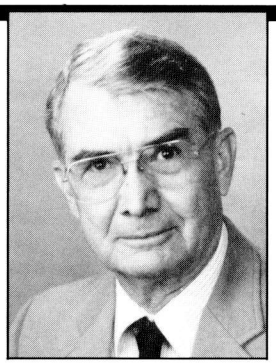
HIGHLIGHTS
of Agricultural Research

Vol. 35, No. 1
Alabama Agricultural Experiment Station
Lowell T. Frobish, Director

Spring 1988
Auburn University
Auburn University, Alabama

A Word With The Editor



R.E. STEVENSON

TODAY'S SUCCESS-ORIENTED farmer or other businessman likes to cut through detailed analyses and get to what is commonly known as the "bottom line." After all, that bottom line is the final measure of success, representing the profit made in a business or farming venture or the return from an investment.

This same bottom-line accounting system is appropriate for evaluating research programs at state agricultural experiment stations. Large sums are spent on U.S. agricultural research, so it is important to know what Americans are getting in return.

We're regularly told that money spent on agricultural research is an investment that pays big dividends, but it has been difficult to document this payoff. Now there is reliable information from research to accurately measure the rate of return. These national studies computed dollar returns from research in regard to the national economy, the efficiency of agricultural enterprises, and advantages to consumers. In every case, returns far exceed what might be expected from investments in other areas of the U.S. economy.

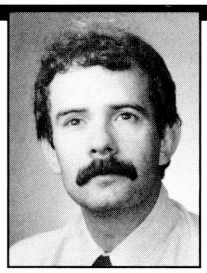
Such research advances as superior crops, farm mechanization, genetic and nutritional break-throughs in meat animals, and effective insect and disease control systems are universally recognized. But these are just the tip of the iceberg. A summary of 21 studies dealing with different crop and livestock enterprises indicates returns of 30-100 percent annually from long-term research. Technology-oriented research in the South from the mid-1940's until the 1970's was reported to return at the rate of 130 percent annually.

The secondary or multiplier effect on income and employment has received less attention, but a Virginia study showed that adding $1 million for public agricultural research adds about $9 million to agricultural output. Furthermore, this $1 million investment adds almost $11 million to the gross state product and more than 300 man-years of employment. Based on this same multiplier effect, Alabama's $26 million expenditure on agricultural research adds: (1) $234 million to the State's agricultural output; (2) $286 million to the gross state product; and (3) 7,800 man-years of employment.

Other data established the payoff to the consuming public. Taxes paid per family to support U.S. agricultural research were reported to average $14.38 per year. For each $1.00, there was an average return of $2.68. Low-income families received the greatest return, $11.60 for each $1.00 they paid in taxes to support research.

Future payoffs should be even greater as research utilizes genetic engineering and other high-tech research methods. The bottom line should be high quality agricultural products at even lower consumer costs, along with a clean environment to be enjoyed by all.

MAY WE INTRODUCE



Dr. Graeme Lockaby, Associate Professor of Forestry. A native of Seneca, South Carolina, Lockaby came to Auburn in 1986 from Louisiana Tech University, where he held a teaching and research appointment in forestry.

Lockaby earned his B.S. and M.S. degrees in forestry from Clemson University and his Ph.D. in agronomy from Mississippi State University. While at Clemson, he served as a graduate research assistant in forestry and held a similar position in agronomy at Mississippi State.

One of his first assignments at Auburn was to help initiate an air pollution study to determine the effects of acid rain and other contaminants on the growth rate of pine trees. He is also studying the relationship of genetics and nutrition in pine trees and is working on a joint project with researchers in wildlife to study forest practices that could improve wildlife habitat and increase forest land hunting lease values in Alabama. Some of Lockaby's work on the factors influencing pine productivity is reported on page 3 of this issue of *Highlights.*

ON THE COVER. Broadleaf weed control in strawberries, like these at the Chilton Area Horticulture Substation, is a major problem for Alabama growers, because of a lack of herbicides registered for use on berries. See related story on page 4.

SPRING 1988 VOL. 35, No. 1

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

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Geographic Patterns of Loblolly Pine Site Productivity in Alabama

B.G. Lockaby and J.P. Caulfield

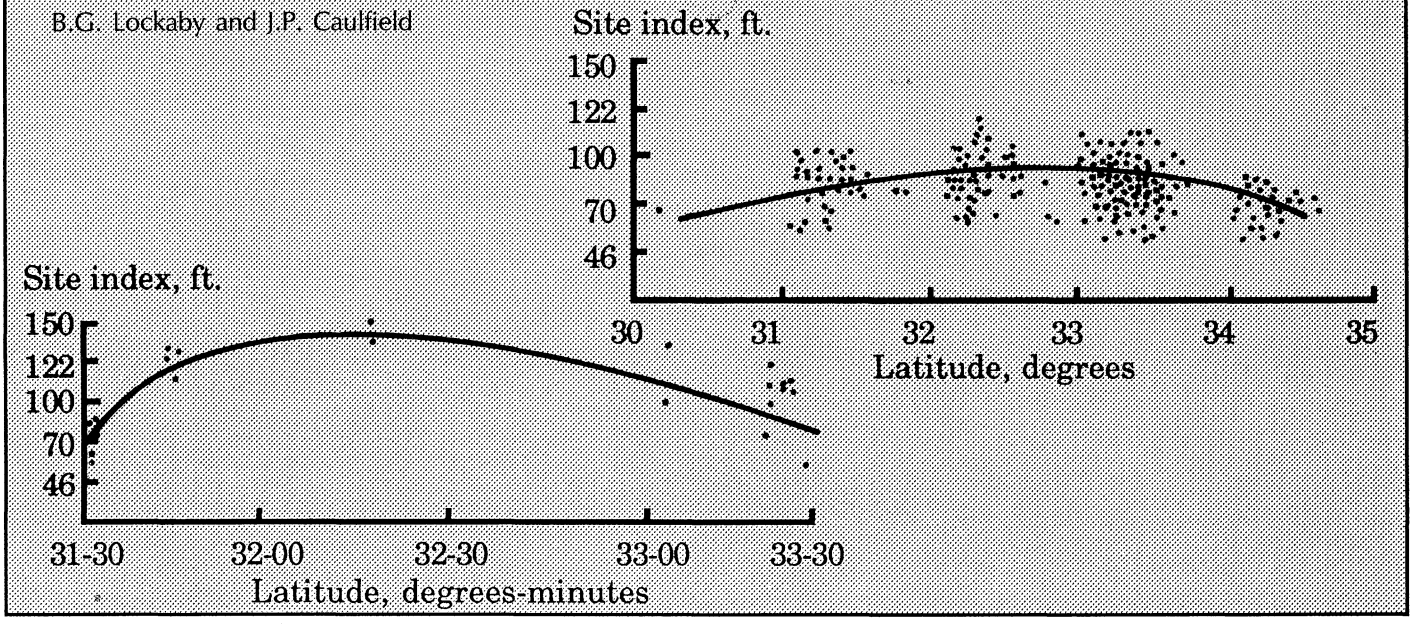


FIG. 1 (left). Relationship between loblolly pine site index and latitutde.
FIG. 2 (right). Relationship between loblolly pine site index and latitude for Typic Hapludults with siliceous mineralogy.

VARIATION in forest productivity occurs with large changes in latitude and longitude. Much of this variation may be attributed to climatic patterns, particularly those associated with precipitation, temperature, and growing season length. Although considerable variation occurs, world forest productivity generally increases from north to south (as latitude decreases). The same generalization has been made for the United States and appears to be true for pines in the Eastern United States.

While knowledge of world patterns of potential productivity has considerable value, an understanding of productivity patterns for single species is also important to understand ecological processes and how they affect growth and to provide new management considerations. However, the first step is to identify any productivity patterns, which was the objective of a recent Alabama Agricultural Experiment Station study on loblolly pines in the State.

Site index at 50 years (the height specified trees are expected to grow in a set number of years), based on field measurements by the USDA Soil Conservation Service, was used as the indicator for site productivity. Field data obtained from the Soil Conservation Service consisted of 461 site index estimates for naturally reproduced loblolly pine stands distributed across Alabama. These field estimates are based on height and age measurements from 5-10 codominant loblolly pines per plot and were taken in conjunction with soil series identification and descriptions on the same plots. Approximate plot locations, in terms of latitude and longitude, were also obtained.

A comparison across all soils of site indices versus latitude revealed the presence of considerable variation. However, site index values tended to increase as latitude decreased until an inflection point was reached just north of 32° latitude. Site indices then decreased south of this point, as the Gulf Coast was approached, figure 1. The range of site index values associated with this pattern was approximately 60-105 ft. No relationship was apparent for site index versus longitude.

In an effort to reduce the soil variation associated with the observed pattern, data associated with Typic Hapludult soils were separated and compared with latitude. Typic Hapludults were chosen because a much larger subset was associated with this subgroup designation than any other. This subgroup accounts for numerous soils in the Appalachian Plateau, Piedmont Plateau, Coastal Plains, and Flood Plains and Terraces areas of Alabama. Included are the series Albertville, Appling, Cahaba, Cecil, Cheaha, Enders, Grover, Hartsells, Linker, Luverne, Madison, McQueen, Tatum, and Townley.

Figure 2 reveals the relationship between site index and latitude for Typic Hapludults with siliceous mineralogy. A similar pattern to that described in figure 1 is seen as site indices increase with decreasing latitude until maximized just north of 32° latitude and decrease thereafter. However, no pattern was apparent for site index versus longitude for any Typic Hapludult subset.

