farm methane production are directly determined by digester performance, which is measured in terms of methane production, biodegradable solids reduction, and the economic value of the produced methane. Performance characteristics using the reconcentrated flushed waste showed that approximately 4.75 cu. ft. of methane can be produced per pound of solid material loaded into the digester. This figure, when converted to a more useful basis, shows that approximately 13.2 cu. ft. of methane per day can be produced per 1,000 lb. of animal live weight-standing capacity. The solids content of the screened waste was reduced by approximately 54%, which reduces the ultimate disposal of solid material by approximately one-half.

Because the energy production system studied here employs a solids concentrating step, it can be easily retrofitted to any swine production facility that uses a liquid transport system. More than 60% of Alabama's commercial swine production facilities already have flushing waste collection systems. The reconcentration process enhances the methane production characteristics of the flushed waste by increasing the total solids content, by increasing the fraction of the total solids that is biodegradable, and by removing a major portion (70%) of the ammonia in the flushed waste.

Using Reconcentrated Swine Waste for Methane Production Has Practical Applications

D.T. HILL and J.P. BOLTE
Department of Agricultural Engineering

During the screening process, approximately 35 to 40% of the potential methane production in the flushed waste is lost. The economic value of the energy produced during the study was based on the replacement of LP gas at 90¢ per gal. From the 200-head finishing operation at the Swine Research Unit, which utilizes a standard slatted floor-flushing system, the methane produced was valued at \$3.13 per produced pig per year. Thus, in a typical operation where 600 head are finished per year, this represents a potential energy savings of approximately \$1,900 annually.

Based on the cost of the digestion system at Auburn, the pay-back period would be approximately 6 years, with an expected operating life of 20 years. The economics of this system become more attractive as production size increases because unit capital cost of digestion systems decreases as volume increases. Thus, for the total Alabama swine industry, significant production cost reduction can occur.

QUALITY IMPROVING IN ALABAMA'S SMALL STREAMS

D.R. BAYNE, Department of Fisheries and Allied Aquacultures
E. HILL, Mississippi Cooperative Fish and Wildlife Research Unit,
Mississippi State University

ALABAMA STREAMS have less organochlorine contamination than they did 10 years ago. This finding from an Alabama Agricultural Experiment Station study of three small streams is good news for both regulatory agencies (state and federal) and environmentalists concerned with protecting our nation's wetlands.

Aside from the disruption or displacement by industrial, agricultural, or real estate development, aquatic ecosystems are frequently hardest hit by chemical pollution because contaminants tend to find their way either directly or indirectly into these systems. Some contaminants are more persistent than others and resist natural degradation. Among the more resistant chemical pollutants are organochlorine compounds, including insecticides DDT, aldrin, dieldrin, chlordane, and lindane, and industrial contaminants such as polychlorinated biphenyls (PCBs).

Alabama has over 1,350 linear miles of streams, of which well over half are less than 10 ft. wide. These small streams are a valuable resource, but they have received relatively little attention by researchers. The fact that these systems have small, relatively well defined watersheds makes them a valuable research entity. Discrete sources of pollution can be more clearly identified and whole ecosystems can be more practically and economically studied.

Three small streams in the Tallapoosa River drainage in east-central Alabama were studied in the Experiment Station project to determine the effect of varied land-use practices on organochlorine contamination of these ecosystems. Saugahatchee Creek received municipal-industrial wastes, Opintlocca Creek drained an agricultural (primarily cotton) watershed, and South Sandy Creek drained a forested watershed. Residues of chlorinated hydrocarbons were measured in samples of streambed and fauna taken at regular time intervals over a 2-year period. Fauna sampled included aquatic macroinvertebrates (mostly immature insects and snails), fishes, bullfrogs, water moccasins, and various terrestrial vertebrates. Representative herbivores, detritivores, omnivores, and carnivores within each of the major groups were selected for analysis.

