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Lowell T. Frobish, Director

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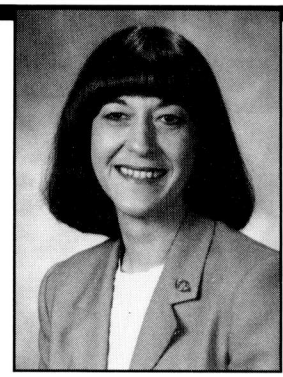
Human Sciences at Auburn



DR. JUNE HENTON

HUMAN SCIENCES is a new name for home economics at Auburn University. The name change reflects the evolution of an academic unit keeping pace with the new challenges of a changing world. As an integral part of the land-grant system from its beginning, home economics has played a vital role in agricultural research. Our mission is to enhance quality of life by addressing the "human dimension" of problems confronting our society. In our Agricultural Experiment Station research, we study those factors which affect the health and well-being of families and individual consumers.

Throughout the years, home economists have focused on solving practical family problems. In a recent publication, Elizabeth Y. Davis chronicled past Experiment Station research accomplishments for the field, including nutrition studies leading to the establishment of recommended dietary guidelines; management and economics research related to cost of raising a child, and family time-use studies resulting in the alteration of poverty guidelines; housing space studies culminating in standardized kitchen and bath designs as well as storage requirements; and clothing and textiles research which established sizing standards for patterns and ready-to-wear apparel.

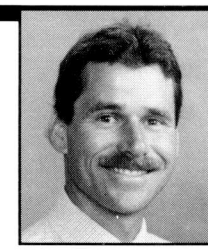
Although home economics researchers have made outstanding contributions over the years, today we face increasingly difficult issues. The task of solving problems for families and consumers is becoming more and more complex. The demographic, technological, social, and economic changes that we currently confront require the expertise of highly trained scientists doing cutting edge research. The necessity to attract top quality faculty and to acquire external funding for research has made it imperative that we carefully evaluate how we can best compete. Just as animal husbandry determined a few years ago that animal sciences is more descriptive of its program, we concluded that human sciences more clearly delineates our scientific focus than our previous name.

What does the name change mean? It means a chance to create a stronger academic image for our School. It means the opportunity to be more competitive in the recruitment of outstanding students. It means that the scholarly work done by our faculty may be evaluated more fairly instead of being prejudged. It means a broader scope of employment alternatives for our graduates. It means a chance to actively define what we do in our academic programs rather than respond to what people think we do.

What the name change does *not* mean is a change in mission. Human sciences at Auburn is committed now, as home economics was in the past, to improving the quality of life of individuals and families. *That will not change.*

June Henton, Dean
School of Human Sciences

MAY WE INTRODUCE



Dr. Gary Keever, Associate Professor of Horticulture. Keever, a native of Rock Hill, South Carolina, earned a B.S. degree in ornamental horticulture, graduating with highest honors from Clemson University. He went on to earn M.S. and Ph.D. degrees in floriculture and ornamental horticulture from Cornell University. While at Cornell, Keever served as a graduate research assistant.

Since coming to Auburn in 1982, Keever has worked closely with Alabama's booming ornamental horticulture industry. His research on the effects of pot and container design on plant growth was the subject of an article published recently in World Flower Trade Magazine. Keever is a frequent contributor to Highlights, and he currently serves on the magazine's Editorial Committee.

In his article on page 4 of this issue of Highlights, Keever discusses some of the results of lengthening light periods and interrupting night periods with artificial light. His results show both negative and positive aspects of using artificial light on species sensitive to photoperiodic interruption.

ON THE COVER. A small electric aerator in operation in an Alabama catfish pond, see related story on page 5.

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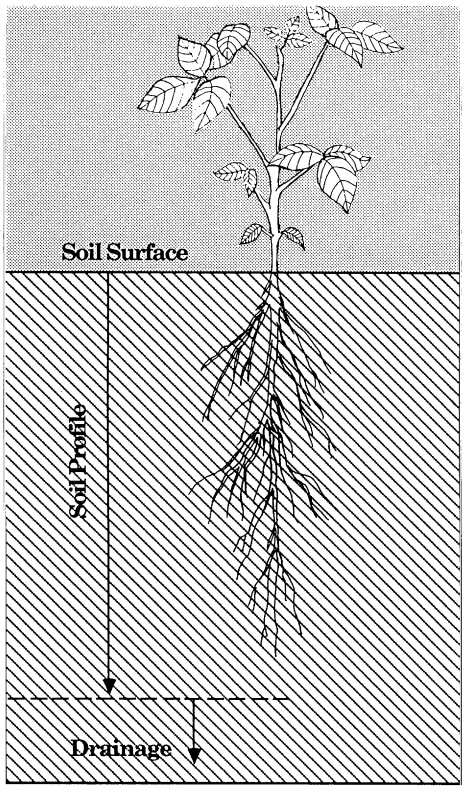


Computers help explain environmental effects on plant growth

G. HOOGENBOOM, C.M. PETERSON, and M.G. HUCK

INADEQUATE soil moisture resulting from too little rainfall is an important factor limiting growth and yield of most crops in the Southeast. The absence of definitive information about the effects of drought stress on plant growth led to a 4-year Alabama Agricultural Experiment Station-USDA, ARS study in an underground root observation laboratory (the Auburn Rhizotron) using soybeans.

Responses of plants to different environmental conditions, such as drought stress or irrigation, were measured in the Rhizotron studies. Yields predictably increased 50-100% when plants were irrigated continuously, compared with rain-fed plants. A surprising observation, however, was that the root system of drought-stressed plants was larger than that of the irrigated plants. Data from this research were then used to develop mathematical equations from which a computer model was designed to help explain how plants respond to varying environmental conditions.

Important plant processes, such as food production through photosynthesis, shoot respiration, leaf and stem growth, and loss of water from plants via transpiration, were described in several sets of equations. A different set of equations summarized processes occurring in the root system, such as water uptake, root growth, and respiration. These equations were then combined into a computer model that simulates plant growth and development in relation to environmental variables. Special attention was given to the relationship between the shoot and root system, and the interactions that occur as a result of stress conditions imposed upon plants due to inadequate soil moisture, figure 1.

During the early part of the growing season, most of the root growth and water uptake occurs in the upper part of the soil profile. As the plants grow taller, however, the roots penetrate deeper into the soil and absorb soil moisture at these greater depths. Such interactions between the above-ground and below-ground environment must be considered by the computer program for predicted growth to be accurate.

To simulate plant growth, the environmental conditions under which the plant grows must be defined. Weather information, including minimum and maximum daily temperatures, total radiation or light exposure, and rainfall, and soil information, such as water holding capacity, drainage rate, and soil type, are required.

With all the environmental inputs in place, plant growth simulation begins. The model calculates dry matter production, shoot and root growth, transpiration, water uptake, and soil water flow at 1-hour time intervals. Depending on the type of computer system used, a 100-day season can be simulated in less than an hour.

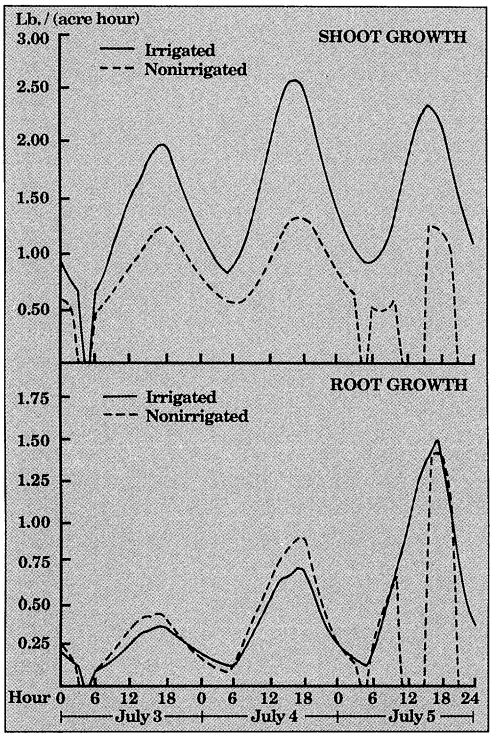
If model predictions prove accurate, the model can then be used to study such things as effect of drought stress on root-shoot partitioning. The model can predict at what depth most of the root growth occurs and where most of the water is extracted.

The model also can predict root and shoot growth for irrigated vs. nonirrigated crops for a specific part of the growing season, figure 2. During the 3 days illustrated, shoot growth of irrigated plants exceeded that of rain-fed plants, except for a short period on July 3 when no growth was predicted. Also shown is that root growth was faster for the rain-fed plants than for the irrigated plants during this same period—a time of diminished rainfall.

The model demonstrates that the fastest shoot and root growth occurs during the middle of the day when plants intercept most of the light and are quite active photosynthetically. On the last day of this 3-day simulation period, a severe drought began which caused a sharp reduction in both shoot and root growth of the rain-fed plants. The irrigated plants were not affected.