The identification of this gradient will help define interactions of growth factors that control loblolly pine productivity. Several implications for management also are generated by the existence of this gradient. Spatial patterns in the natural productivity of the species may indicate the need for adjustments of silvicultural prescriptions to fit the gradient. Similarly, the element of risk in forestry investments may be shown to be influenced by the pattern.

Lockaby is Associate Professor and Caulfield is Assistant Professor of Forestry.

Cobra, Reflex, or Blazer Effective Against Broadleaf Weeds in Strawberries

A.W. Caylor, W.A. Dozier, Jr., G.R. Wehtje, and J.A. Pitts

A LACK OF registered broadleaf herbicide compounds for strawberries makes broadleaf weed control a difficult problem for strawberry producers. Most of the herbicides now available for use in strawberry production are restricted in use and in effectiveness. For example, Tenoran®, the most commonly used herbicide for broadleaf weed control in the Southeast, generally exhibits poor control when used alone. Other herbicides, such as Sinbar®, Princep®, 2, 4-DB, and Paraquat®, are limited by such factors as soil composition, plant maturity, and growing seasons.

Research at the Alabama Agricultural Experiment Station may help expand herbicide choices for strawberry producers. At the Chilton Area Horticulture Substation, various herbicides were evaluated using them with and without Tenoran. All herbicide treatments contained a non-ionic surfactant at the rate of 1% by volume. Herbicide treatments were evaluated for their effect on percent broadleaf weed and grass control, percent strawberry foliar injury, runner mortality, and yield.

Dormant Delite strawberry plants were placed in a Ruston fine sandy loam during the fall of 1985. Plants were spaced 12 in. apart in 42-in. rows and allowed to form a matted row. Plantings were drip irrigated using biwall tubing. Recommended cultural practices for fertility and insect and disease control were followed.

Natural weeds present in the plots included common purslane, Florida pusley, carpet weed, spiny pigweed, large crabgrass, and goosegrass. All plots were overseeded with sicklepod, coffee senna, morningglory species, and prickly sida following renovation of the planting in June.

Tenoran was applied pre-emergence following renovation. Diphenyl ether herbicides (Blazer®, Cobra®, and Reflex®) and 2, 4-DB were applied when 70% to 80% of the broadleaf weeds were in the dicotyledon to three-leaf stages. Weed-free plots were hand-weeded as needed to control broadleaf weeds and grasses.

As shown in the table, all diphenyl ether herbicide treatments resulted in excellent control of broadleaf weeds, considerably better than 2,4-DB treatments. The addition of Tenoran to the postemergence herbicide treatments increased broadleaf weed control.

The only weed not effectively controlled by treatments was sicklepod. The first flush of sicklepod germination was killed by the diphenyl ether and 2,4-DB treatments. However, second and third flushes of sicklepod germination were not controlled by any of the herbicide treatments, even with the addition of Tenoran.

Blazer, Cobra, and Reflex treatments resulted in good control of some annual grasses in strawberries. Crabgrass and goosegrass in the seedling stage were killed by these treatments. Mature crabgrass and goosegrass were stunted by the three herbicides, but the grasses outgrew this damage in 2 to 3 weeks. The treatments were able to control annual grasses for up to 6 weeks, and their use in conjunction with Tenoran increased annual grass control.

Plants treated with Blazer, Cobra, and Reflex experienced some slight foliar toxicity to the foliage present at the time of application. This injury was characterized by chlorosis and necrotic spotting on the foliage; however, plants outgrew it within 3 weeks.

All diphenyl ether treatments caused injury to runners present when applications were made. Cobra and Reflex caused the highest levels (20% to 25%) of runner mortality. Blazer resulted in the lowest rate (15%). These injuries also were characterized by chlorosis and necrotic spotting. Immature runners were killed by the treatments but mature runners outgrew the damage in about 3 weeks. Plants treated with the diphenyl ether herbicides alone developed the highest number of runners, while plants treated with Cobra and Reflex combined with Tenoran developed the fewest runners.

Strawberry yields were not adversely affected by the diphenyl ether or 2,4-DB treatments when compared to yields from the hand-weeded and Tenoran-only plots. Highest yields and best weed control were achieved when Tenoran was applied in conjunction with the diphenyl ether or 2-4-DB herbicides.

Caylor is a Research Specialist and Dozier is Professor of Horticulture, Wehtje is Associate Professor of Agronomy and Soils, and Pitts is Superintendent of the Chilton Area Horticulture Substation.

EFFECT OF POSTEMERGENCE HERBICIDES* ON BROADLEAF WEED CONTROL, RUNNER DEVELOPMENT, AND YIELD OF DELITE STRAWBERRIES

Treatment, lb./acre	Broadleaf weed control	Runners/ sq. yd.	Yield/ acre
	Pct.	*No.*	*Qt.*
Tenoran, 4.0	62	47	24,903
Blazer, 0.5	89	47	32,509
Cobra, 0.25	89	40	27,816
Reflex, 0.25	91	47	23,415
2,4-DB, 0.25	82	46	28,862
Tenoran & Blazer, 4+0.5	96	48	27,978
Tenoran & Cobra, 4+0.25	93	36	32,015
Tenoran & Reflex, 4+0.25	94	29	31,167
Tenoran & 2,4-DB, 4+0.25	86	53	27,472
Control/hand-weeded	100	54	29,774

*Blazer, Cobra, and Reflex are not registered for use on strawberries.

Peanut Weed Control After Dinoseb

G.R. Wehtje and J.W. Wilcut

SINCE REGISTRATION of dinoseb-containing herbicides for use on peanuts was cancelled by the U.S. Environmental Protection Agency in October 1986, the Alabama Agricultural Experiment Station has accelerated testing of several herbicide alternatives. While no herbicide offers activity identical to dinoseb, some of the replacements proved to be superior in some respects.

Though Gramoxone® has received the most interest as a dinoseb replacement, it was not included in this research. This study was intended to focus on herbicides that have received less attention.

Sicklepod control with treatments 1 and 2, see table, was variable and did not exceed 68% with any treatment or year. Florida beggarweed control was also variable. These two treatments provided good to excellent beggarweed control, with Lasso® being slightly superior in 1986. The next year Dual® provided 92% control and Lasso only 54%. This performance demonstrates the unpredictable weed control from these treatments. Peanut yields from these treatments were superior to the untreated check.

All treatments with Amiben® (3-6 in table) provided at least 85% control of Florida beggarweed. In contrast, sicklepod control with Amiben alone never exceeded 35%. The addition of Dyanap increased control, but the amount of improvement was variable. The best treatment was Amiben (2.0 lb. per acre) plus Dyanap (4.5 lb. per acre), which provided 55% and 88% control of sicklepod for the 2 years, respectively. This treatment also resulted in the maximum yield among the Amiben-based treatments.

The next series of treatments (7-11 in the table) utilized Cobra® , and since no Dyanap was included, it is meaningful to compare performance from these treatments to that of the standard. The total amount of Cobra applied was 0.4 lb. per acre, and with the exception of the last treatment in the series, control of Florida beggarweed was in the good to excellent category. Sicklepod control was not as good, nor was it as consistent. The best control was from Lasso plus Cobra applied at ground cracking with a sequential application of Cobra. This treatment also provided the highest yield in this series.

The next series of treatments (12-15 in the table) utilized Tough® (pyridate) and Tough plus 2,4-DB as a supplement to the traditional cracking time applications. Tough was initially targeted for use in peanuts as a supplement, but it is now being considered as a replacement for dinoseb-containing herbicides. Tough is extremely active against Florida beggarweed (at least 98% control from any Tough-containing treatment). In subsequent tests, this degree of control has been observed apart from the use of either Lasso or Dyanap. Tough offers some sicklepod control, and this control was consistently enhanced by the addition of 2,4-DB. But since Dyanap had been used, further tests are needed to determine if Tough can be relied upon as a sole source of sicklepod control. The highest yield in both years was provided by Tough-containing herbicides, demonstrating the herbicide's excellent crop safety.

The final two herbicidal treatments (16 and 17 in the table) featured Zorial® alone and in combination with Lasso. While Zorial alone provided variable control of Florida beggarweed (99% and 61% for the 2 years, respectively), control was consistently 99% with the addition of Lasso. Zorial alone provided poor control of sicklepod. Control was markedly improved with Lasso. Yields were intermediate between the best treatments and the nontreated control.

Wehtje is Associate Professor and Wilcut is a Former Research Associate of Agronomy and Soils.