Based on analysis of streambed materials, Saugahatchee Creek (municipal-industrial

watershed) had the highest occurrence and concentration of organochlorine residues and Opintlocca Creek (agricultural watershed) the lowest. A total of nine compounds was detected in the three streams, but only DDE (a DDT metabolite) and BHC were found in all three. PCB (Arochlor 1254®) was found in both Saugahatchee and South Sandy (forested watershed) creeks. In all three streams, contaminant concentrations in sediments were low. For example, the highest seasonal mean DDE and PCB concentrations (dry weight basis) encountered were 0.005 p.p.m. and 0.272 p.p.m., respectively.

DDE was detected in a larger proportion of the macroinvertebrates and fish tissue samples than any other chlorinated hydrocarbon. The frequency of occurrence of DDT metabolite residues was similar for all streams. However, Opintlocca Creek (agricultural watershed) fish had significantly higher concentrations of DDT metabolite than did fish from the other two streams. The highest mean DDT residue concentration was 0.18 p.p.m. (wet weight) found in detritivorous suckers in Opintlocca Creek. Opintlocca Creek dragonfly and dobsonfly larvae (carnivores) had the highest mean DDT residue concentration at 0.04 p.p.m. (wet weight).

Chlordane metabolites were found in 53% of the macroinvertebrates and fish tissues analyzed from Saugahatchee Creek. Dieldrin, lindane metabolites, and mirex were detected in at least one tissue sample from all three streams.

PCBs occurred with greater frequency and at significantly higher concentrations in Saugahatchee Creek (municipal-industrial watershed) fish and macroinvertebrates than in the other two creeks. Highest mean concentrations of 0.08 p.p.m. and 0.23 p.p.m. (wet weight) occurred in Saugahatchee Creek mollusks and suckers, respectively.

In vertebrates other than fish, DDE was detected in 63% of the samples analyzed. Observed mean DDE levels in the bullfrog, water moccasin, beaver, raccoon, and river otter were highest in specimens collected from Opintlocca Creek. Mean residue levels ranged from 0 for beaver collected on South Sandy Creek to 6.5 p.p.m. (wet weight) in river otter from Opintlocca Creek. The high DDE levels observed in vertebrates collected on the predominantly agricultural watershed occurred in spite of the fact that

DDT was banned from use as an agricultural pesticide in 1973. Except for river otter from the Opintlocca watershed, all DDE values were less than 1.00 p.p.m. The higher residues for Opintlocca Creek river otter may be attributed to: (1) biomagnification of DDT metabolites via the food web, (2) relatively long life of the river otter, and (3) low capability of this mammal to dissipate organochlorines.

PCBs were detected in 38% of all vertebrate (other than fish) tissue samples submitted for analysis. Mean values for all watersheds increased in the higher trophic levels, with the river otter having a mean residue concentration of 0.714 p.p.m. No watershed had consistently high PCB levels. Chlordane isomers were found in 19% of the vertebrate tissues analyzed.

Levels of pesticides and PCBs in the fauna were relatively low and, aside from the danger of biomagnification in the case of DDT, pose little if any significant threat to the environment. All residues found in fish were well within the acceptable range prescribed in federal guidelines for fish to be utilized for human consumption. With the exception of the DDT concentrations found in Opintlocca Creek river otter, organochlorine residues encountered in this study were less than the levels reported in the previous decade. This suggests a general improvement in the quality of aquatic systems and riparian habitats of the State.



R ESEARCHERS at the Alabama Agricultural Experiment Station have found that *Acremonium coenophialum*, a fungus that infects tall fescue pastures, causes weight loss in beef cows that are nursing calves, decreased milk production, lowered weaning weights, and elevated body temperatures in both the cows and their calves.