According to the model, rain-fed plants direct a larger portion of their carbohydrates into the root system during drought periods than do well watered plants. As a result, the rain-fed plants have deeper roots; this allows them to absorb water from the deeper, wetter parts of the soil profile. This could be one of the plant's survival mechanisms for drought. As a consequence, however, the plant distributes more energy from photosynthesis into root dry matter production rather than into its shoot system (stems, leaves, pods), which can lead to decreased yield.

FIG. 1 (title drawing). Soil profile.
FIG. 2 (below). Shoot and root growth of irrigated and nonirrigated plants.



Hoogenboom is former Graduate Research Assistant of Agronomy and Soils, Peterson is Professor of Botany and Microbiology, and Huck is former Adjunct Associate Professor of Agronomy and Soils.

Is Photoperiod Manipulation A Viable Tool For Alabama Nurserymen?

G.J. KEEVER and G.S. COBB

DAYLENGTH is one of the most important factors influencing the duration of shoot growth and affecting the onset of dormancy in woody plants. Generally, the rate and duration of shoot growth are increased under long day conditions, while short day conditions decrease the rate of growth and hasten the onset of dormancy. Dormancy can be delayed by exposing plants to supplemental light, but the effects may not be clear-cut due to photoperiod-temperature interactions or to wide variation in photoperiodic sensitivity among species.

Daylength-sensitive species exposed to long photoperiods produce either (1) continuous growth if temperatures are favorable, (2) extended growth with dormancy eventually occurring, or (3) an alteration of growth flushes with a shortened period of dormancy between successive flushes. By providing long day conditions, dormancy may be delayed and the growing season extended into the fall, possibly shortening the overall production cycle. However, winter injury may be increased if plants are exposed to winter conditions before they become fully dormant. Based on research at the Alabama Agricultural Experiment Station, if photoperiodic manipulations are to be used to increase growth of photoperiodic sensitive woody ornamental crops in zone 9a (southern Alabama), sufficient winter protection must be provided to prevent cold injury to actively growing and nondormant tissues.

Thirteen species of temperate ornamental trees and shrubs were evaluated for their growth responses to extended (EP) and night interrupted (NI) photoperiods in zone 9a. Test species included abelia, boxwood, redbud, euonymus, Japanese holly, dwarf Burford holly, dwarf yaupon, crapemyrtle, Southern magnolia, nandina, Florida azalea, Fashion azalea, and cleyera.

Container-grown plants of each species were placed outdoors in full sun, and maintained following standard nursery practices from March until June at which time photoperiodic treatments began. An extended photoperiod (EP) was provided from 3 a.m. until 2 hours after sunrise and from 2 hours before sunset until 9 p.m. using 100-watt incandescent bulbs spaced 48 in. apart and 48 in. above the plant. A night interrupted photoperiod (NI) was provided between 10 p.m. and midnight. Natural photoperiod (NP) ranged from 14 hours 8 minutes on June 21 to 10 hours 37 minutes on November 15, at which time natural photoperiods were resumed for all plants. In December and again in June, following the spring growth flush, growth measurements were taken.

On December 10, all species, except nandina, receiving EP and NI were actively growing. Abelia was flowering, while recently emerged leaves of crapemyrtle and redbud had been burned during a light freeze in November. Only euonymus and boxwood were actively growing under the NP.

Electric lightbulb arrangement used to manipulate photoperiod of nursery plants.

Plant growth through December varied among species and photoperiodic treatments. Shoot growth of Florida and Fashion azaleas, crapemyrtle, yaupon, compacta holly, Southern magnolia, and redbud were greater for plants grown under EP and NI compared to NP. Growth of other species was similar under the three photoperiodic treatments.

Root growth of species whose top growth was unaffected by photoperiod (abelia, dwarf Burford holly, and cleyera) was higher under NP compared to EP and NI. In contrast, with species whose top growth was increased with EP and NI (Japanese holly, yaupon, Florida and Fashion azaleas, redbud, crapemyrtle, and Southern magnolia), root growth was unaffected by photoperiod. Neither shoot nor root growth of boxwood, euonymus, and nandina was affected by photoperiod manipulation.

During the winter, subfreezing temperatures were experienced 24 times, beginning December 3 and ending March 22. The total number of hours below freezing was 206 and the minimum temperature was 3°F. Plants of abelia, Florida and Fashion azaleas, cleyera, and redbud exposed to EP and NI during the previous fall exhibited extensive twig dieback in early June. Shoots of crapemyrtle were either killed to the ground with new growth emerging from the base or the entire plant killed (57% mortality under EP, 29% under NI). Fourteen percent of cleyera and redbud receiving EP and 14% of cleyera under NI were also killed. No injury occurred to plants of the remaining species. Growth, as measured in June, was either greater under NP compared to EP and NI or similar.

Growth of several species of woody ornamentals in zone 9a was enhanced during the fall with EP and NI compared to NP; however, the benefits of long day conditions were not present following the spring flush of growth, either because of greater growth under NP or winter injury under EP and NI. If photoperiodic manipulations are to be used to increase growth of photoperiodic sensitive woody ornamental crops in zone 9a, sufficient winter protection must be provided to prevent cold injury to actively growing and nondormant tissues.

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

Electric Paddle Wheel Aerators for Catfish Farming

C.E. BOYD

AERATORS have become important tools in replacing depleted dissolved oxygen supplies in management of commercial catfish ponds. Until recently, most fish farmers in Alabama relied on paddle wheel aerators powered by PTOs of tractors to provide emergency aeration when dissolved oxygen concentrations in ponds dropped to low levels. However, it is more economical to use electrically powered paddle wheel aerators, and research on this type aerator was initiated at the Alabama Agricultural Experiment Station to determine the most efficient designs.

An electric paddle wheel aerator consists of a motor, a speed reduction mechanism, and paddle wheels mounted on a trailer or on a flotation device. Floating electric paddle wheel areators are much more common than trailer-mounted ones. The oxygen-transfer efficiency of a paddle wheel aerator depends upon design and operating characteristics of the paddle wheel. Thus, paddle wheel fabrication specifications are rigid, while design of the flotation system is flexible.

In tests at Auburn, the highest oxygen transfer efficiency was achieved with a paddle wheel 36 in. in diameter with triangular paddles (120 to 135° interior angle) spiralled on the hub. The most efficient of the electric paddle wheel aerators tested had paddles extended 3.5 to 4.0 in. into the water and the paddle wheels rotated at 75 to 80 r.p.m. The optimum horsepower requirement was about 1 hp per linear foot of paddle wheel. If either paddle submergence or paddle wheel speed is increased, power requirement will increase and oxygen-transfer efficiency will decline. The spiral arrangement of paddles on the hub, figure 1, allowed a fairly constant area of paddle surface to move continuously through the water, reducing vibration and wear.

Paddle wheel shafts are fitted with bearings and mounted on a metal frame which is floated with steel boxes, styrofoam blocks, or plastic or metal tanks. Some means of raising and lowering both ends of the paddle wheel are provided so that minor adjustments in depth may be made once the aerator is installed in a pond. Take-up bearings provide one convenient way of adjusting paddle wheel elevation and paddle depth. Aerators usually are anchored in ponds by aid of two metal stabilizer bars attached to each end of the floating frame and to metal bars driven into the pond bank.

A gear reducer is the simplest way to reduce motor output shaft speed to 75 or 80 r.p.m. A gearmotor has the gear reducer built onto the motor. The output shaft of a gearmotor can be connected to the input shaft of the paddle wheel with a flexible coupling. Alternatively, a gear box may be connected on one side to the output shaft of the motor with sheeves and cog belts and coupled on the other side to the input shaft of the aerator.

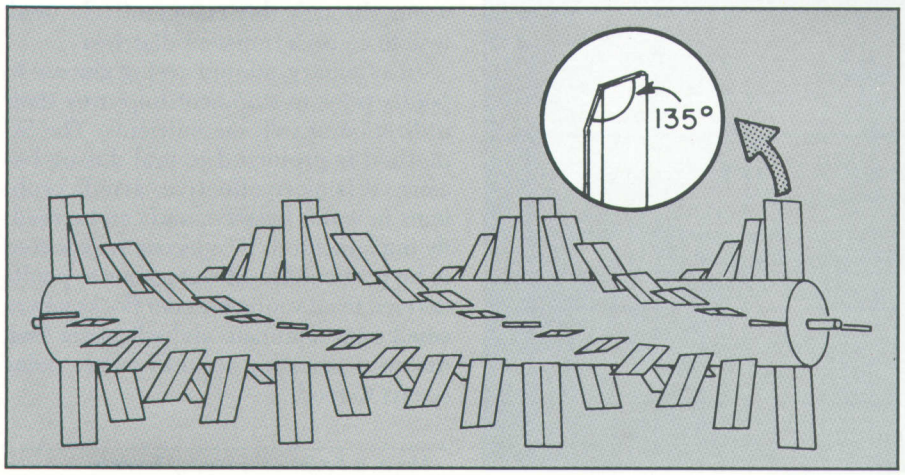
A 10-hp electrical paddle wheel aerator is shown in figure 2. Aerators of this type have standard oxygen transfer efficiencies of about 4.5 lb. of oxygen per horsepower per hour. Other types of surface aerators used in catfish farming have oxygen transfer efficiencies of 2-3 lb. of oxygen per horsepower per hour. A 10-hp electric paddle wheel aerator of this design will transfer about 80% as much oxygen per hour as a PTO paddle wheel aerator driven by a 65-hp tractor.