PERFORMANCE OF VARIOUS HERBICIDE TREATMENTS FOR WEED CONTROL IN PEANUTS, WIREGRASS SUBSTATION, 1986-87

Treatment, lb./active acre	Weed control: Sicklepod 1986	Weed control: Sicklepod 1987	Weed control: Florida beggarweed 1986	Weed control: Florida beggarweed 1987	Peanut yield/acre 1986	Peanut yield/acre 1987
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Lb.*	*Lb.*
1. Dual (PPI), 2.0; Dual + Dyanap (CR), 2.0+ 4.5	55[1]	30	87	92	3,521	2,468
2. Lasso (PPI), 2.0; Lasso + Dyanap (CR), 2.0 + 4.5	68	31	99	54	3,075	2.868
3. Amiben DS (CR), 1.8	21	36	99	92	3,220	2,061
4. Amiben DS + Dyanap (CR), 1.8 + 3.0	28	41	99	92	3,231	1.742
5. Amiben (CR), 2.0	34	27	90	91	3,111	1,815
6. Amiben + Dyanap (CR), 2.0 + 4.5	55	88	99	85	3,526	2,214
7. Lasso + Cobra (CR), 3.0 + 0.4	76	0	97	100	3,568	2,069
8. Lasso + Cobra (LTCR), 3.0 + 0.4	64	0	95	92	3,532	1,343
9. Lasso (PRE); Cobra (EPOT), 3.0 + 0.4	86	24	95	92	3,412	1,924
10. Lasso + Cobra (CR), 3.0 + 0.2; Cobra (EPOT), 0.2	91	64	99	88	3,884	3,013
11. Lasso + Cobra (CR), 3.0 + 0.2; Cobra (EPOT/7 day seq.), 0.1 + 0.1	55	0	78	0	3,412	2,868
12. Lasso + Dyanap (CR), 3.0 + 4.5; Tough (EPOT-seq.), 0.9375	90	14	100	100	3,267	2,795
13. Lasso + Dyanap (CR), 3.0 + 4.5; Tough + 2,4-DB (EPOT-seq.), 0.9375 + 0.2	99	66	100	100	4,211	3,703
14. Lasso + Dyanap (CR), 2.0 + 4.5; Tough (EPOT-seq.), 0.9375	84	32	98	100	3,438	3,521
15. Lasso + Dyanap (CR), 2.0 + 4.5; Tough + 2,4-DB (EPOT-seq.), 0.9375 + 0.2	100	79	100	98	3,510	3,340
16. Zorial + Lasso (PRE), 1.5 + 3.0	96	69	99	100	2,987	2,940
17. Zorial (PRE), 1.5	52	22	99	61	3,147	2,178
18. Nontreated-weedy	0	0	0	0	2,904	1,742

[1]Weeds were harvested and weighed and percentage control for each herbicide treatment is a comparison in weed weight to the nontreated plots.

Small Towable Center Pivot Systems Offer Economical Irrigation

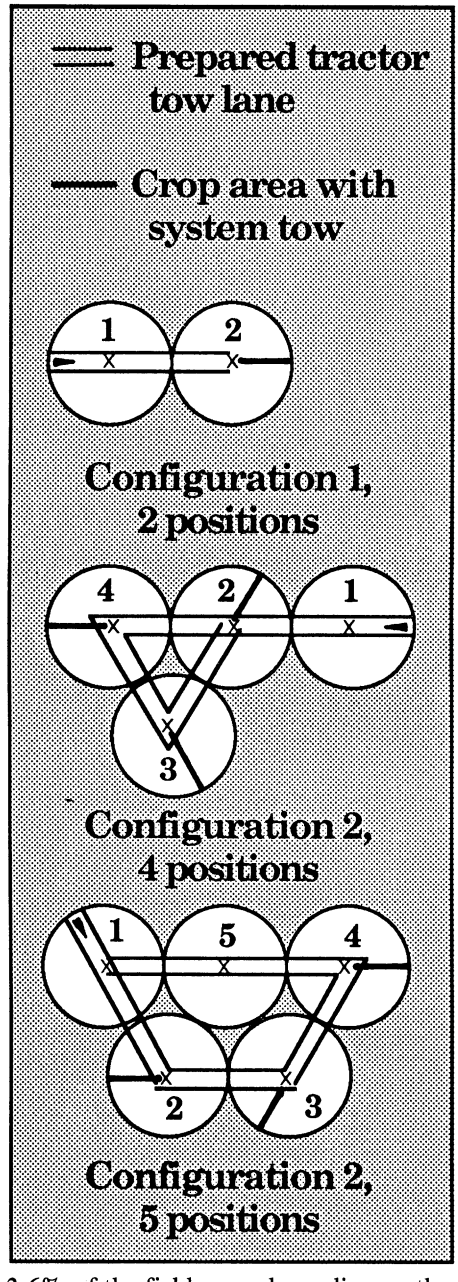
E.W. Rochester,
L.U. Hatch, and
J.M. Gillespie

THE LARGER the better is the general rule for reducing initial per acre costs of center pivot irrigation systems. But what about smaller fields or fields with irregular shapes where large systems just won't fit? Research at the Alabama Agricultural Experiment Station indicates that a small towable center pivot system may be the answer. Although more labor was involved, towing a system to several points effectively reduced the cost per acre of the system.

To evaluate the potential of towable pivots for Alabama farmers, a two-tower, 13-acre towable center pivot irrigation system was set up at the E.V. Smith Research Center. The pivot was to be moved over five pivot points to provide measurements for the required engineering and economic analyses. These results were then extended to evaluate three- and four-tower systems. Thus, the study was applicable to irrigated fields from 13 to 220 acres.

A key feature of the procedure was to irrigate a full circle in less than 24 hours so that the system would be towed once per day and at the same time each day. An automatic shutdown allowed the system to stop unattended, usually during the night. The next morning, the electric motor-driven system was moved at its highest speed to provide alignment for towing along the prepared travel lanes. Two men made the system ready for towing by rotating wheels and unhooking pipes. The system was towed to the next pivot point where it was set up and irrigation was then begun.

Some of the layout configurations are shown in figure 1. The straight parallel lines represent prepared travel lanes that were left out of production since a tall crop, corn, was being grown. The lanes were 21.5 ft. wide and represented up to

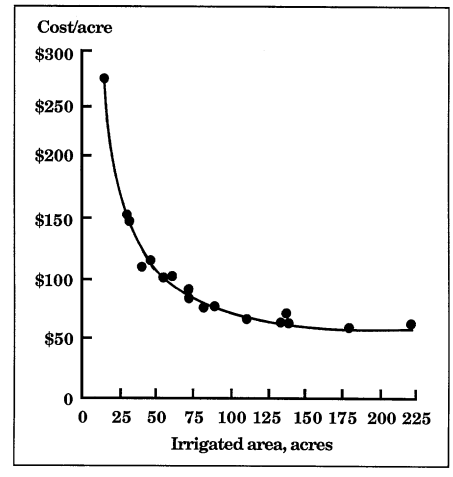


3.6% of the field area, depending on the particular configuration.

Economics was the major interest, so the engineering designs and budgets were based on minimum cost procedures. For example, it was assumed that an established water supply and three-phase power were adjacent to the field and no pumping lift was required except for that required by the center pivot.

Some of the other system features included a centrifugal pump and three-phase electric motor with a buried pvc pipe distribution system. Power was provided to the center pivot with buried electrical wires along with a kill wire to automatically shut down the pump.

FIG. 1 (left). Lane layouts with different configurations and positions.
FIG. 2 (below). Effect of irrigated area on yearly costs.



Component costs were obtained from a local farm equipment dealer and annual interest and insurance were assumed to be 9.7% of the average investment. Pumping costs were based on seven 1.5-in. applications.

Economic results were gathered for five major system components: center pivot machine, service bundle (water and power), pump components, labor, and energy. The total annual cost of some of these components decreased with increasing irrigated area, while the reverse was true for other components. For example, the annual cost of the center pivot machine was much higher than any of the other components for small irrigated areas. This changed as irrigated area increased, with machine cost decreasing to about the same as the service-bundle and energy costs. Pumping plant and labor costs also decreased with increasing area and were the smallest cost components in the higher flow rate range.

Combining all costs resulted in the relatively simple relationship illustrated in figure 2. Total annual per acre costs decreased sharply with increasing area for small areas and then approached a relatively constant cost of $80 per acre per year for irrigated areas in the 125- to 220-acre sizes. Importantly, neither system size nor number of tows affected the bottom line costs. Thus, small towable center pivot irrigation systems are a cost effective method to irrigate crops in Alabama.

Rochester is Associate Professor of Agricultural Engineering and Hatch is Assistant Professor and Gillespie is a Graduate Student of Agricultural Economics and Rural Sociology.

Job Opportunities for Graduates Stable Despite the Farm Crisis

J.E. Dunkelberger, S.F. Holland, and G.W. Wheelock

THE PROBLEMS confronting U.S. agriculture from the mid-1970s to mid-1980s caused a farm crisis with major challenges to young college graduates seeking jobs in agriculture. Employment opportunities, both on and off the farm, were often limited, sporadic, or nonexistent. University recruiters and advisors were asking if, in good faith, they could recommend agriculture as a career. To assess the impact of the farm crisis on agriculture-related jobs, research turned to the actual experiences of agricultural college graduates for answers.

In a study conducted through the Alabama Agricultural Experiment Station, career experiences of students who had been enrolled in an agricultural major at Alabama A&M University, Auburn University, and Tuskegee University in 1977 (a time of peak enrollments in agriculture at the State's land grant universities) were surveyed. The results provided detailed information on 293 students. Of these, 34 (13%) graduated from A&M, 177 (69%) graduated from Auburn, and 44 (18%) graduated from Tuskegee.

The educational accomplishments of this survey group were varied. In 1977 the sample included students at all levels of undergraduate education—freshman through senior. Ten years later, 253 (87%) of the survey respondents had graduated, most of them (82%) earning a degree from the same university in which they were enrolled in 1977. The graduation years ranged from 1977 through 1985.

Among these graduates, 91% completed their undergraduate education in an agricultural major. The remaining 9% changed majors between their enrolling in an agricultural major in 1976 and before completing their college work. Animal science and forestry/forest management accounted for the largest proportions of students, 17% and 20%, respectively, table 1.

Many of these graduates continued their academic studies at the graduate and professional school levels. Masters degrees were obtained by 23% of the graduates, while 3% earned doctorates and 7% received professional degrees, primarily in veterinary medicine.

With these degrees in hand, were graduates able to find jobs? More than half reported their first job included agriculture-related duties. Of these, 17% were employed in farming either for themselves or someone else and 36% were employed in agribusiness, a total of 53%, table 2. By 1986, fewer than half (48%) said they were currently employed in farming or agribusiness. This indicated only a modest shifting out of agriculture-related employment during the farm crisis years.