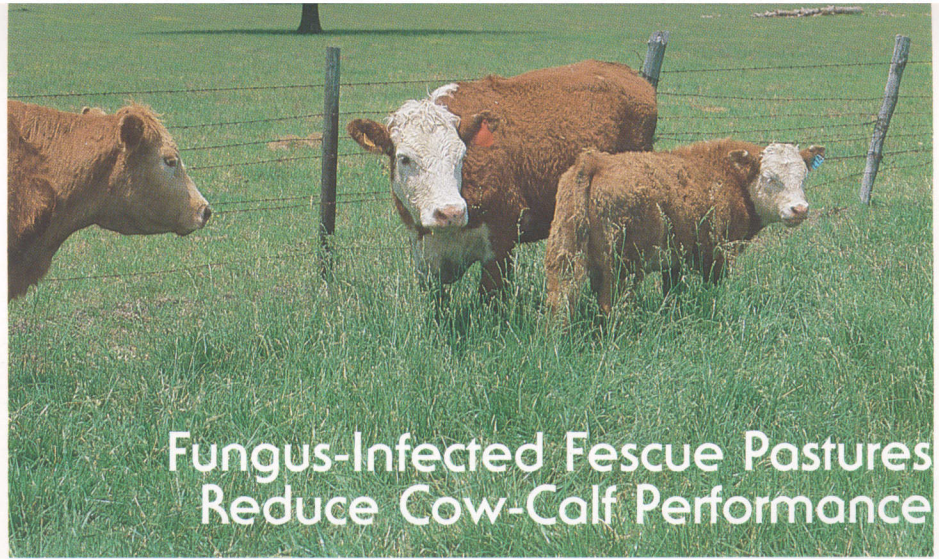
Tall fescue is one of the most widely grown forage grasses in the United States. It has excellent agronomic characteristics and its nutrient analysis is good. However, cattle grazing tall fescue frequently have reduced weight gains, rapid respiration, excessive salivation, elevated body temperatures, a rough hair coat, and a desire to remain in the shade a high percentage of the time. Collectively, these symptoms have come to be known as "fescue toxicity," "summer syndrome," or "summer slump."

Previous grazing studies with beef steers at the Experiment Station have shown that when tall fescue was relatively free of *Acremonium coenophialum* (less than 5% of the plants infected), steer gains were 66% greater than they were on pastures in which more than 90% of the fescue was infected.

Although the toxicosis is commonly referred to as summer syndrome because of the visible symptoms in grazing animals during hot weather, poor weight gains on the fungus-infected pastures occurred during cool weather as well. It is not known whether "fescue foot," the sloughing of the feet or tails of cattle during cold weather, is related to the summer syndrome.

Many of Alabama's nearly 1 million beef cows graze tall fescue. The objective of a study conducted at the Black Belt Substation, Marion Junction, was to compare the performance of beef cows and calves grazing fungus-infected or relatively noninfected Kentucky-31 fescue.

Existing tall fescue pastures that were either greater than 90% infected or less than 5% infected (noninfected) were used in this 3-year study. Grass residue was mowed and removed from the paddocks in late July or August and nitrogen was applied at 100 lb. per acre in September and again in February. Applications of phosphorus, potassium, and lime were made according to soil test recommendations. Crossbred cow-calf pairs were divided according to age, sex,



Fungus-Infected Fescue Pastures Reduce Cow-Calf Performance

S.P. SCHMIDT, Department of Animal and Dairy Sciences, C.C. KING, J.F. PEDERSEN, and C.S. HOVELAND¹, Department of Agronomy and Soils, and L.A. SMITH, H.W. GRIMES, and J.A. HOLLIMAN, Black Belt Substation

and breed of calf and put on the pastures at a stocking rate of one pair per acre. The grazing season began in mid-November. During January and February when sufficient forage was not available, the cattle were removed from the paddocks and fed johnsongrass hay with a 20% protein supplement composed of corn and cottonseed meal. The cows were rebred while off the paddocks. Spring grazing began in March and ended about June 1 each year.

Additional put-and-take cow-calf pairs were added to the paddocks and removed as necessary to keep the height and availability of forage the same among all pastures. Milk production by the cows and body temperatures were measured during May. At the termination of fescue grazing, all cattle were put on a dallisgrass-clover pasture until the calves were weaned in early August.

Cow-calf grazing days per acre were greater for the fungus-infected pastures, table 1. Cattle grazing infected fescue spend more time in the shade, which reduces forage consumption, so it took a higher stocking rate to maintain forage availability similar to noninfected pastures. Cows grazing noninfected fescue gained weight, whereas those on the infected fescue lost 0.51 lb. daily. This severe weight loss could reduce conception rate in the cow. In this study, however, the cows were rebred off the pastures while receiving good supplemental feed and conception was not affected.