After the aerator is installed in a pond, the electrical current used by the motor can be measured with an ammeter. If the current is higher than the rated current for full load of the motor, the paddle wheel should be raised. If current use is low, the paddle wheel should be lowered. For best service life, the motor should not be loaded beyond 90 to 95% of rated current.

The cost of operating a single-phase electric paddle wheel aerator may be approximated by multiplying voltage times current (amperes) to obtain watts. Convert watts to kilowatts by dividing by 1,000 and multiply kilowatts by the cost of electricity per kilowatt hour. For example, a 5-hp single-phase electric motor will use about 28 amperes of current at 230 volts; 28 amps x 230 volts = 6,440 watts or 6.44 kilowatts. At 7.5¢ per kilowatt-hour, electrical cost will be 48¢ per hour (6.44 kilowatts x 0.075¢/kilowatt hour). In practice, the operating cost will be slightly less, because motors will have a power factor less than 1.0. For a three-phase electric motor, to obtain watts, multiply volts x amps x 1.732.

Boyd is Professor of Fisheries and Allied Aquacultures.

FIG. 1. Spiral arrangement of paddles on the hub of an electric pond aerator.



Alabama Agricultural Experiment Station

FIG. 2. A 10-horsepower electric pond aerator in operation.

GLUCOSE INJECTION IMPROVES POULT STATUS FOR SHIPMENT

E.T. MORAN

ADMINISTERING glucose to turkey poults prior to farm shipment improves the likelihood of survival by allowing young birds to better utilize yolk sac nutrients. Research at the Alabama Agricultural Experiment Station also indicates subcutaneous (SC) injection is more effective than oral dosing in providing the glucose.

Poults, like chicks, have yolk sac nutrients to provide for continued growth during their perinatal transition to feed. Although reserves are capable of sustaining poults for 5 days prior to feeding, fat is the primary energy form and adverse changes in metabolism occur without early access to small amounts of dietary carbohydrate.

Carbohydrate reserve at hatch is low because muscles used in emergence require and expend large amounts of glucose. In nature, immediate access to seed starch would satisfy the small needs to optimize yolk sac assimilation. This access is denied commercially, and the low remaining carbohydrate reserve is progressively depleted to create a ketotic condition.

Ketosis itself is not lethal, however, the ensuing listlessness reduces the initiation of feed intake after placement. "Starveouts" typically appear during the first week. Poults most likely to suffer from this condition come from small eggs in which the dynamics of heating and cooling during incubation encourages early emergence from the shell.

Sugar solutions given orally at hatch have been shown to improve overall early performance; however, this method of administration is not commercially feasible. Subcutaneous injection (SC) of antibiotic-vitamin preparations in the nape of the neck is routine because machinery exists for the rapid treatment of large numbers of birds. Having glucose dissolved in the aqueous carrier seemed to be a reasonable alternative in supplying glucose to the poult; thus, its efficacy was examined in commercially simulated conditions.

A 0.5-ml dose of 50% glucose in saline was used, and the SC method was compared to oral dosing. Based on the overall status of poults 2 hours after treatment, SC glucose was far more effective than oral dosing. Body carbohydrates, as judged by liver glycogen and plasma glucose, were improved at a time when the stresses of transportation would have been imposed.

Live weight at the time of slaughter was heavier after poults had been given SC glucose than when left untreated; however, oral glucose unexpectedly led to a weight loss, table 1. An examination of body composition indicated that both methods of glucose administration had improved the assimilation of protein and fat coming from the yolk sac, but oral dosing led to a decrease in moisture, table 2.

At this stage of development, the poult's intestinal tract is in the midst of maturing, and its condition at this time could explain the loss of body water and reduced efficacy when glucose was orally administered. Microbes which could use a portion of the glucose for themselves are just establishing a substantial population. While overall digestion-absorption of nutrients is functional at this time, full capacity in this respect is lacking because the gut wall still has a high proportion of cells retained from embryonic development. Strong glucose solutions have been shown to "pull" water through this comparatively weak wall to cause a transient diarrhea.

In summary, administering glucose to poults prior to shipment improves their utilization of yolk sac nutrients. The SC method is preferred to oral dosing because it is more effective, avoids problems in water balance, and can be readily implemented. SC glucose is expected to be particularly advantageous to poults derived from young breeder flocks where small eggs dominate and whenever long distance shipping would further delay access to feed.

Table 1. Poult Live Weight and Carbohydrate Status 2 Hours After Glucose Administration

Glucose treatment	Live wt.[1] grams[2]	Liver glycogen, total milligrams[3]	Plasma glucose, milligrams/deciliter[4]
None	51.9	0.4	201
SC	52.9	1.8	283
Oral	50.4	1.1	251

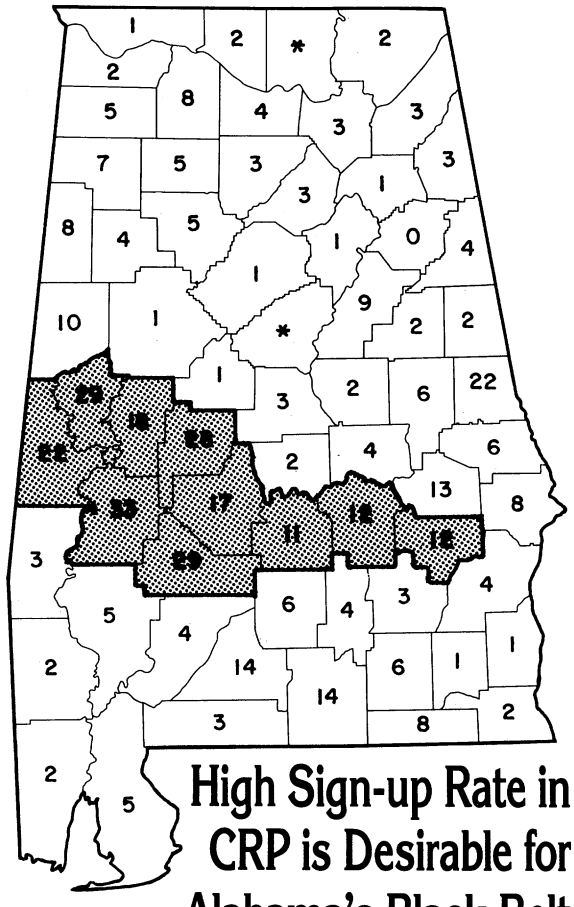
[1]Average body weight when removed from the hatcher was 52.6 g. Glucose when administered was given 6 hours later when age from shell emergence would average 36 hours.
[2]One ounce equals approximately 28 grams.
[3]One ounce equals approximately 28,000 milligrams.
[4]One quart equals 10.6 deciliters.

Table 2. Poult Body Composition 2 Hours After Glucose Administration

Glucose treatment	Total amount, grams[1]			
	Moisture	Protein	Fat	Ash
None	34.3	2.39	3.28	0.74
SC	34.9	2.48	3.56	.75
Oral	32.5	2.44	3.40	.75

[1]Exclusive of yolk sac and liver.

Moran is Professor of Poultry Science.



Numbers represent percent CRP participation in each county of Alabama (* = less than 5%). Shaded area is Black Belt.

High Sign-up Rate in CRP is Desirable for Alabama's Black Belt

N.R. MARTIN, JR., W.B. HUGHES, J.H. YEAGER and G.C. JONES

BLACK BELT AREA farmers are leading Alabama in rate of sign-up for the Conservation Reserve Program (CRP) of the 1985 Food Security Act. Four counties—Greene, Marengo, Perry, and Wilcox—have already reached the 25% sign-up ceiling for cropland in any one county. The sign-up rate is much lower outside the Black Belt, as indicated by the map.

Indications are that a 40% sign-up rate would be advantageous for the Black Belt, should the Secretary of Agriculture waive the sign-up ceiling. The ceiling can be raised in counties where exceeding the 25% ceiling will not adversely affect the local economy. CRP payments to participating land owners, expenditures to establish tree and grass cover on CRP land, periodic expenditures for maintenance of grass cover, and value of tree growth would be expected to provide more net economic benefit than currently low crop production levels on the affected acres.

Heavy CRP sign-up in the Black Belt reflects drastic changes in the agricultural economy. The decade of the 1970's saw dramatic growth in soybean acreage, with 10 Black Belt counties reaching a total of 470,000 acres (2.2 million acres statewide). Because of opportunities for double-cropping, wheat production followed a similar pattern.