The majority of the students who changed from an agricultural major to a non-agricultural major entered non-agricultural occupations. Only 12% of non-agricultural majors said their first employment after college was related to farming or agribusiness. By 1986, following several years in the work force, 22% of this group had jobs that involved agriculture-related duties.

These survey results showed a surprising stability in agricultural employment despite the farm crisis. It indicated there was no major exodus of young, college educated people out of agriculture. But it also revealed that many young people who were interested in agricultural careers never had the opportunity to enter those fields. This suggests that the real issue may be the failure of agricultural job markets to provide enough jobs for the number of young people wishing to enter the agricultural work force.

Comments from those surveyed also indicated that many of the agricultural graduates who did not find employment in agribusiness were frustrated and disappointed by the lack of opportunity in these fields. As a group, female respondents indicated they found even less opportunity in agribusiness than their male counterparts.

Dunkelberger is Professor and Holland is a Graduate Research Assistant of Agricultural Economics and Rural Sociology, and Wheelock is Professor of Agribusiness Economics, Alabama A&M University.

TABLE 1. GRADUATES IN AGRICULTURE-RELATED ACADEMIC FIELD OR MAJORS

Major	No.	Pct.
Agricultural Economics	10	4.4
Agribusiness	10	4.4
Agronomy	17	7.4
Horticulture	18	7.9
Forestry	17	7.4
Forest Management	29	12.7
Animal Sciences	39	17.0
Poultry Science	20	8.7
Wildlife	8	3.5
Fisheries	5	2.2
Veterinary Medicine[1]	2	.9
Agricultural Education	16	7.0
Agricultural Engineering	7	3.1
Other[2]	31	13.4
TOTAL	229	100

[1]Student accepted into the Professional Veterinary Medicine program prior to completing the B.S. degree in an agricultural major.
[2]Biological science accounts for 23 of these majors at AU, where this was included in agriculture during the 1970's.

TABLE 2. CLASSIFICATION OF FIRST AND CURRENT EMPLOYMENT AS INVOLVING AGRIBUSINESS OR FARMING DUTIES

Employment duties	Employment	
	First	Current
	Pct.	*Pct.*
Agricultural graduates		
Farming	17	NA[1]
Agribusiness	36	48
Non-agricultural	47	52
Non-agricultural graduates		
Agribusiness	12	22
Non-agricultural	88	78

[1]The question pertaining to current job did not distinguish between farming and agribusiness. Farming is included in the 48% reporting agribusiness occupations.

Clean, Dry Surroundings Impede Migration of Millipedes

A.G. Appel

MASS MIGRATIONS of the garden millipede are relatively common in Alabama during the late spring and early fall. Thousands of millipedes may move from their habitats in decaying leaf litter and under debris into man-made structures such as apartments, homes, and hospitals where they become a nuisance. Although relatively harmless, in severe cases, their control may be desirable.

Barrier and soil treatments with pesticides have provided only limited control of migrating millipedes. Because of numerous infestation reports and the lack of basic biological information on millipedes, the Alabama Agricultural Experiment Station began studies in June 1987 to develop a biologically based control strategy for these migrating insects.

Since millipedes do not possess the water-proofing cuticular wax layer of many other arthropods, moisture is an important factor in their biology. Laboratory studies were undertaken to determine the rate of water loss and desiccation tolerance of migrating garden millipedes. In addition, the effect of water loss on millipede movement was investigated. The practical results of these studies were then taken into the field to develop a control stratgegy.

Millipedes were collected from around ornamental plantings and under rocks outside an infested building. They were maintained in plastic boxes containing moist soil and provided water and food. The size and weight of individual millipedes were measured prior to the experiments. Groups of millipedes were then held at 85 °F and 0% relative humidity, reweighed, and mortality evaluated hourly for 10 hours. Then the millipedes were completely dried at 140 °F. From these data, the rate of water loss, the percentage water content, and the level of water loss causing death were calculated.

To determine how desiccation affects millipede movement, 1- to 5-hour desiccated millipedes were placed into 3¾-in.-diameter petri dishes lined with filter paper. The distance moved in 1 minute was measured by covering the petri dishes and tracing the movements with a marker. Paper copies of the tracings were retraced with digitization equipment and the distance traveled computed.

Migrating garden millipedes contained approximately 60% water, and they lost water at an average rate of 7.7% per hour. These factors caused millipedes to die after about 6 hours of exposure to warm dry air, or a loss of approximately 46% of their total body water.

COMPARISON OF CUTANEOUS WATER LOSS RATES AMONG SEVERAL ANIMALS RELATIVE TO MAN

Animal	Relative rate of water loss
Earthworm	8.33
Frog	6.25
Garden millipede	1.63
American cockroach	1.02
Man (not sweating)	1.00
Iguana lizard	.21
Mealworm	.13

Even slight desiccation dramatically affected millipede movement. After only 1 hour of drying, millipedes reduced their distance moved per minute from 31 in. to 14 in., a 55% decrease. Movement decreased linearly with desiccation time; there was no movement after 5 hours. Other movement experiments have shown that millipedes are attracted to moisture and are repelled by dry environments.

These laboratory studies suggested that moisture is a critical factor in millipede distribution. Since millipedes lose water rapidly, do not tolerate drying, decrease movement when desiccated, and are repelled by dry areas, a control strategy based on moisture reduction was devised. Lawns, ornamental plantings, and debris often form a continuous high humidity pathway for millipedes to migrate. Dethatching and removing moisture-containing debris will aid in lowering microclimate humidity and should also repel millipedes.

This strategy was applied to the site where millipedes were collected for the laboratory experiments. Within 7 days of a thorough outdoor clean-up, primarily debris removal and close lawn mowing, the average number of millipedes entering buildings decreased from nearly 200 per day to less than 15, a 93% decrease. The numbers of millipedes remained unchanged in the one untreated control building.

These results suggest that a biologically based, non-pesticide control strategy consisting of environmental moisture reduction can effectively control migrating millipedes.

Appel is Assistant Professor of Entomology.

Adequate Prey Populations In Ponds Assure Growth of Largemouth Bass

W.D. Davies

GOOD CONDITIONING and growth are important factors in largemouth bass production. Research at the Alabama Agricultural Experiment Station has shown that, for largemouth bass to appear plump and express satisfactory growth rates, they must feed efficiently. That means the energy content of their food must be greater than that required to forage. This situation exists when the pond has sufficient numbers of prey of the appropriate size that are readily available to the bass.

Adult largemouth bass feed primarily on fish, although frogs, snakes, turtles, and small ducks are also eaten. They can swallow a bluegill or related sunfish approximately one-third their own body length, though fish that are not as deep-bodied as bluegill are more readily swallowed.

A measure of the general well being of fish populations is the relative condition of the individual fish. For example, if a number of bass of a certain length have an average weight less than the Alabama average (predicted from a large number of measured lengths and weights collected across the State), then it is likely that there is a scarcity of the appropriate size prey for that length of fish. On a relative scale, poor condition would be expressed as a value of less than 1.0 where 1.0 indicates an average weight for a specific length equal to the State average.

Sampling Southeastern farm pond fish populations from 1977 to the present by seining and electrofishing provided an opportunity to observe a wide variety of conditions under which fish populations were functioning. A total of 187 ponds was sampled during the 10-year period, with evaluations made of 1,029 largemouth bass. Fish from the stomachs of these bass were measured (total length) and compared to the length and relative condition of the bass. The stomach contents were flushed from the bass into a container by running a strong stream of water through a tube into the stomach. Using this procedure, almost all of the bass were released unharmed.

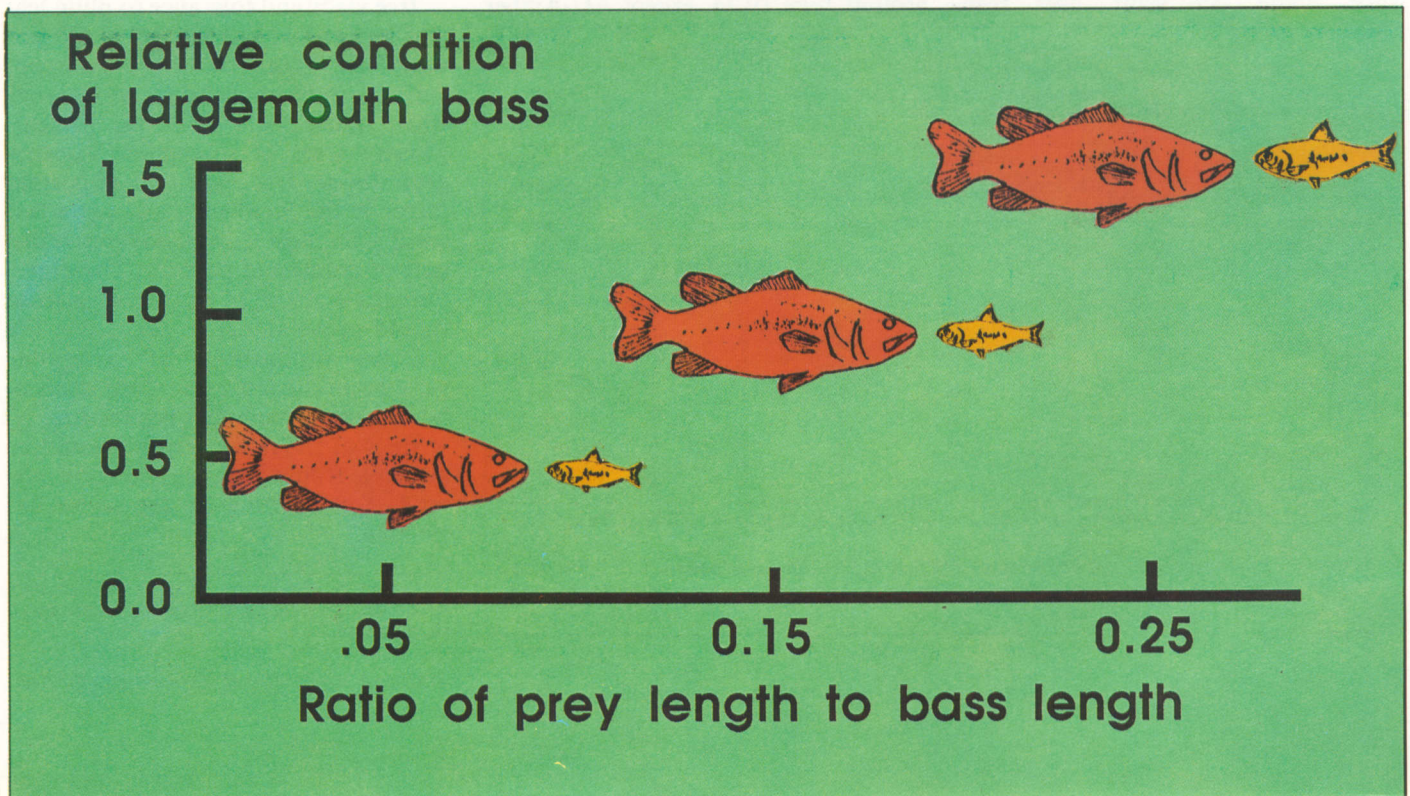
As illustrated by the drawing, results implied that prey of about 15% of the bass' length must be readily available for largemouth bass to maintain a relative condition of 1.0. Other factors also appeared to affect this relationship. For instance, rooted aquatic vegetation, if abundant, appeared to reduce feeding efficiency. Also, fish populations in ponds that were not well fertilized (did not have desirable phytoplankton "bloom") had average relative condition factors less than 1.0.