Calf daily gains were nearly 50% greater on the noninfected fescue, table 1, resulting in calves that were 91 lb. heavier at the end of the fescue grazing, table 2. Body temperatures were elevated in both the cows and calves that grazed fungus-infected fescue. Presence of the fungus resulted in a 57% decrease in milk production by the cows. When the cattle were put on dallisgrass-clover pastures, the calves that had previously been on infected fescue did not exhibit compensatory gains and catch up with the calves from noninfected fescue, table 2. It appears fescue toxicity has a prolonged effect on calf performance after removal from the infected fescue.

These results show that presence of the fungus in tall fescue dramatically reduces cow-calf performance. Most of the tall fescue in Alabama and the Southeastern United States is infected. The best solutions at this time for infected fescue pastures appear to be overseeding clover in the fescue (clover stands are somewhat difficult to establish and maintain), or reestablishing pastures with a noninfected variety such as AU-Triumph or with aged seed in which laboratory grow-out tests show the fungus has died.

¹Resigned. Now Professor of Agronomy, University of Georgia.

TABLE 2. EFFECT OF GRAZING FUNGUS-INFECTED FESCUE ON CALF WEANING WEIGHTS¹

Measure	Fungus-free fescue	Fungus-infected fescue
Weight at end of fescue grazing (May 30), lb.	525	434
265-day weaning weight (Aug. 1), lb.	650	540
Gain after removal from fescue, lb.	125	106
Daily gain (June and July), lb.	2.1	1.8

¹Cows and calves grazed dallisgrass-clover pastures during June and July.

TABLE 1. COW-CALF PERFORMANCE ON TALL FESCUE PASTURES AS AFFECTED BY FUNGUS, BLACK BELT SUBSTATION, 1980-1983

Pasture	Per acre cow-calf grazing days	Daily gain		Body temperature		Daily milk
		Cows	Calves	Cows	Calves ¹	
		Lb.	Lb.	°F	°F	Lb.
Free of fungus . . .	133	1.02	2.55	103.6	103.9	11.7
Fungus present	177	-.51	1.87	104.7	105.5	6.7

¹Calf temperatures were measured only in 1981. For comparison, the 1981 body temperatures were 103.4°F and 104.8°F, respectively, for cows grazing noninfected and infected pastures.

Economic Aspects of the U.S. Farm-Raised Catfish Industry

H.W. KINNUCAN, Department of Agricultural Economics and Rural Sociology

PER CAPITA CONSUMPTION of commercially processed catfish has increased tenfold since 1970. Since most of these fish are raised on farms in Mississippi, Alabama, and Arkansas, the tremendous growth in catfish consumption is a significant development for Southern agriculture.

An obvious effect of this growth is a change in agricultural land use. Today, about 73,000 surface acres of land are devoted to commercial catfish production, compared to 2,400 acres in 1963. Establishment of processing plants in the region (currently 16 plants service the industry's 1,000 producers) and feed mills are other important aspects of this growth in consumer demand for catfish.

To gain some insight into the demand for catfish and to trace through implications for future industry growth, a recent Alabama Agricultural Experiment Station study estimated price and demand relationships for catfish at both the processor and farm levels. A major finding of the study is that the demand for catfish is price elastic, that is consumers appear to be quite sensitive to changes in the price of catfish. The implications of this finding, as well as other findings relating to seasonal price behavior, the impact of imports on farm prices, and industry growth potential were studied.

A commodity with a price elastic demand has the property that small changes in price induce relatively large changes in the quantity demanded. Commodities having a relatively large number of substitutes, or at least one close substitute (e.g., margarine may be considered a close substitute for butter), usually have an elastic demand. Thus, because consumers can easily substitute other fish, or even poultry, beef, and pork for catfish, it is not surprising that the demand for catfish was found to be price elastic (the particular elasticity coefficient is -1.54, which means that if the farm price of catfish is increased 1%, and other factors affecting catfish demand such as consumer income, population growth, and prices of substitute commodities remain unchanged, the quantity demanded of catfish would decrease 1.54%).