Favorable soybean prices ($6-$8 per bushel) during the production build-up time had a lot to do with increasing acreages. By the end of 1986, however, prices had dropped to less than $5 per bushel. Other crop prices also were well below those 3 to 5 years earlier. With limited crop alternatives for large acreages of land, soybeans in the Black Belt led a trend towards drastically declining crop acreage. In fact, soybean production in the Black Belt dropped by 66% from the 1980 peak.

This drop in crop acreage not only created idle land, but also resulted in fewer agricultural input purchases and reduced crop sales—an overall drop in the Black Belt economy. Thus, CRP participation can make a viable economic contribution to agricultural-based local economies from land that otherwise would probably remain idle.

An Alabama Agricultural Experiment Station study evaluated potential economic impacts of CRP participation at levels above the 25% ceiling for the Black Belt. This evaluation accounted for the enrollment of both idle and productive acreages.

Benefits from CRP participation considered in the anlaysis included annual payments to land owners, expenditures to establish tree and grass cover on CRP land, periodic expenditures for maintenance of grass cover, and value of tree growth. Conversely, economic costs to an area resulting from CRP participation consist of lost crop production expenditures because of reduced plantings.

The economic analysis for the 10 Alabama Black Belt counties strongly supports a level of CRP participation up to 40% of the cropland area, instead of the present ceiling of 25%. Beyond 40%, costs increased substantially and the ratio of benefits to costs declined. Net economic benefits would accrue not only to farmers, but to agribusiness and related firms from up to 40% participation.

The increased business activity from CRP payments and expenditures would mostly benefit the 10-county area, but there would be some spill-over into other areas. A multiplier effect would generate additional income and employment. With 40% participation, for example, an estimated $300 million of economic activity would be generated and about 6,600 additional jobs would be created from the expenditures between 1985 and 1997. These estimates are based on multipliers reported in a previous study of the agricultural economy of Alabama.

Certain long-term resource benefits not evaluated in the economic analysis would result from a higher than 25% level of CRP participation. Soil erosion would be reduced substantially on land placed in the CRP, thereby reducing sediment and agricultural chemicals entering the area's streams and improving water quality. The carrying capacity of the water and land for fish and wildlife would be increased. With a substantial portion of the CRP program land going into grass, soil organic matter would be enhanced, producing a reserve fertility potential for the future. Thus, benefits would accrue not only to individual land owners but also to society in general.

While the study was specific for the Black Belt, similar results could be expected for other areas with similar land-use patterns that are experiencing significant crop acreage reductions.

Martin is Professor of Agricultural Economics and Rural Sociology; Hughes is Agricultural Economist, Soil Conservation Service; Yeager is Head of Agricultural Economics and Rural Sociology; and Jones is Agricultural Economist, Soil Conservation Service.

MULTIPLIED INCOME AND EMPLOYMENT EFFECTS OF ALTERNATIVE CRP PARTICIPATION RATES IN THE BLACK BELT, ALABAMA, 1985 TO 1997

CRP participation rate	Gross income		Employment, add. jobs created[1]
	Direct benefits	Total generated in region[1]	
	Mil.	*Mil.*	*No.*
25%	$ 82	$199	4,400
33%	105	255	5,600
40%	124	301	6,600
50%	148	360	7,900

[1]Based on multipliers from: The Structure of the Alabama Economy, Curtis, et al., 1972; An Input-Output Model of Alabama's Economy, Flick, et al., 1982; and USDA-SCS analyses.

Alabamians Favor Preserving State's Free-Flowing River Segments

J. MALONE and H.A. CLONTS

ALABAMA IS BLESSED with numerous rivers, streams, and other waterways. There are approximately 3,200 miles of rivers, plus about 11,000 miles of other major streams.

Most of the State's large-flow waterways have been impounded for navigation, electric power generation, or both. This impoundment resulted in a loss of natural river flows in those areas, but created lakes that have become popular recreational resources. However, the remaining segments of free-flowing rivers and streams scattered throughout the State are popular for alternative forms of river recreation, such as boating, whitewater canoeing, and recreational floating or fishing.

Strong appreciation for the State's remaining free-flowing streams showed up in an Alabama Agricultural Experiment Station survey that was done in the fall of 1986 to determine the extent and type of recreational use of such rivers. Results of the survey indicated that over half a million Alabamians utilize free-flowing rivers as a resource base for recreation.

Among river recreationists, the most popular rivers are Locust Fork of Black Warrior River, the Cahaba River, West Fork of the Sipsey River, the Little Cahaba River, and Little River. Popular recreational activities while visiting these rivers include fishing, hiking, picnicking, photographing and/or viewing nature, swimming, camping, canoeing, and driving for pleasure.

Attitudes toward protection of free-flowing rivers also were investigated in the telephone survey of 733 households throughout the State. River preservation values were used as an indicator of the attitudes of Alabamians toward maintaining selected free-flowing rivers in a natural state. River preservation values are defined as the expressed "willingness to pay" to prevent construction of water development projects on free-flowing rivers.

Preservation values were separated into four categories: (1) recreational use value—the amount of money each respondent would be willing to pay to visit a free-flowing river for recreation, (2) existence value—the willingness to pay to insure the rivers continue to exist as natural habitats for flora and fauna, (3) option values—the willingness to pay to insure possible recreational use of the rivers in the future, and (4) bequest value—the willingness to pay to insure the rivers remain free-flowing for future generations to enjoy.

The average total willingness to pay to maintain the study rivers in their natural condition was $56.64 per year per household. Assuming that all Alabamians have values similar to those interviewed, the statewide aggregate preservation value thus amounted to about $76 million per year, excluding any multiplier effects.

Existence value and bequest value were the two highest average values among the four categories. This indicates that although some Alabamians enjoy free-flowing river recreation, most feel river preservation is more important for protection of natural habitats along watercourses and for enjoyment by future generations. As the table indicates, both river recreationists and those who did not visit a free-flowing river expressed a willingness to pay for river preservation. Thus, there appears to be ample support for maintaining these natural streams.

River resources in Alabama are adequate to satisfy a wide variety of river uses. However, this situation can continue to exist only if there are policies that will provide a balance between river development and preservation. Alabamians included in the Experiment Station survey indicated support for preservation of some rivers in their natural, free-flowing state.

AVERAGE PRESERVATION VALUES FOR SELECTED FREE-FLOWING RIVERS REPORTED BY HOUSEHOLDS, ALABAMA, 1986-87

Type of value	Average river preservation value/household		
	River recreationist[1]	Non-recreationist[1]	All respondents
Recreational use value	$ 7.51	$ 8.45	$ 7.98
Option value	11.86	7.36	9.61
Existence value	28.64	15.90	22.27
Bequest value	22.75	11.65	17.20
Total of all values	70.17	43.12	56.64

[1]River recreationists are those who had visited a free-flowing river since 1983. Nonrecreationists were respondents who had not visited a free-flowing river during the same time.

Malone is a former Graduate Research Assistant and Clonts is Professor of Agricultural Economics and Rural Sociology.

Habitat Management Methods Identified for Gopher Tortoise Maintenance

D.W. SPEAKE and D.M. SPILLERS

THE GOPHER TORTOISE has been a part of life for generations of south Alabama farm families. Many people claim that without the nutrition from meat of this gentle creature, a large part of the south Alabama rural population might not have survived the Great Depression.

Now there is worry about survival of the gopher tortoise. Conservationists have been concerned for several years that populations of the tortoise are declining. They cite loss and alteration of sand hill habitat, the most important type for the gopher tortoise, as a major factor in this drop in population. A generally low reproductive capacity of the tortoise, which is slow to attain sexual maturity, and the wide exploitation of the animal for human food are cited as factors involved in declining populations.

Concern over the decline of the gopher in Alabama resulted in a 1981 regulation by the State Department of Conservation and Natural Resources that fully protects the gopher tortoise in the State. Another reason this protection is needed is that burrows dug by the gopher tortoise provide shelter to numerous invertebrates and more than 30 species of vertebrates. Some of these are endangered or rare species. Thus, protection of the tortoise may help preserve some scarce species.

Several states have documented declining gopher tortoise populations, but Alabama had no up-to-date data on its status and density until a recent Alabama Agricultural Experiment Station study was done. This project studied the general distribution of the gopher tortoise in southern Alabama east of the Tombigbee River, including 24 counties south of the fall line. (The three counties west of the Tombigbee River had been studied by Mississippi researchers.) One objective was to determine the current status of the tortoise in the 24-county area, including an examination of habitats as they relate to tortoise density.

Data on distribution were gathered through questionnaires, personal interviews, and field surveys. Data on status were gathered by determining tortoise density per acre through use of a burrow-viewing device on 339 sample plots in eight habitat types within regions having sandy soils greater than 3 ft. in depth. Then the acreage of each habitat type on sandy soils in the 24-county area was determined using Landsat satellite imagery. Various vegetation parameters were measured in the sample plots to compare understory, midstory, and overstory characteristics.