Results of the study indicate that good management practices can help correct an imbalance in largemouth bass condition. Such practices may include the elimination of the rooted aquatic vegetation and fertilization to increase production. Harvest regulations also appear to be helpful. Harvesting thin and "racy" looking fish while leaving the plump, fast-growing fish in the population also can help improve the relative condition of the fish.

The research did encounter small bass (12-in.) in relatively poor condition while the few large bass present were considerably more robust. This indicates low growth rates and reproduction in the prey populations, which can sometimes be so severe that returning bass to the pond will not be enough to restore a balanced fish population. Under these conditions, additional management inputs may be required to sustain quality fishing in the pond.

Davies is Professor of Fisheries and Allied Aquacultures.

The chart shows the weight-to-length ratio of largemouth bass in relation to the size of prey available, with 1.0 representing an ideal relative condition for bass.



Disease Resistance an Advantage of New Auburn Plum Varieties

J.D. Norton, T.L. Kamps, and T.E. Conaty

PLUM PRODUCTION in the Southeast is limited because commercial varieties are susceptible to black knot, bacterial canker, bacterial fruit spot, and plum leaf scald. Thus, there has been a need for varieties resistant to these damaging diseases.

Four varieties developed by the Alabama Agricultural Experiment Station (AU-Amber, AU-Rubrum, AU-Rosa, and AU-Cherry) should help overcome the disease problem. Au-Rubrum, AU-Rosa, and AU-Cherry proved resistant to all of the diseases listed, and AU-Amber was resistant to all except black knot disease.

The new varieties, developed for areas that receive 700-800 hours of chilling below 45 °F, resulted from crossing native plums with commercial varieties. Resistance to bacterial, fungal, and viral diseases came from the native plums, while the commercial varieties in the crosses provided desirable fruit quality.

Evaluations of the new varieties were made during 1979-87 in test plantings at the Main Station, Auburn; Chilton Area Horticulture Substation, Clanton; Piedmont Substation, Camp Hill; Gulf Coast Substation, Fairhope; Wiregrass Substation, Headland; and E.V. Smith Research Center, Shorter. Observations were made on fruit and tree characteristics, disease injury, and yield.

Recommended pesticide sprays were applied to the test trees, but susceptible trees at all locations showed injury from brown rot, bacterial fruit spot, leaf spot, and canker. However, injury from black knot was severe only on susceptible varieties at the Chilton Area Horticulture Substation. Plum leaf scald injury was recorded on infected trees in the disease screening planting at Auburn, where trees had been infected by double budding 1-year whips with infected wood.

The varieties were tested before being named, as Methley 12-10 (AU-Amber), Crimson M-1 (AU-Rubrum), Santa Rosa A-5 (AU-Rosa), and Methley C-50 (AU-Cherry). The original designations indicate parentage of the new varieties.

Low disease severity of the new varieties (except for AU-Amber's susceptibility to black knot) is apparent from data in table 1. They are similar in resistance to AU-Producer, AU-Roadside, and Crimson, other Auburn releases. Other commercial varieties in the comparisons (Methley, Morris, Ozark Premier, and Santa Rosa) were much more susceptible.

Fruit quality of the new varieties was rated excellent. All had peak maturity around June 19-24, except AU-Amber which peaks June 2, table 2. Yield of the new plums compared favorably with earlier Auburn releases and with the standard Methley variety. Details about each of the four follow:

AU-Amber—red/purple skin, yellow/amber flesh; small fruit with medium firmness limit it to roadside and local markets and home use.

AU-Rubrum—maroon skin, red flesh; large, firm fruit makes variety suited for commercial market.

AU-Rosa—red skin, yellow/red flesh; large, firm fruit suitable for commercial market.

AU-Cherry—red skin and flesh; small fruit of medium firmness makes it desirable for home production only.

TABLE 1. DISEASE SEVERITY ON PLUM VARIETIES IN EXPERIMENTAL PLANTINGS AT AUBURN, CAMP HILL, CLANTON, FAIRHOPE, HEADLAND, AND SHORTER, 1979-87

Variety	Disease index[1]					
	Bacterial fruit spot	Bacterial leaf spot	Bacterial canker	Black knot[2]	Brown rot	Plum leaf scald[3]
AU-Amber	0	0	0	5	2	0
AU-Cherry	0	0	0	0	2	0
AU-Producer	0	0	0	0	2	1
AU-Rosa	0	0	0	0	2	1
AU-Roadside	0	0	0	0	2	1
AU-Rubrum	0	0	1	0	2	1
Crimson	0	0	1	0	2	3
Homeside	0	0	1	1	3	1
Methley	5	5	5	5	3	4
Morris	1	2	2	2	2	2
Ozark Premier	0	1	1	1	3	4
Santa Rosa	5	5	5	5	3	5

[1]Disease index: 0 = 0, 1 = 1-20%, 2 = 21-40, 3 = 41-60, 4 = 61-80, and 5 = 81-100% of fruit, leaves, and trees infected.

[2]Infection and severe injury of susceptible trees only at Chilton Area Horticulture Substation.

[3]Injury recorded on trees in disease screening planting at Auburn. Trees infected by double budding 1-year whips with infected buds.

TABLE 2. SELECTED FRUIT CHARACTERISTICS OF PLUM VARIETIES AT AUBURN

Variety	Fruit size	Fruit firmness[1]	Soluble solids	Peak harvest date
	In.		*Pct.*	
AU-Amber	1.5	7.2	18.0	6/2
AU-Cherry	1.3	7.0	18.0	6/23
AU-Producer	1.7	8.0	16.5	6/24
AU-Rosa	2.0	8.0	17.6	6/22
AU-Roadside	1.9	6.8	17.2	6/23
AU-Rubrum	1.9	8.0	15.6	6/19
Crimson	1.6	8.3	16.3	7/10
Homeside	2.2	6.6	18.8	6/22
Methley	1.4	6.6	18.5	6/7
Morris	1.8	7.5	13.4	6/20
Ozark Premier	2.1	6.8	15.7	6/29
Santa Rosa	1.7	7.7	16.7	6/22

[1]Fruit firmness: 0-10, 0 = softest; 10 = firmest.

Tree vigor and tolerance to plum leaf scald are primary advantages of the new varieties. Trees of these resistant varieties were observed to be vigorous where plum leaf scald was present, whereas trees of susceptible varieties grew slower. Tree vigor is an important factor in the Southeast, and plum leaf scald is implicated in phony peach disease of plums and peaches. Therefore, disease resistance of these new varieties should prove valuable. Short tree life and low productivity of susceptible varieties in the test make them uneconomical for commercial production.

Trees of the new varieties should be available from wholesale and retail nurseries for planting in the winter of 1988-89.

Norton is Professor, Kamps is Research Associate, and Conaty is a Research Assistant of Horticulture.

Limiting Feed Reduces Feed Cost Without Harming Reproductive Performance of Broiler Breeder Males

K.J. Sexton and J.A. Renden

DUE TO heavy selection pressure placed on growth rate, broiler breeder males overeat and become obese, resulting in decreased flock fertility. Preventing male obesity by restricting feed is difficult because they are subjected to intense feed restriction during the growing period, then essentially full-fed during the breeding season. Males, being larger and more aggressive than hens, eat as much as desired.

Overcoming the problem has been difficult because little is known about temporary or permanent effects of feed restriction on male body composition or reproduction. Therefore, research was conducted at the Alabama Agricultural Experiment Station to investigate effects of three common feeding regimes during the growing period (3-22 weeks of age) on body composition and reproductive performance of breeder males. Feeding regimens included (1) limited daily (LD) in which birds were fed breeder recommended amounts of feed on a daily basis, (2) skip-a-day (SAD) in which birds were fed twice the recommended amount of feed every other day, and (3) limited time (LT) in which the birds were allowed to eat for a limited time period each day.