Since the percentage change in quantity

demanded is greater than the percentage change in price when demand is elastic, an industry facing an elastic demand curve for its product finds its revenues varying inversely with price, i.e., when prices fall revenues increase and when prices rise revenues fall. A corollary to this statement is that an elastic demand implies a direct relationship between quantity marketed and price. Thus, if the finding of an elastic demand for catfish is correct, one should observe a positive relationship between industry revenues and harvests. Industry data confirm this relationship: between 1977 and 1983, harvests increased nearly sixfold while industry revenues increased 6.5 times, see table. Hence, an important implication of a price-elastic demand for catfish is that the market can absorb relatively large increases in supply without declines in producer revenues.

An elastic demand implies stable prices at the farm level. Actual data confirm this expectation: between 1970 and 1983, prices at the farm level typically varied by less than 4¢ per pound on a month-to-month basis. Changes in average annual prices also are modest, especially in light of the large increases in supply that have occurred in recent years, see table. Specific econometric estimates indicate a 100% change in harvests would change farm prices by only 21%, assuming no change in processors' inventories or imports of catfish. Thus, a catfish enterprise helps stabilize revenues in a diversified farming operation.

A further implication of an elastic demand for catfish is that conventional policies designed to assist farmers, i.e. price supports and/or supply control measures, will be

counterproductive for the industry. Thus, public or cooperative private measures to assist the industry, should they prove to be necessary, will need to differ fundamentally from past and many current agricultural subsidy programs. One policy option that might benefit the industry is a research and promotion program designed to expand markets for catfish, perhaps funded by a checkoff against processors.

Other findings of the study relate to seasonal price behavior at the farm level and the impact of imports on farm prices. A common complaint of catfish processors is the sporadic supply of catfish supplies throughout the year. However, results show that seasonal price incentives have not been adequate to encourage catfish producers to alter the existing harvesting pattern. If processors wish to effectively address the problem of seasonal deficits in supply, they will need to consider changes in their pricing policy.

In the early stages of the industry, imports of catfish constituted an important component of the U.S. supply of catfish. In recent years, however, imports of catfish have declined and today represent only about 3% of the domestic harvest, see table. Improvements in the quality of grain-fed fish raised in ponds in the United States, the more constant availability of supply, and an increasing price for "wild" imported fish (mainly from Brazil) have combined to make the domestic fish more attractive to consumers. In fact, the research results show catfish imports during the 1977-82 period having no significant impact on the price domestic producers receive for their catfish.

The demand for catfish is projected to eventually represent 6% of all fish consumed by Americans. The present market share is 2.4%. Most of this growth will occur by the turn of the century, requiring a tripling in size of the industry over the next 16 years. However, because of the elastic nature of the demand for catfish, the achievement of this growth will require that the industry remain efficient and price competitive. This means aggressively adopting new technology and management practices so maximum possible efficiencies in the production, processing, and marketing of the fish are realized.

FARM PRICES, HARVEST, IMPORTS, AND FARM REVENUES, UNITED STATES
FARM-RAISED CATFISH INDUSTRY, 1977-82

Year	Farm prices ¢/lb.	Harvest Lb.	Imports Lb.	Farm revenues, mil. Dol.
1977.....	57.9	22,128	17,988	12.8
1978.....	54.6	30,180	18,372	16.5
1979.....	61.5	40,632	16,992	25.0
1980.....	67.6	46,464	14,928	31.4
1981.....	63.8	60,132	9,624	38.5
1982.....	55.0	99,408	5,892	54.7
1983.....	61.0	137,250	4,274	83.8

Source: Crop Reporting Board, ESS, USDA, and U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. "Farm-Raised Catfish Processors' Report," various issues.

SOME EGG PRODUCERS in Alabama may be paying up to 10 times too much to satisfy the calcium requirements of their pullets and hens. At the same time, they are causing poor shell quality, excess feed consumption, excess body weight, and fatty liver. Results of Alabama Agricultural Experiment Station tests indicate that these adverse effects occur when dietary calcium is not increased to the correct level at the proper time in the transition from pullet feed to layer feed and by feeding inadequate calcium to older hens.