In counties with small relict populations, direct censusing was used. Age class structure estimates were obtained by measuring the width of occupied burrows in the sample plots and by using a formula that estimates age from shell length which is also related to burrow width.

The estimated number of tortoises in the 24-county area was 482,848. All populations sampled contained sexually mature adults and juveniles, the latter indicating recent reproduction and hence a viable population.

The highest average densities of tortoises occurred in fields that had once been farmed (termed "oldfield" habitat), 0.62 per acre. Next in order were planted pine (0.29 per acre), burned pine/scrub oak (0.26 per acre), composite field-forest edge (0.26 per acre), and pasture (0.02 per acre) habitat types, respectively. Agricultural fields, unburned pine/scrub oak, and new clearcuts had zero densities. The edges of all habitat types other than oldfields had higher densities than the interiors.

Considering the two vegetation variables that were significantly related to tortoise density (basal area and percent canopy closure) and their optimum values (approximately 5 sq. ft. per acre and 10%), it seems that gopher tortoises prefer habitats with an open overstory and a variety of understory plant species as found in oldfields but not in pastures or agricultural fields. However, human activities frequently deter tortoises from maintaining burrows in pastures and agricultural fields.

Edge habitats or ecotonal (transitional) areas appear important to tortoises. In each habitat type except oldfields, tortoises tended to cluster near the edges. Oldfields in various stages of succession approximate an ecotonal area. In general, the more edge available in a given habitat type, the higher the gopher tortoise density. Some tortoises were found in the edges of all habitat types sampled, even the ones with zero density in the interior.

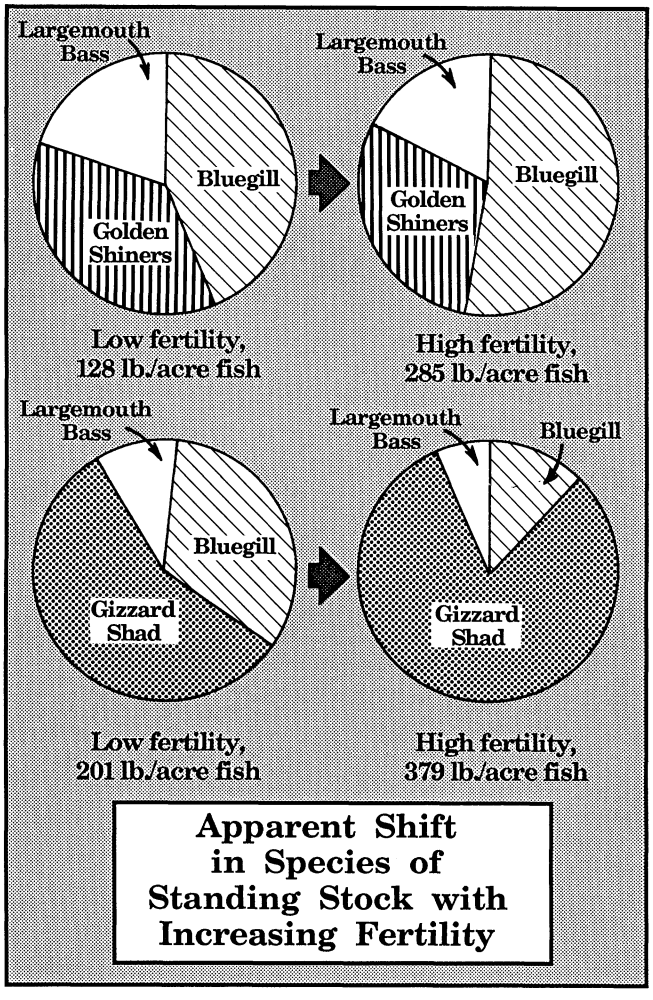
Habitat that had been burned recently had much higher tortoise density than unburned habitat. Unburned woods had a dense overstory and midstory and a very sparse understory. Burned habitat with a low basal area and low canopy closure will usually have a lush herbaceous growth and still will retain some overstory cover. Another factor that may be correlated with open overstory and tortoise density may be the amount of sunlight reaching the ground. Gopher tortoises tend to lay their eggs in areas that are exposed to sunlight. Obviously, the habitat just described has a high amount of sunlight reaching the ground.

Since the gopher tortoise is now protected in Alabama, habitat availability is the primary conservation concern. There is adequate habitat available, but correct management is needed if higher tortoise densities are desired. Controlled burning, thinning, and increasing the amount of edge available are all beneficial management techniques for tortoises as well as many other wildlife species. Low overstory density is preferred, along with a lush and diverse understory. Gopher tortoises are adaptable, however, and are found in the edges of pastures, agricultural fields, and unburned woods.

Speake is Associate Professor of Zoology and Wildlife Science and Spillers is a Technical Assistant.

Special Management Is Needed for Bass-Bluegill in Ponds with Gizzard Shad or Golden Shiners

W.D. DAVIES



GOLDEN SHINERS and gizzard shad are undesirable in ponds in which largemouth bass and bluegill are being cultured for maximum production. The golden shiner competes directly with adult bluegill for food and eats the eggs of both species. Gizzard shad compete directly with young-of-year of both species by removing many of the larger microorganisms from the water by filter-feeding. In both cases, the bluegill populations exhibit relatively slow growth, few young-of-year bass survive to age 1, and ultimately fishing is poor.

Experiments have been conducted since 1976 in 10 bass-bluegill stocked farm ponds in east-central Alabama where either golden shiners or gizzard shad were present. Results suggest the need for management strategies that shift the balance in favor of the principle species and improve fishing.

The experimental ponds ranged in size from 0.6 to 9.7 acres. Six ponds were fertilized and limed at the recommended rates for high fish production, while the others had relatively soft water and little plankton production to reduce visibility. The ponds were seined during the summer months with a standard 30-ft., 3/8-in.-mesh seine with a 6-ft. bag constructed of 1/8 in. "ace"-type mesh.

Seine results suggested that bass-bluegill stocked ponds with golden shiners receiving fertilization had more desirable fish populations than those not receiving fertilization. Of interest was the apparent competitive advantage exhibited by bluegill. On the average, bluegill reproduction throughout the summer was higher, with small bluegill available for food for young-of-year largemouth bass. Young-of-year largemouth bass appeared to be more abundant.

The situation was altered when gizzard shad were present. Under highly fertile conditions, no reproduction of bluegill was evident throughout most of the summer, and the relatively few young-of-year largemouth bass were small.

Four pond fish populations were recovered in August after renovating with a 2 p.p.m. concentration of a 5% rotenone formulation. The contributions of each species to total standing stock are illustrated in the graph. There is some indication that bluegill and bass populations are better able to compete (occupy a higher percentage of total standing stock) at higher levels of fertility when the golden shiner is the competing species, but not when gizzard shad are present. The reasons for this appear to be a function of relative growth rates, time of spawning, and feeding strategies of the competitor as influenced by the productivity of the system.

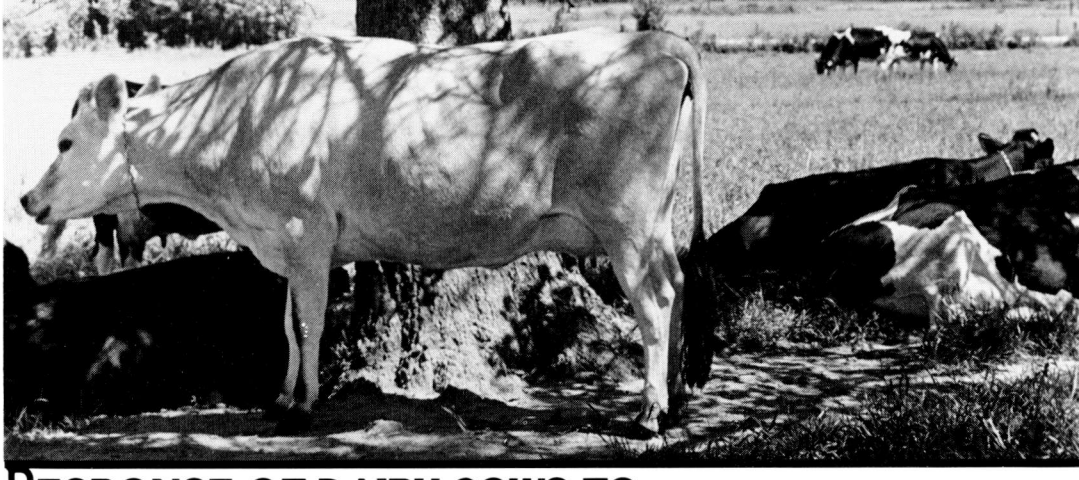
If the pond cannot be drained, or it is deemed undesirable to eliminate the fish populations and restock, two options are available to bring bass-bluegill populations into better balance when one or the other competing species is present.