During the growing period, body weight, feed consumption, age at first semen production (sexual maturity), and litter moisture were measured. At 22 weeks of age, one-half of the birds in each treatment were randomly selected, and testes and liver weights and body composition were determined. The remaining birds were placed on unlimited feeding to stimulate commercial conditions during the breeding period. From 22 to 34 weeks of age, body weight, semen weight, and sperm concentration were measured at regular intervals. At 34 weeks of age, testes and liver weights and body composition were determined.

Body weights of the three treatment groups were similar throughout the growing period. However, limited daily birds consumed less feed per day than the other groups, indicating more efficient use of feed. Litter moisture during the growing period ranged from 57% for limited time and 52% for limited daily feeding to 32% for skip-a-day regimen. Litter moisture levels for limited time and limited daily were higher than optimum (20-40%), indicating a difference in water consumption among the treatments. This difference is important due to cost of litter replacement and increased risk to flock health.

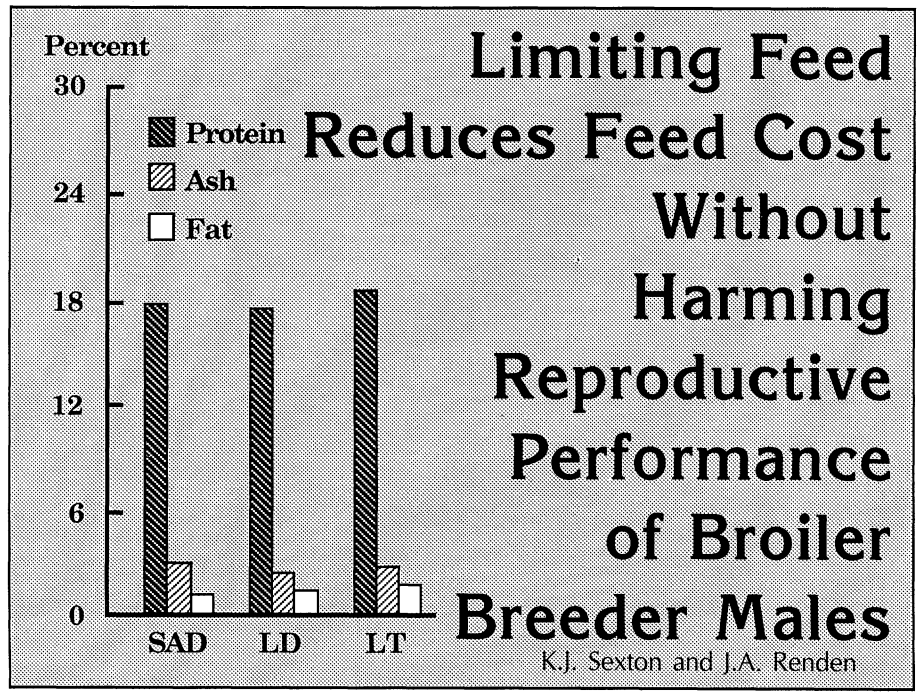
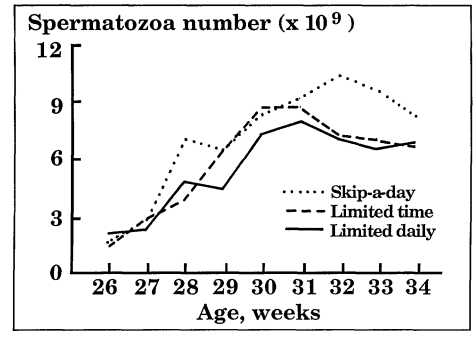


FIG. 2 (above). Effects of feeding regimen during growth on body composition at 34 weeks.
FIG. 1 (below). Effects of feeding regimen during growth on spermatozoa number from 26 to 34 weeks of age.



Age at sexual maturity ranged from 170 days for limited daily to 180 days for skip-a-day. Stress of having every other day without feed may be sufficient to slow reproductive development. Body composition and testes and liver weights at 22 weeks were not affected by treatment.

When the birds were placed on unlimited feeding, body weights of all groups increased dramatically. The limited daily birds gained weight most rapidly, probably due to the higher feed efficiency established during the growing period, compared to skip-a-day and limited time feeding. By 28 weeks, however, there were no differences in body weight due to treatment.

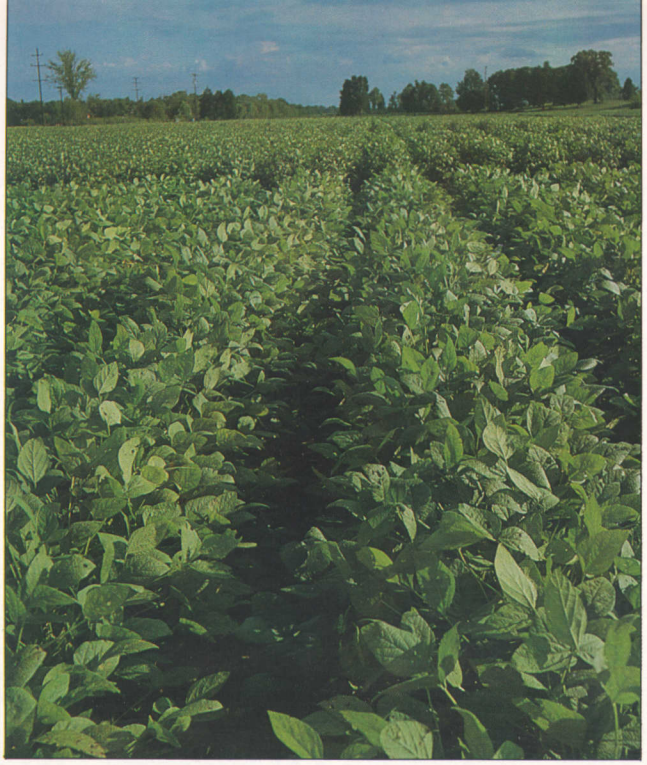
Reproductive performance was affected by feeding regimen. Semen weight and spermatozoa concentration were higher in skip-a-day males than in limited daily males. Semen production also declined less rapidly after 30 weeks of age in skip-a-day males, figure 1.

At 34 weeks of age, testes weights were lower in limited daily birds than in skip-a-day or limited time birds (LD 1.5 oz., SAD 1.7 oz., and LT 1.9 oz.). The limited daily birds had extremely enlarged, yellow, fatty, friable livers when compared to the other groups. The limited daily birds had more body fat and less body protein than skip-a-day or limited time birds at 34 weeks, figure 2. These differences occurred at similar body weights among treatment groups.

Although maintaining desirable body weight is important, it should not be the only criterion for selecting a feeding program for growing birds. The results of this study can be summarized to indicate that feeding programs have these effects:

1. Litter moisture content—higher than desired on limited time and limited daily feeding.
2. Feed efficiency—limited daily birds made most efficient use of feed.
3. Adult body composition—limited daily birds were fatter and had less body protein.
4. Male reproductive performance—skip-a-day feeding resulted in higher semen weight and spermatozoa concentration.

Sexton is a Graduate Research Assistant and Renden is Associate Professor of Poultry Science.



Lime and Molybdenum Needed For North Alabama Soybeans

C.H. Burmester, J.F. Adams, and J.W. Odom

RESEARCH with soybeans in Alabama as early as 1907 showed yield increases from liming acid soils. Only recently, however, have yield increases been observed from additions of small amounts of molybdenum (Mo) to the soils of northern Alabama.

The Alabama Agricultural Experiment Station established on-farm programs of soil fertility experiments in 1976 for the northern counties of Alabama to improve soil-test calibration. A part of this program was to identify critical soil pH for soybean production on the three major soil areas of north Alabama. These areas were the sandy soils of the Appalachian Plateau, the silty clay soils of the Tennessee Valley, and the silty soils of the Highland Rim bordering Tennessee.

It soon became apparent that the critical pH varied widely among sites, suggesting that more than one soil factor was involved. In several of the unlimed test plots, soybean plants had a noticeably light green color. This indicated a possible nitrogen deficiency caused by poor N fixation by soybean rhizobia. A possible Mo deficiency was suspected since Mo is needed in nitrogen fixation and Mo availability is less on acid soils. The possibility of a Mo deficiency was unexpected since earlier tests on soils in north Alabama had shown no response to additions of Mo fertilizers.

EFFECTS OF LIMING AND MO ON YIELD OF SOYBEANS IN NORTH ALABAMA, 1981-85

Site	Unlimed soil pH	Yield/acre			
		No lime		Lime	
		-Mo	+Mo	-Mo	+Mo
		Bu.	*Bu.*	*Bu.*	*Bu.*
1...	4.6	10	13	16	16
2...	4.7	11	13	13	14
3...	4.8	28	37	46	46
4...	4.9	27	26	31	37
5...	4.9	31	34	35	34
6...	5.0	35	38	45	47
7...	5.0	24	28	30	29
8...	5.2	22	22	22	22
9...	5.3	44	50	54	51
10...	5.3	30	38	43	44
11...	5.3	22	31	30	32
12...	5.4	50	53	53	56
13...	5.4	26	37	40	38
14...	5.6	24	30	25	28
15...	5.6	20	26	31	34

Starting in 1981, on-farm experiments were established to identify the soil factors causing soybeans to respond to liming. Lime was applied in farmers' fields at rates of 0 and 2 tons per acre in late winter. Farmers planted these test areas (one in each field) along with the rest of the field and followed normal production practices. To check for response to Mo, a sodium molybdate solution was sprayed on two rows at a rate of about 1 oz. per acre in both the limed and unlimed plots about 2 weeks after soybean emergence. Fifteen tests were conducted on sites between 1981 and 1985 with unlimed soil pHs ranging from 4.6 to 5.6.