Three common methods are used for increasing calcium in the transition feed from pullet to layer feeds:

1. A 1% calcium diet is fed until pullets reach approximately 5% production, and then a regular layer calcium level (over 3%) is fed.

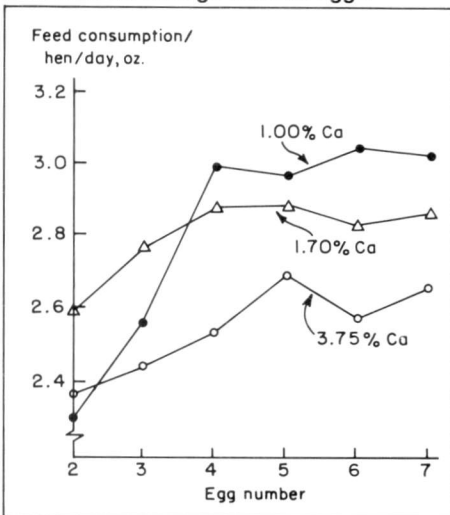
2. A change is made from 1% dietary calcium to 2% calcium at 18 weeks (approximately 2 weeks prior to the start of production). This level is maintained until about 5% production is reached, at which time a shift is made up to the regular calcium level (over 3%).

3. A change from the 1% calcium diet to a regular layer calcium level is made approximately 1 week before the first egg.

Several experiments were conducted at Auburn to compare these different feeding methods. Specifically, the tests were to determine if increasing dietary calcium to 3.75% 1 week prior to production to meet needs of early maturing pullets will (1) adversely affect immature pullets causing a reduction in feed consumption, and (2) affect egg production, egg weight, shell quality, liver fat, and body weight.

The results indicated that feeding a regular calcium level (3.75%) 1 week before production began did not adversely affect immature pullets and cause them to reduce feed intake. It did cause mature pullets (laying

Feed consumption of pullets fed three levels of calcium (Ca) on the day of oviposition of their second through seventh eggs.



Timing of Calcium Diet Increase Critical for Young Hens



D.A. ROLAND and M. FARMER, Department of Poultry Science
D.N. MARPLE, Department of Animal and Dairy Sciences

pullets) to reduce feed intake. However, that was a beneficial effect since they were consuming too much feed to begin with.

The early maturing laying pullets fed the calcium deficient diets (1% or 2% calcium) tried to compensate for the deficiency by eating extra feed to get more calcium, see table and graph. This resulted in fat birds. In some instances, pullets fed the 1% calcium diet overconsumed feed (energy) as much as 30% for short periods. Older birds also showed the same overconsumption patterns. Other researchers have shown that birds develop fatty liver hemorrhagic syndrome (FLHS) within 2 weeks when force fed 15% more than they would eat free choice. Thus, the 30% overconsumption noted could be analogous to force-feeding and represent a problem.

The extra feed consumed by hens fed calcium-deficient diets had no benefit on egg size or production, but it did increase feed cost and reduce shell quality. Early maturing pullets fed diets containing 1% or 2% calcium produced eggs with shell quality equivalent to that expected from hens 12 or 6 months in lay, respectively. The extra feed consumed by hens or pullets fed inadequate calcium also increased body weight, liver weight, fat pad weight, liver hemorrhage score, and liver fat and decreased production. These are symptoms previously described for FLHS.

Since FLHS was first described, much research effort nationwide has addressed the problem. This research has associated many factors with FLHS, including vitamins, minerals, fat, temperature, type housing, hormones, bird age, feed ingredients, drugs, force feeding, energy, and aflatoxins. Although FLHS is complex and involves several factors and other nutrient deficiencies, no other nutrient deficiency is more likely to occur than calcium. In fact, the conditions of young pullets recorded in these studies were created feeding calcium

levels recommended in most management guides and levels used in industry.