If golden shiners are the competitor, feeding a commercially prepared feed to the pond's fish populations can be advantageous. Both bluegill and golden shiners will respond to feeding. Three-in. to 5-in. bluegill already in the population will reach a harvestable size of 6 in. by midsummer if fed a total of 10 lb. per acre per day.

The ideal feeding method is the use of an electronic feeder with a timer that allows food to be distributed three to five times each day. Feeding a floating pellet, commonly sold for feeding catfish fingerlings, during March-October has produced harvestable crops of bluegills where few were present before. Most bass, especially larger individuals in excellent condition (i.e., deep bodied), should not be harvested when caught, as bass production will still be less than when only bluegill and bass are present.

A different approach is necessary if gizzard shad are present since its competition cannot be overcome by feeding a pelleted ration. In this case, a better solution is to remove a portion of the shad population every second or third year by applying a 0.1 p.p.m. concentration of a 5% rotenone formulation during fall or winter. Largemouth bass and bluegill are not usually affected by that concentration. The following year all species will spawn abundantly, thus bringing the populations into better balance. As in ponds containing golden shiners, few, if any, of the larger bass should be harvested if shad persist in the system.

Davies is Professor of Fisheries and Allied Aquacultures.



RESPONSE OF DAIRY COWS TO ELEVATED ENVIRONMENTAL TEMPERATURES

K.A. CUMMINS

HEAT STRESS is the major environmental problem facing Southern dairymen. From June through September, air temperatures generally exceed the upper critical temperature of dairy cattle (approximately 78-80°F). Above this temperature, a cow cannot maintain a stable body temperature without either expending energy to cool herself (via panting or perspiration) or reducing energy intake (by reducing feed intake). Reduced feed intake generally results in less energy available for milk production.

A variety of management practices is used during hot weather to reduce the heat-load of dairy cattle. These range from use of structures and trees to provide shade that reduces radiant heat-load from the sun to providing fans, water-misters, and sprinklers to move air and cool both air and cows.

Since hot weather reduces feed intake, current recommendations are to generally increase the nutrient density of diets fed to dairy cows in hot weather while reducing fiber in the diet. However, there are at present no guidelines as to how much to increase nutrient content (protein, energy, or minerals) of feeds to compensate for reduced total feed intake since information is lacking as to how much feed intake will be depressed at a given environmental temperature.

A 2-year research project was conducted at the Alabama Agricultural Experiment Station during the summers of 1985 and 1986 to evaluate the effect of hot weather on feed intake and to develop equations to describe this relationship. This equation could then be used to predict feed intake during specific environmental conditions. Possible breed differences were investigated by using both Jersey and Holstein cows in the study.

The weather pattern for the summer of 1985 consisted of periods of 2-4 days with maximum temperatures over 90°, followed by periods of 2-4 days of lower temperatures. Maximum daily air temperature moved up and down in a relatively uniform manner. Maximum daily temperatures above 94°F resulted in decreased feed intake and milk production and increased body temperature of the cows. The table lists maximum daily temperatures at which changes in milk production and feed intake occurred.

As temperature increased, Jersey cattle reduced feed intake to reduce internal heat load sooner, and thus maintained milk production and normal body temperatures longer than Holstein cows, probably at the expense of body weight loss. All temperatures were above the upper critical temperature of 78-80°F, indicating considerable capacity of the cows and the management system used to cool and mitigate the effects of heat stress.

Feed intake was more closely related to daily maximum temperature in Jersey than Holstein cows. In this study, milk production had a low correlation to feed intake during periods of heat stress and was not included in the final form of either equation. The equations for predicting feed intake are available from the author.

During the summer of 1986, daily high temperature exceeded 96°F for virtually all of July and August, with little day-to-day variation. As a result, the relationship of feed intake and milk production to environmental temperature varied from that observed in 1985. Over the 2-month period, adaptation to heat stress occurred, probably as a result of prolonged exposure to high environmental temperatures rather than to the cyclic pattern of the previous year.

Maximum daily temperature averaged 100.1°F for the period July 1 - August 31, 1986. Feed intake, however, increased 38% in Holstein and 22% in Jersey cows over the same period. Milk production decreased in both breeds at the same rate in a manner consistent with increasing days in milk. Holsteins appeared to adapt more readily in terms of feed intake to prolonged high temperatures than Jerseys.

Management practices that reduced heat stress, such as providing shade and ventilation, can significantly alter the effect of elevated environmental temperature, thereby increasing the environmental temperature beyond which feed intake and milk production decrease. Holstein and Jersey cattle appear to respond differently to periods of heat stress. Jersey cattle decrease feed intake to decrease internal heat load at lower temperatures than Holstein cattle and adapt feed intake during prolonged heat stress to a lesser degree.

Maximum daily temperature was more closely related to feed intake in Jersey than Holstein cattle. However, Jersey cattle maintained milk production better under higher environmental temperatures than Holstein cattle, but probably lost body weight to supply energy not available due to reduced feed intake. Both breeds of cattle can adapt to prolonged high environmental temperatures, and the relationship of feed intake, milk production, and environmental temperature will change over prolonged periods of hot weather.

MAXIMUM DAILY AIR TEMPERATURE AT WHICH MILK PRODUCTION AND FEED INTAKE DECREASE AND RECTAL TEMPERATURE INCREASES, BY BREED[1]

Measure	Holstein	Jersey
	Degrees	*Degrees*
Milk production	99.9	101.8
Feed intake	97.6	93.9
Rectal temperature	99.9	101.8

[1]Jersey cattle decrease feed intake at lower temperatures in order to decrease heat load. This allows them to maintain normal rectal temperature and milk production to higher environmental temperatures, probably at the expense of body weight loss.

Cummins is Associate Professor of Animal and Dairy Sciences.

Farm Models Aid in Decision Making

E.F. KOLAJO and N.R. MARTIN, JR.

THE RECENT financial stress of many farmers in the United States has brought about the need for greater use of farm growth models to evaluate resource allocation from a long-range perspective. The Multi-Period Linear Programming Model (MPLP) is the most commonly used, but an alternative approach to the model, Recursive Strategic Linear Programming (RSLP), was recently developed at the Alabama Agricultural Experiment Station. Outcomes from the two models were compared in tracking the 8-year growth of a north Alabama farming operation.

The MPLP model is free from risk of bankruptcy, managerial errors in judgement, and production shocks such as pests, weather, and diseases. While many advances have been made in the MPLP model to allow its practical use in farm planning, it still fails to take into account feedback resulting when what actually happens on the farm deviates from what the model expects to happen.

The RSLP model includes farm production, consumption, investment, and financing decisions in an analytical framework involving time, risk, and uncertainty. Both the MPLP and RSLP models were applied over an 8-year period to a row crop farming operation in north Alabama. Using three debt-to-asset ratios, the growth of the farm was followed using each model.

The objective function of both models was to maximize cumulative expected net worth of the farm at the end of an 8-year planning period subject to price, yield, and financial constraints. Gross returns from prices and yields obtained were assumed to follow expectations derived by synthesizing the USDA's information of aggregate production and by using the supply and demand approach to commodity price forecasting. The three debt-to-asset ratios evaluated were 25, 40, and 70%, which represent alternative farm firm responses to financial risk.

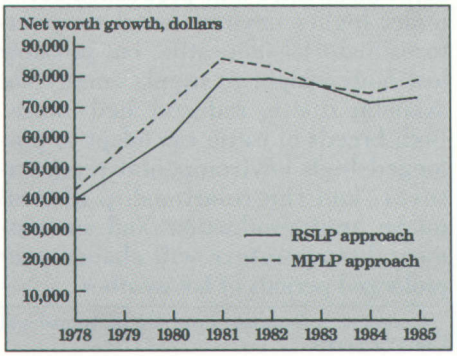
The graph illustrates sample results describing the growth of net worth of the farm from 1978 to 1985 under the assumptions of a medium leverage condition, such as a debt-to-asset ratio of 40%. Throughout the study period, the growth rate described by the MPLP model was faster than the RSLP model.

Beginning from a total asset value of $402,951 in 1978, results of the RSLP model in the above situations indicated an ending net worth of $721,155, while the MPLP model indicated $777,116. Evaluating growth in terms of physical measures, such as acres, the farm grew from 600 acres in 1978 to 876 acres under the RSLP model and 968 acres in 1985 under the MPLP model. The operational routine of the MPLP model does not reflect in its results how the main sources of farm problems, such as outstanding debts and interest payments, could hinder growth.

The economically realistic possibility of farm growth was biased upward by the 'no risk' farm plans described by the MPLP model. Increasing debt-to-asset ratios under all situations indicated a positive relationship between farm growth and net worth. However, high debt-to-asset situations led to serious inability to meet cash flow needs as they came due. This is particularly true because a greater proportion of farm assets is held in the form of non-liquid assets, such as land and machinery, which cannot quickly be sold in order to meet cash flow requirements.