Liming increased soybean yields at 12 of the 15 sites, see table. Of the 12 sites that responded to lime, 11 also showed a yield increase with Mo addition. Soybeans in the unlimed plots were a noticeably lighter green color and leaf analyses confirmed nitrogen deficiencies. Deficiency symptoms did not appear until soybeans reached the bloom stage, when the soybeans' requirement for N drastically increases. These N deficiency symptoms were seen in soybeans grown in all three soil areas of north Alabama. Addition of lime or Mo corrected discoloration and resulted in higher yields.

Addition of Mo was found to produce the same yield increase as liming at five sites, while at seven sites liming produced the larger yield increase. In three cases, addition of lime plus Mo increased soybean yield more than liming alone. The average soybean yield increase found in these tests was 6.0 bu. per acre from Mo addition (11 sites), 8.3 bu. per acre from liming (12 sites), and 6.8 bu. per acre from lime plus Mo (3 sites).

Results of these tests suggest that Mo deficiency is extensive on acid soils in north Alabama, a condition which would not have been found through soil testing. Addition of lime or Mo generally has increased Mo availability and corrected the deficiency. Liming is the preferred treatment as it can correct other problems, such as aluminum and manganese toxicities, associated with acid soils. However, the low cost of Mo treatment ($1-2 per acre) and the possibility of a response at higher pH values make Mo application attractive in northern Alabama for optimum soybean production.

Molybdenum is needed in only a small amount by the soybean plant, so no more than the recommended dosage is indicated. Molybdenum can be applied as a seed treatment or as a foliar spray prior to blooming of the soybeans. In either case, 1 oz. per acre of sodium or ammonium molybdate should be sufficient.

Burmester is a Research Associate, Adams is Assistant Professor, and Odom is Associate Professor of Agronomy and Soils.

Game-Food Crops Show Tolerance To Postemergence-Applied Herbicides

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

PRODUCING PLANTING seed for game-food crops offers opportunities for a farm enterprise. There is a strong interest in such crops as American jointvetch for deer food and Comanche partridge pea and Amquail lespedeza for quail food. As a result, there is a shortage of planting seed.

As with any other crops, weed control is essential for economical and efficient production of seed. Broadleaf weeds are particularly troublesome in the desirable game-food crops. Since no information was available concerning tolerance of these plants to herbicides, a greenhouse study was done to determine response of American jointvetch, Comanche partridge pea, and Amquail lespedeza to seven postemergence-applied herbicides.

Ten mechanically scarified seed of the appropriate species were planted in quart containers that contained 2 lb. of a sandy loam soil amended with peat moss. Soil-test results indicated a pH of 6.2 and high levels of P and K. All containers were watered daily and plants were thinned to two per container within 10 days of emergence. Natural sunlight was supplemented with artificial lights which were set for 16 hours light and 8 hours dark. Day temperature maximums averaged 90°F and night temperature lows averaged 70°F. Relative humidity during the day averaged 50%.

Herbicides were applied when the jointvetch plants averaged 5 in. in height and had nine fully expanded leaves, partridge pea averaged 5 in. tall and had six leaves, and the lespedeza plants averaged 4 in. in height and had three leaves. All herbicides were delivered in a volume of 15 gal. per acre. Ortho X-77 nonionic surfactant was included at 0.25% by volume in all treatments.

Data collected included injury ratings using a scale of: 0 = none; 1 to 29 = slight; 30 to 59 = moderate; 60 to 99 = severe; 100 = death. All plants were harvested for dry weight determinations after the final injury rating. Results are reported in the table.

American jointvetch and Amquail lespedeza tolerated three of the seven selected herbicides. Injury was slight and dry weight was equal to the untreated when these species were treated with 2,4-DB (Butyrac® or Butoxone®), 2,4-D (Weedar 64®), or Basagran®. These three herbicides show potential for control of a large number of broadleaf species in both American jointvetch and Amquail lespedeza.

AVERAGE RESPONSE OF GAME-FOOD CROPS TO SEVEN POSTEMERGENCE-APPLIED HERBICIDES, THREE EXPERIMENTS, 1987

Herbicide[1] and rate/acre	Comanche partridge pea		American jointvetch		Amquail lespedeza	
	Injury[2]	Weight[3]	Injury	Weight	Injury	Weight
	Pct.	*Grams*	*Pct.*	*Grams*	*Pct.*	*Grams*
2,4-DB amine, ½ lb.	80	1.35	9	4.03	13	3.00
Scepter, 1/8 lb.	57	2.84	53	2.55	48	1.31
MSMA, 1½ lb.	34	3.13	65	1.30	88	.17
Classic, 1/8 oz.	83	1.07	74	.57	87	.14
Blazer, ½ lb.	100	.08	100	.15	85	.65
Basagran, ¾ lb.	2	4.14	9	4.30	8	3.72
2,4-D amine, ½ lb.	85	1.69	11	4.53	9	2.47
Nontreated	0	5.35	0	4.36	0	2.40

[1]All rates are given as active per acre, except 2-4-DB and 2,4-D which are acid equivalent/acre; Ortho X-77 nonionic surfactant included at 0.25% by volume.
[2]Injury ratings taken 12 to 24 days after herbicide treatment.
[3]Average grams dry weight per container 24 to 33 days after treatment (1 oz. = 28 grams).

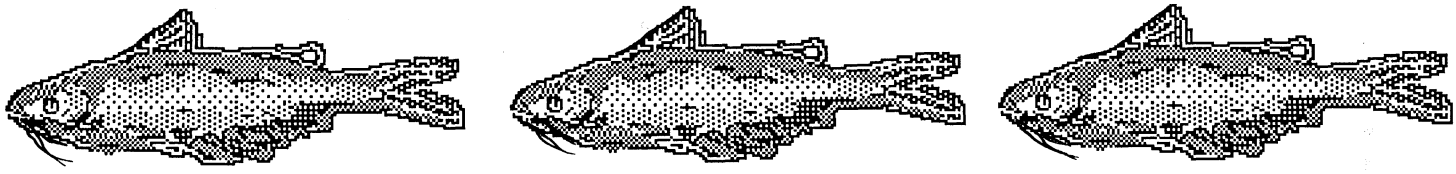
Earlier Experiment Station research had revealed that AU Lotan and AU Donnelly low-tannin sericea lespedeza tolerated three applications of 2,4-DB (½ lb. acid equivalent per acre per application) or 2,4-D (¼ lb. acid equivalent per acre per application) when applied to young seedlings. It is highly probable that Amquail lespedeza will respond in a similar manner to these two herbicides, but this has yet to be determined.

Comanche partridge pea was injured by all herbicides except Basagran. However, there was enough tolerance to MSMA (Bueno 6®) applied at 1½ lb. active per acre to warrant evaluation of this herbicide at lower rates. Tolerance to Basagran is not sufficient to anticipate good weed control in partridge pea at this time because Basagran does not control sicklepod and several of the annual morninglories. In another experiment comparing herbicide tolerance of the native Alabama partridge pea and Comanche, both responded the same to these seven herbicides.

Since the game-food crops tested proved tolerant to some of the seven herbicides, there is hope for effective weed control programs. At this time, however, none of these is labeled for weed control in partridge pea, jointvetch, or lespedeza.

Walker is Associate Professor and Wyatt and Abney are Research Assistants of Agronomy and Soils.

Marketing and Processing Viewed As Major Constraints to Catfish Farming



J.J. Molnar and S. El-Ghamrini

CATFISH FARMING has been the most rapidly expanding Alabama food producing industry in the past decade. Like other aquacultural enterprises, catfish production offers the promise of profitably combining the State's unique water, land, and climate resources in an era of stagnant prices for many other commodities. Several public agencies with agricultural and natural resource management responsibilities have worked together to assist catfish producers in responding to the new set of opportunities.

In fall 1987, a Statewide survey of administrators and officials in public agencies serving the aquacultural industry was undertaken. The 144 respondents to the mail questionnaire represent a 95% response rate. The study, conducted by the Alabama Agricultural Experiment Station, asked these individuals to rate a series of possible constraints or sources of difficulty for the future of Alabama aquaculture. The table shows the top 15 constraints as rated by public agency personnel in the sample.

Marketing and the availability of processing facilities were viewed as major constraints by more than 83% of the respondents. Currently, catfish processing plants are located only in the Greensboro area in Alabama. Producers often express concerns about the somewhat lower prices (about 5¢ per lb.) they receive for catfish in Alabama relative to Mississippi, a consequence of more facilities and greater competition for product that occur there. Clearly, the sale and utilization of aquacultural commodities is the major concern in the industry. The availability of more processing plants in other parts of the State would enhance the expansion of catfish production.

Off-flavor detection is a concern for many catfish farmers because this determines the quality of their product and the price received. Thought to be caused by geosmin found in certain pond algaes, off-flavor can force growers to hold stock until the problem corrects itself or go to the expense of moving fish to uncontaminated ponds.

Only 23% saw production advice as a limitation. About 30% saw the need for adequate financial management advice as a constraint. The lack of willingness by Alabama farmers to innovate was viewed as a constraint by about 31%. About 27% saw the need for quality control in fish production and processing as a constraint.

Genetic stock and water availability were seen as major problems by about 23% of the sample. Fish disease treatment was felt to be a limitation by only about 21%.

Less than 21% thought that water quality, legal definitions of fish culture, fish feed, and seedstock supplies were constraints on the industry. An additional four items were rated by the public officials, but were noted as constraints by less than 10% of the sample. These included: adequate feed formulating, consumer acceptance, dam inspection, and water discharge regulations.