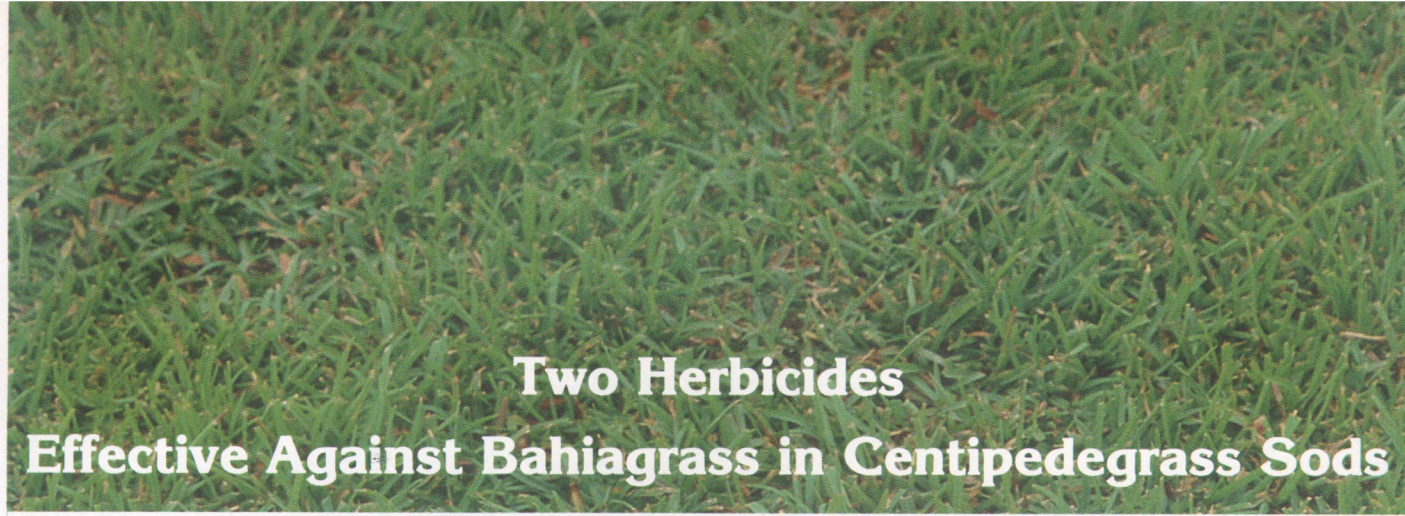
It is hypothesized that the mechanism responsible for the increased body weight, liver fat, fat pad weight, and liver hemorrhage score in hens consuming inadequate calcium is related to the excess energy consumed or the increased secretion of estrogen, or both. The evidence for this is: (1) hens can overconsume feed when fed marginal calcium-deficient diets, (2) serum estrogen levels increase in hens with FLHS, and (3) fat metabolism is altered by calcium, a hypolipemic factor, and estrogen, which promotes lipid deposition.

Although much remains unknown about the complicated relationship of calcium to feed consumption and reproductive performance, results of the Alabama Experiment Station research leave no question that feeding inadequate calcium will reduce shell quality in young and old hens and possibly cause FLHS. But even more important than the FLHS, the increased feed consumption has no beneficial effect on egg size or production, but could result in an economic loss. Based on these data, young pullets need adequate calcium (3.75%) just prior to or at sexual maturity, not after sexual maturity, especially since increase in liver and body fat deposition can occur in a short period.

FEED CONSUMPTION OF LAYING DEKALB XL PULLETS AS INFLUENCED BY DIETARY CALCIUM DURING THE FIRST 3 WEEKS OF PRODUCTION

Treatment, pct. calcium	Feed consumption, oz./hen/day	Pct. difference ¹		
		Wk. 1	Wk. 2	Wk. 3
1.00	3.6	30	22	11
3.75	3.0	--	--	--

¹Difference in feed consumption between laying pullets fed different calcium levels during each weekly test period.



Two Herbicides Effective Against Bahiagrass in Centipedegrass Sod

D.L. TURNER and R. DICKENS, Department of Agronomy and Soils

LOW FERTILITY and maintenance requirements make centipedegrass an excellent warm season turf for home lawns and other areas. These same conditions are also favorable for bahiagrass growth, making this widespread pasture grass a serious weed pest.