The fact that expected income may deviate from realized income indicates that a cost is associated with an incorrect decision. The modeling approach developed in this study addresses risk management research which should provide a useful guide for Alabama agriculture in particular and for United States agriculture in general.

Kolajo is Research Associate and Martin is Professor of Agricultural Economics and Rural Sociology.



CHARACTERISTICS OF FARM STRUCTURAL ADJUSTMENTS DESCRIBED BY ALTERNATIVE MODELING APPROACHES GIVEN A MEDIUM LEVERAGE CONDITION (I.E., DEBT/ASSET = 40%), COLBERT COUNTY FARM, 1978 AND 1985

Item	Beginning of 1978	End of 1978		End of 1985	
		MPLP approach	RSLP approach	MPLP approach	RSLP approach
Land use in acres	600	876	786	968	876
Machinery asset value in dollars	86,751	78,076	125,866	246,356	194,197
Total land value in dollars	316,200	461,652	414,222	744,392	680,565
Outstanding debts in dollars	—	161,180	176,826	374,887	289,254
Interest paid on debt in dollars	—	15,503	17,561	47,277	31,276
Net worth in dollars	402,951	431,706	309,440	777,116	721,155

TILLAGE IMPROVES DOUBLE-CROPPED RYE

J.T. TOUCHTON, J.R. AKRIDGE, and H.W. IVEY

THROUGHOUT the Southeast, double-cropping rye for winter grazing with summer annuals such as cotton, corn, soybeans, and grain sorghum is a common practice. Since early planting of rye is critical for adequate fall and winter grazing, using disking-only land preparation after harvesting the summer crop also is a fairly common practice. In some areas, winter grazing crops are no-till planted into summer crop stubble with no-tillage grain drills or by seeding with aircraft.

During the past 6 years, data from studies conducted by the Alabama Agricultural Experiment Station at seven locations in the State indicate that some form of deep tillage is necessary for wheat grain production. In the fall of 1986, the winter crop was changed from wheat to rye at the Wiregrass Substation in Headland and at the Brewton and Monroeville Experiment Fields to determine if deep tillage also was needed for rye. Soils on the experimental sites were Dothan fine sandy loam at Headland, Benndale coarse sandy loam at Brewton, and Lucedale fine sandy loam at Monroeville.

The tillage treatments, originally established for wheat in the fall of 1980, consisted of no tillage, disk only, chisel plow, and turn plow prior to planting wheat. Each main plot was divided into two subplots for the summer crops. One subplot was planted without in-row subsoiling and the other was planted with in-row subsoiling. In 1984, subsoiling with shanks spaced at 24 to 36 in. prior to planting wheat was added as an additional main plot. Rye was drilled in the fall of 1986 after harvesting grain sorghum. Seeding rate was 90 lb. per acre, and it was cut for forage yields in early March. Oven-dry weights are listed in the table.

Rye forage yields followed the same trends as wheat grain yields in that no-tillage resulted in the lowest yields. Disking-only improved yields over no-tillage, but resulted in lower yields than deep tillage, and no one form of deep tillage was generally superior to another. In-row subsoiling prior to planting the summer crop improved yields at Brewton (1,320 and 940 lb. per acre with and without in-row subsoiling, respectively), but not at the other locations. Although in-row subsoiling for the summer crop improved yields at Brewton, the improvements primarily occurred within the no-tillage and disk-tillage systems, and it would not substitute for deep tillage prior to planting rye.

Although strict no-tillage did not result in acceptable yields, high yields can be maintained with conservation tillage. On most fields in Alabama, the chisel plow should be an adequate conservation-tillage practice for rye production provided a drag bar rather than multiple disking operations is used to level the soil. Subsoiling, (36-in. shank spacing) is certainly an acceptable practice and may even be a better conservation-tillage system than strict no-tillage.

The results from the first year of this test strongly indicate that no-tillage is not an acceptable production practice for rye on Sandy Coastal Plain soils, especially when the cost of a no-till grain drill is figured into production costs. When purchase price of equipment and cost of tillage operations are considered, the most economical system appears to be chisel plowing.

Touchton is Professor of Agronomy and Soils, Akridge is Superintendent of Brewton and Monroeville Experiment Fields, and Ivey is Superintendent of Wiregrass Substation.

OVEN-DRY RYE FORAGE YIELDS AS AFFECTED BY TILLAGE PRIOR TO PLANTING RYE AND IN-ROW SUBSOILING PRIOR TO PLANTING THE PREVIOUS SUMMER SORGHUM CROP AT THREE LOCATIONS IN THE COASTAL PLAINS OF ALABAMA

Tillage at rye planting	Subsoiling for summer crop	Yield per acre at each location		
		Headland	Brewton	Monroeville
		Lb.	*Lb.*	*Lb.*
No-till	yes	3,870	1,170	1,730
	no	—[1]	530	1,790
Disk	yes	4,960	1,220	2,520
	no	—	660	2,690
Chisel	yes	5,690	1,400	2,680
	no	—	1,400	3,140
Turn	yes	5,320	1,370	2,940
	no	—	860	2,890
Subsoil	yes	5,320	1,450	2,700
	no	—	1,240	2,780

[1]The in-row subsoiled and nonsubsoiled plots were not harvested separately at Headland.

Conservation Tillage Changes Quantity and Quality of Surface Runoff

K.H. YOO, J.T. TOUCHTON, and R.H. WALKER

CONSERVATION TILLAGE is the "in thing" as farmers seek farming methods that control erosion while maintaining crop yield. It is estimated that over 90% of U.S. farmland will be under conservation tillage by the end of this century. For this to succeed, however, there is a need for information about how such non-inversion tillage systems influence the quantity and quality of surface and subsurface runoffs from fields.

A soil erosion study site at the Alabama Agricultural Experiment Station's Tennessee Valley Substation is being used to evaluate and compare three tillage systems for cotton production. Surface runoff, soil erosion, and plant nutrient and pesticide losses under natural rainfall conditions in the Tennessee Valley region are being determined under tillage systems described as follows:

Tillage systems	*Fall tillage*	*Spring tillage*	*Summer tillage*
No-tillage without cover crop (NT)	none/crop stubble	none/ plant 4-22-85	none
Reduced-tillage with wheat cover crop (RTC)	disk, chisel plow/plant wheat 11-7-84	none/ plant 4-22-85	none
Conventional tillage (CT)	disk, chisel plow/fallow 11-7-84	disk/ plant 4-22-85	3 cultivations 5-21-85, 5-31-85, 6-21-85

There were 15 rains during the 1985 growing season (April 22-November 7) which generated measurable surface runoff. The growing season was divided into two periods for data analysis, before and after the last cultivation of the CT system (June 21 or 2 months after planting). As shown by data in the table, there were variations among the tillage systems in surface runoff, soil erosion, and plant nutrient losses. During the early part of the growing season, total surface runoff was about equal from the NT system and the CT system; however, soil loss from the CT system was twice that of the NT system. The early growing period is often called a "critical period" in terms of soil erosion when the crop has not yet developed full canopy.

After the critical period, the soil loss was low from all treatments, with the lowest from the RTC system. More than 85% of the total soil losses from all treatments occurred during the 2-month critical period. However, there was more rainfall but less surface runoff during the later, noncritical growing period than during the critical period. Sediment concentration during the noncritical period remained relatively low for all treatments even during high runoff events.

Heavy crop coverage during the noncritical period plays a major role in preventing soil erosion by reducing the erosive forces of raindrop impact on the soil surface. The RTC system had the lowest level of surface runoff and soil loss throughout the growing season. This may have been the result of a combination of the enhanced infiltration and the protection of the soil surface by the wheat stubble against raindrop impact. The summer cultivation in the CT system helped reduce surface runoff during the summer months without increasing soil erosion.

The overall mean concentration of nitrate nitrogen (NO_3-N) in the runoff water from all three tillage systems was well within the 10 p.p.m. upper limit recommended for drinking water. However, the concentrations of ammonium nitrogen (NH_4-N) averaged well above the 0.5 p.p.m. standard for public water supplies. There were several runoff occurrences where the NH_4-N concentrations even exceeded the 2 p.p.m. level considered to be toxic to fish.

The percentage of the applied pesticides—pendimethalin (Prowl®) and aldicarb (Temik®)—that left the field was lower than 0.5% from all tillage systems. The first runoff after the application of pesticide carried the highest concentration, and the concentration level rapidly decreased thereafter. The pendimethalin was detected throughout most of the growing season.

The CT system gave the highest loss of the plant nutrients and pesticides, whereas the RTC system gave the lowest.

An important concern about conservation tillage is its effects on crop yield. Seed cotton yields from all three tillage systems were comparable for the 1985 season: 3,225 lb. per acre from the NT system, 2,920 lb. from the RTC system, and 2,775 lb. per acre from the CT system.