The data profile the perceptions of public agency administrators who have extensive contact with and knowledge of the aquaculture industry in Alabama. Financial and marketing concerns dominate their view of the future of the industry. Producers, however, may have somewhat different perspectives on where their industry is going and how it will get there, but they are not likely to differ greatly on the relative importance of the major issues facing fish farming in the State.

Molnar is Professor of Rural Sociology and El-Ghamrini is a Graduate Student of Fisheries and Allied Aquacultures.

PERCEIVED CONSTRAINTS OF THE AQUACULTURE INDUSTRY IN ALABAMA, NATURAL RESOURCE ADMINISTRATORS, 1987

Constraint on industry	Extent		
	None or little	Some	Moderate or great
	Pct.	*Pct.*	*Pct.*
1. Availability of markets for farmers	4	12	84
2. Too few processing plants in the State	5	14	1
3. Lack of objective off-flavor measurement	22	39	9
4. Adequate advice for financial management	30	40	31
5. Alabama fish farmers' willingness to innovate	31	39	30
6. Quality control problems in production	30	42	8
7. Adequate advice for production management	41	36	23
8. Availability of improved genetic stock	44	33	23
9. Water availability	42	35	23
10. Availability of fish disease treatments	40	40	21
11. Quality of water supplies	39	40	21
12. Quality control problems in processing	10	33	18
13. Laws defining fish as livestock	62	24	14
14. Sources of seedstock/broodstock	50	38	12
15. Quality of fish feed	69	20	11

Number of respondents = 144.

Oriented Strand Board and Waferboard Competitive With Structural Plywood

E.J. Biblis

AFTER WORLD WAR II, softwood structural plywood produced primarily from Douglas fir in the Pacific Northwest began to be utilized as sheathing in house construction in the United States. Softwood plywood soon replaced lumber in housing as floor underlayment and subflooring and roof and wall sheathing because of its high strength, dimensional stability, and significantly lower material and installation costs than tongue-and-grooved lumber.

In 1960, production of softwood structural plywood from southern yellow pine began in the Southeast. Currently, about 50% of all softwood plywood in the United States is produced from southern yellow pine.

The next change was the introduction of non-veneered structural panels, primarily oriented strand board (OSB) and waferboard. In 1987 these products accounted for approximately 13% of the total wood panel sheathing used for floors, roofs, and walls in housing.

All of these non-veneered panels are fabricated with exterior type resin (phenol-formaldehyde) and approved for use in housing by all regulatory agencies and codes. However, there are significant differences among the different types of panels, and recent tests at the Alabama Agricultural Experiment Station evaluated the mechanical and structural properties of southern pine plywood (3-ply, ½-in. thick), southern pine OSB (oriented flakeboard, 7/16-in thick), and aspen waferboard (½-in. thick).

From each panel type, three panels 4 ft. wide by 8 ft. long were randomly selected and cut into standard small specimens for flexure (stiffness and strength) testing. Flexure testing was with span parallel to face particle orientation for the oriented flakeboard and span parallel to the face veneer grain for plywood. Six specimens from each panel were tested to destruction under each of two test conditions: (1) Original, conditioned to equilibrium at 65% relative humidity and 72 degrees F, and (2) cycled, soaked for 48 hours in water and then reconditioned to original condition.

The flexure properties of the three panel types are shown in the table. There was a significant difference in panel weight ranging from 45 lb. for southern pine plywood to about 48 lb. for the other two panels.

Test samples shown are (A) waferboard, (B) southern pine plywood, and (C) oriented strand board.

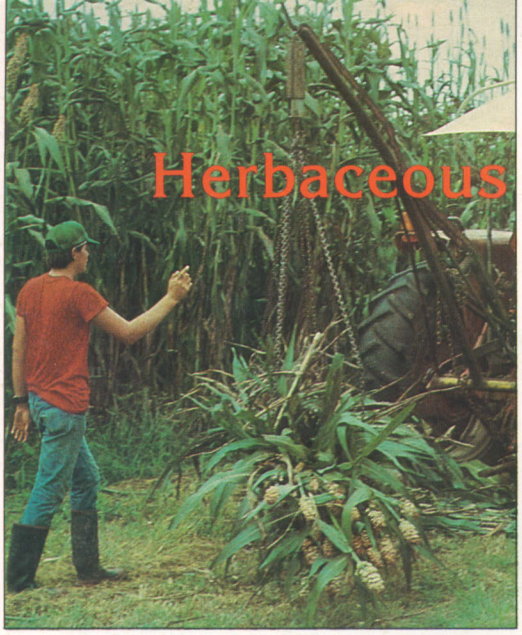
In flexure with spans parallel to face orientation, or veneer grain, the stiffness and strength were higher for the southern pine plywood, followed by the OSB from southern pine and the aspen waferboard. Although the southern pine plywood was 13% less dense than the OSB, after cycling it was 288% stiffer and 208% stronger than the OSB. On the other hand, the OSB panels in the direction of flakes after cycling were 33% stiffer and 30% stronger than randomly oriented aspen waferboard.

Though retail prices vary, plywood sheathing of approximately equal thickness costs about 20% more than OSB or waferboard.

Biblis is Professor of Forestry.

FLEXURAL PROPERTIES OF THE STRUCTURAL WOOD PANELS

Panel type	Moisture condition	Panel weight	Flexure	
			Stiffness	Strength
		Lb.	*Lb./sq. in.*	*Lb./sq. in.*
Plywood (southern pine)	Original	45	1,450,000	7.170
	Cycled		1,339,000	5,504
	Reduction (%)		(7.7)	(23.2)
Oriented flakeboard (southern pine)	Original	49	699,425	3,825
	Cycled		464,455	2,650
	Reduction (%)		(33.6)	(30.7)
Waferboard (aspen)	Original	48	477,533	2,558
	Cycled		349,495	2,033
	Reduction (%)		(26.8)	(20.5)



Herbaceous Crops Show Promise As Energy Producers Of The Future

D.I. Bransby, C.Y. Ward, C.C. King, Jr., and G. Sims

MEETING DAY-TO-DAY energy needs by growing crops may seem far-fetched. Yet, judging by the extensive research effort in this field, many scientists and institutions consider such a possibility entirely feasible.

Plant material (known as "biomass") is obtained from woody or herbaceous energy crops and can be converted by various processes to liquid fuel, gases such as methane, or thermal energy. Due to the relative abundance of conventional energy sources, such as fossil fuels and atomic energy, and the adaptation of technology to these energy sources, biomass has not yet received adequate research and development attention as an energy resource. Although interest in biomass as an energy source has been sporadic and surged periodically only in association with energy crises, certain institutions (the Tennessee Valley Authority, the Gas Research Institute, and the U.S. Department of Energy) have developed ongoing bioenergy research programs.

The Alabama Agricultural Experiment Station has been a cooperator in new research sponsored by the U.S. Department of Energy's Biofuel, Municipal Waste, and Technology Division, and coordinated by the Oak Ridge National Laboratory. The aim of the research is to evaluate herbaceous crops for biomass production in the Southeast.

Warm-season crops in the research in clude annuals (sweet sorghum and pearlmillet) and perennials (bermudagrass, johnsongrass, switchgrass, and sericea lespedeza). Cool-season species are mainly rye mixed with various annual legumes. Tall fescue is the only temperate perennial. These cool-season crops were planted in rotation with summer annuals or into the sod of summer perennials following fall harvesting of summer growth.

Generally, sweet sorghum has been the best summer crop, producing over 15,000 lb. per acre in a good season at some sites, see table. However, a disadvantage is that this species requires annual planting and its soil protection capability is lower than for perennials.

The most successful summer perennial species have been switchgrass, johnsongrass, and sericea lespedeza. These produced up to 8,000 lb. per acre in low rainfall years. In 1987, however, elephantgrass (a sub-tropical perennial grown in south Georgia and Florida) produced over 20,000 lb. per acre in spite of erratic rainfall. The problem with this species is low winter survival. Therefore, specialized management practices must be developed to grow this productive crop in north Alabama.

Production from cool-season species has been as high as 6,942 lb. per acre, with most of this composed of rye. Consequently, rotation of warm-season followed by cool-season crops appears to have potential for production exceeding 20,000 lb. per acre per year. Cost of biomass production under these high yielding production systems is estimated at around $40 per ton.

The cost of converting this biomass to liquid fuel would result in a price of about $3.00 per gal. with existing conversion technology. Thus, fuels from biomass would not be competitive at current prices of gasoline. However, in the event of cheaper biomass production and conversion methods and higher prices of gasoline that may occur in the future, this situation could change. In many European countries with strong economies, the price of gasoline is currently similar to the production cost of fuels from biomass.

Bransby is Associate Professor, Ward is Professor, King is Professor Emeritus, and Sims is Research Associate of Agronomy and Soils.

Weighing samples to determine biomass yield in field trials.

AVERAGE BIOMASS YIELDS OF SOME TEST SPECIES GROWN ON MARGINAL LAND AT FOUR SITES IN ALABAMA FROM MAY 1985 TO MAY 1986

Crop	Dry matter yield/acre		
	Summer	Winter	Total
	Lb.	*Lb.*	*Lb.*
Sweet sorghum-rye + sweet clover	15,989	6,942	22,931
Johnsongrass alone	8,995	0	8,995
Pearlmillet-rye + vetch	11,743	4,265	16,008
Sericea-rye	3,226[1]	4,896	8,122
Switchgrass-rye + vetch	1,789[1]	4,163	5,952

[1]This was the establishment year for these two perennial species and yields were lower than would be expected in subsequent years.

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