Because of prolific seedhead production by bahiagrass, centipedegrass turf infested with bahia requires frequent mowing throughout the growing season to maintain an acceptable quality. Bahiagrass infestations in the turf make it necessary to mow with rotary mowers instead of the more efficient reel type mowers.

Unfortunately, there has been no acceptable method of controlling bahia in centipedegrass in the past. Available herbicides simply did not offer selective kill of bahia and safety to centipede. This problem may be nearing solution, however, since several new postemergence herbicides show promise for selectively controlling bahiagrass in centipedegrass. Two of these materials, an experimental identified as DPX-6376 (met-sulfuron methyl) and Oust® showed promise in tests by the Alabama Agricultural Experiment Station begun in 1983.

The Auburn study also evaluated Fusilade® and Poast® for selective control of bahiagrass in centipedegrass turf. The herbicides were applied to replicated plots of centipedegrass and bahiagrass.

Fusilade and Poast were applied at 0.25 and 0.5 lb. a.i. (active ingredient) per acre with 0.5% by volume of crop oil concentrate added to the spray solution. DPX-6376 was applied at 0.5, 1.0, and 2.0 oz. a.i. and Oust at 1.0, 2.0, and 3.0 oz. a.i. per acre. All four herbicides were applied June 21, 1983; half of the plots were treated again 35 days later. Percent injury ratings were taken at 10, 35, 50, and 85 days following the initial applications and at 15 and 45 days after the second applications on both grasses. Additional injury ratings were made the following spring to evaluate recovery of the two grasses.

Fusilade and Poast produced only temporary injury to the bahiagrass. Recovery occurred within 2-3 weeks after each appli-

cation. Thus, control was inadequate. However, two applications of Fusilade produced from 70 to 80% injury to centipedegrass in the fall, and the injury was still evident the following spring.

DPX-6376 and Oust were more effective herbicides for the control of bahiagrass. The following spring, bahiagrass control was nearly complete at all rates tested, see table. Little or no injury to centipedegrass was observed from DPX-6376, Oust, or Poast.

Fusilade and Poast showed little promise

for controlling bahiagrass in this test. The level of injury to centipedegrass from Fusilade would prohibit its use in centipedegrass plantings.

Based on the results reported, DPX-6376 and Oust are promising herbicides for controlling bahiagrass in centipedegrass. Registration of these herbicides for use on centipedegrass is expected within a few years, so these materials may prove useful to home owners and other turfgrass managers in the near future.

EFFECTS OF TWO APPLICATIONS OF HERBICIDES ON CENTIPEDEGRASS AND BAHIAGRASS TURFS

Herbicide rate, a.i./acre	Injury 15 days after initial application		Injury 15 days after repeat application		Injury in spring following application	
	Centipede	Bahia	Centipede	Bahia	Centipede	Bahia
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Oust, 1.0 oz.	2	15	2	95	18	98
Oust, 2.0 oz.	0	10	0	96	15	100
Oust, 3.0 oz.	2	10	0	96	23	98
DPX-6376, 0.5 oz.	2	8	7	95	15	100
DPX-6376, 1.0 oz.	5	7	13	99	8	98
DPX-6376, 2.0 oz.	5	8	28	99	17	100
Fusilade, 0.25 lb.	7	17	78	45	72	23
Fusilade, 0.50 lb.	7	18	90	50	82	22
Poast, 0.25 lb.	0	18	0	50	13	32
Poast, 0.50 lb.	0	17	2	52	7	30
Check	0	0	0	0	15	15

ALABAMA AGRICULTURAL EXPERIMENT
STATION, AUBURN UNIVERSITY
AUBURN UNIVERSITY, ALABAMA 36849

Gale A. Buchanan, Director
PUBLICATION—Highlights of
Agricultural Research 9/84
Penalty for private use, \$300

11M

POSTAGE PAID
U.S. DEPARTMENT
OF AGRICULTURE

AGR 101
BULK RATE