RUNOFF AND POLLUTANT LOSSES IN RUNOFF-GENERATING STORM EVENTS DURING 1985 GROWING SEASON OF COTTON

Tillage systems	Runoff		Runoff losses/acre				
	Inches	Pct. of rain	Soil	NH_4-N	NO_3-N	N[1]	P[2]
			Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Critical period (8.89 in. rain)							
NT	1.90	21.4	842	0.31	0.92	2.00	0.25
RTC	.81	9.1	203	.16	.42	.56	.14
CT	2.18	24.5	1,877	.38	2.83	2.51	.47
Noncritical period (12.6 in. rain)							
NT	1.68	13.3	110	.22	.25	.63	.13
RTC	.55	4.4	28	.10	.08	.22	.04
CT	1.26	10.0	120	.58	.24	1.02	.10
Total (21.5 in. rain)							
NT	3.58	16.6	952	.54	1.12	2.63	.38
RTC	1.36	6.3	232	.26	.50	.73	.19
CT	3.44	16.0	1,997	.96	3.07	3.53	.57

[1]Total Kjeldahl nitrogen.
[2]Total phosphorus in water and sediment.

Yoo is Assistant Professor of Agricultural Engineering and Touchton and Walker are Professor and Associate Professor of Agronomy and Soils, respectively.

Evaluation of Preemergence-Applied Herbicides for Control of Southern Yellow Wood Sorrel in a Pine Bark Medium

D.L. BERCHIELLI-ROBERTSON, C.H. GILLIAM, and D.C. FARE

SOUTHERN yellow wood sorrel is a double-trouble weed for many landscape plant growers to control because it spreads by rooting at the nodes and via seeds from the parent plant. Hand weeding is expensive and rarely removes all vegetative parts of the weed. Ronstar® has been the herbicide of choice to fight Southern yellow wood sorrel, but inconsistent control has been reported. Recent tests at the Alabama Agricultural Experiment Station evaluated several preemergence-applied herbicides for control of this weed pest in container grown ornamentals.

In one test, Surflan®, OH-2®, Ronstar, Goal®, and Rout® (a combination of Surflan and Goal in a granular formulation) were applied in late October to 3½-in. square plastic nursery containers with a pine bark-sand medium. Herbicides were applied at ½, 1, and 2 times the labeled rates. Weed seeds (25 per pot) were sown one week after herbicide application and the pots were watered as needed. Southern yellow wood sorrel seed were counted 4 and 8 weeks after herbicide application and dry weed weights were taken at 8 weeks.

Rout, OH-2, Surflan, and Goal provided excellent control regardless of rates, as indicated by data in the table. Goal, Surflan, and Rout averaged less than one weed per pot after 8 weeks and at the highest rate there were no weeds in pots treated with these materials. Ronstar, on the other hand, showed poor control at both 4 and 8 weeks with the low rate. Though control increased with Ronstar as rates increased, it was not as good as Rout, Surflan, or Goal and only comparable to OH-2 at the 4-lb.-per-acre rate.

The second test was similar to the first one, but herbicides were applied in late February, fewer weed seeds were sown, and they were sown 7 weeks after herbicide application. Southern yellow wood sorrel plants were counted 12 and 18 weeks after herbicide application to determine residual activity.

Surflan, Goal, and Rout at the highest rates provided residual control of Southern yellow wood sorrel beyond 12 weeks. When applied at recommended rates, only Surflan (4 lb. active ingredient per acre) left less than one plant per pot 18 weeks after herbicide application. Rout was the only other herbicide used at recommended rates that provided limited residual activity.

Test results indicate that Surflan, Goal, and Rout provide superior Southern yellow wood sorrel control. Ronstar, the standard treatment, was not effective at low or recommended rates and lost control earlier than the other materials.

Berchielli-Robertson is Graduate Assistant, Gilliam is Associate Professor, and Fare is Research Associate of Horticulture.

EFFECT OF PREEMERGENCE HERBICIDES ON SOUTHERN YELLOW WOOD SORREL

Herbicide	Rate/ acre	Experiment 1			Experiment 2		
		Weeds per pot		Weed dry weight/pot	Weeds per pot		Weed dry weight/pot
		4 weeks	8 weeks		12 weeks	18 weeks	
	Lb.	*No.*	*No.*	*Grams*[1]	*No.*	*No.*	*Grams*
Rout	1.5	0.1	0.1	0.0	5.5	4.3	1.6
Rout	3.0	.3	.3	.0	4.7	3.6	1.4
Rout	6.0	.1	.0	.0	.1	.1	.1
OH-2	2.0	1.4	1.6	.2	3.8	3.3	1.5
OH-2	4.0	1.4	1.4	.2	3.3	3.1	1.1
OH-2	8.0	.3	.0	.0	1.6	1.4	.6
Ronstar	2.0	7.3	6.6	.9	3.6	2.9	1.1
Ronstar	4.0	.9	1.0	.2	5.7	4.9	1.8
Ronstar	8.0	.6	1.6	.0	4.5	3.9	1.5
Surflan	2.0	.8	.4	.0	2.4	1.4	.5
Surflan	4.0	.3	.0	.0	.8	.1	.0
Surflan	8.0	.1	.0	.2	.0	.0	.0
Goal	1.0	.5	.6	.0	4.4	3.3	1.0
Goal	2.0	1.0	.0	.0	1.3	1.3	.9
Goal	4.0	.0	.0	.0	.9	.6	.2
Control	—	25.0	25.0	1.9	9.3	9.4	2.6

[1]One ounce equals approximately 28 grams.

Baits Prove Worth Against German Cockroaches

A.G. APPEL

GERMAN COCKROACHES are the most common household pest in Alabama, costing Alabama consumers over $15 million each year. They also infest restaurant kitchens, hospitals, and high-density housing. In short, cockroaches occur wherever people and food are together. Not only do they contaminate food with their excrement, but many people are allergic to spines and other body parts of cockroaches.

Due to the expense of professional pest control services, many consumers prefer to treat cockroach infestations themselves. The recent successful introduction of the Combat® Roach Control System bait has stimulated the production of competitive bait formulations for the consumer market.

For baits to be effective in German cockroach control they must be placed near cockroach infestations, be nonrepellent and readily consumable, and be relatively slow acting. As of February 1987, there were only three brands of cockroach bait formulations contained in child proof or resistant containers available to Alabama consumers. Thus, the Alabama Agricultural Experiment Station began studies in March 1987 to compare the effectiveness of these three products in reducing German cockroach infestations.

The first step in the test, conducted in a 100-unit housing facility, was to determine populations of German cockroaches. All units were sampled for cockroaches with two 1-qt. mason jars baited with white bread. The inside upper 2 in. of the jars were coated with a thin film of petroleum jelly to keep the cockroaches in the traps. One trap was placed under the kitchen sink and the other behind the stove. Traps were left in place for one week then collected, returned to Auburn, and the cockroaches counted.

After the population counts were made, treatments (listed in the table) were assigned to the apartments and baits were placed in kitchens and bathrooms. In the kitchen, two baits were placed under the sink, behind the stove, behind the refrigerator, and in upper and lower cabinets; one bait was placed in the utility closet and another behind the toilet in the largest bathroom. All units were trapped 2, 4, 8, and 12 weeks following bait placement, with traps placed in the same locations as the pretreatment traps.

A 50% reduction in population is considered the minimum acceptable level of German cockroach control. Two weeks after treatment with Combat, cockroach populations had dropped more than 50%, and there were further reductions at 4 and 8 weeks. There were no further reductions, but there was no increase in numbers within 12 weeks.

In the case of Raid®, there was a better than 50% reduction at 4 weeks after treatment. As shown by data in the table, however, the effectiveness of Raid began waning by 8 weeks and the number of cockroaches at 12 weeks was greater than the pretreatment trap number. The Holiday® bait showed virtually no control.

At 12 weeks, German cockroach populations increased dramatically in the untreated apartments and the apartments treated with Holiday and Raid baits. Only Combat showed continued effectiveness at this time.

Both Holiday and Raid baits contain 0.5% Dursban® (chlorpyrifos), a somewhat repellent insecticide. Combat, however, contains 1.65% hydramethylnon (the same active ingredient as Amdro® fire ant bait), obviously a nonrepellent insecticide.

These results clearly show that the Combat bait formulation reduces German cockroach populations quicker, longer, and to lower levels than the other bait products currently available to consumers.

Appel is Assistant Professor of Entomology.

EFFECT OF CONSUMER COCKROACH BAIT FORMULATIONS AGAINST GERMAN COCKROACHES IN HIGH-DENSITY HOUSING

Treatment	Cockroaches before treatment, average	Cockroaches trapped after treatment, average			
		2 weeks	4 weeks	8 weeks	12 weeks
	No.	*No.*	*No.*	*No.*	*No.*
Untreated	47	52	61	33	149
Combat	50	22	15	8	8
Raid	47	36	22	27	68
Holiday	45	46	43	40	60

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