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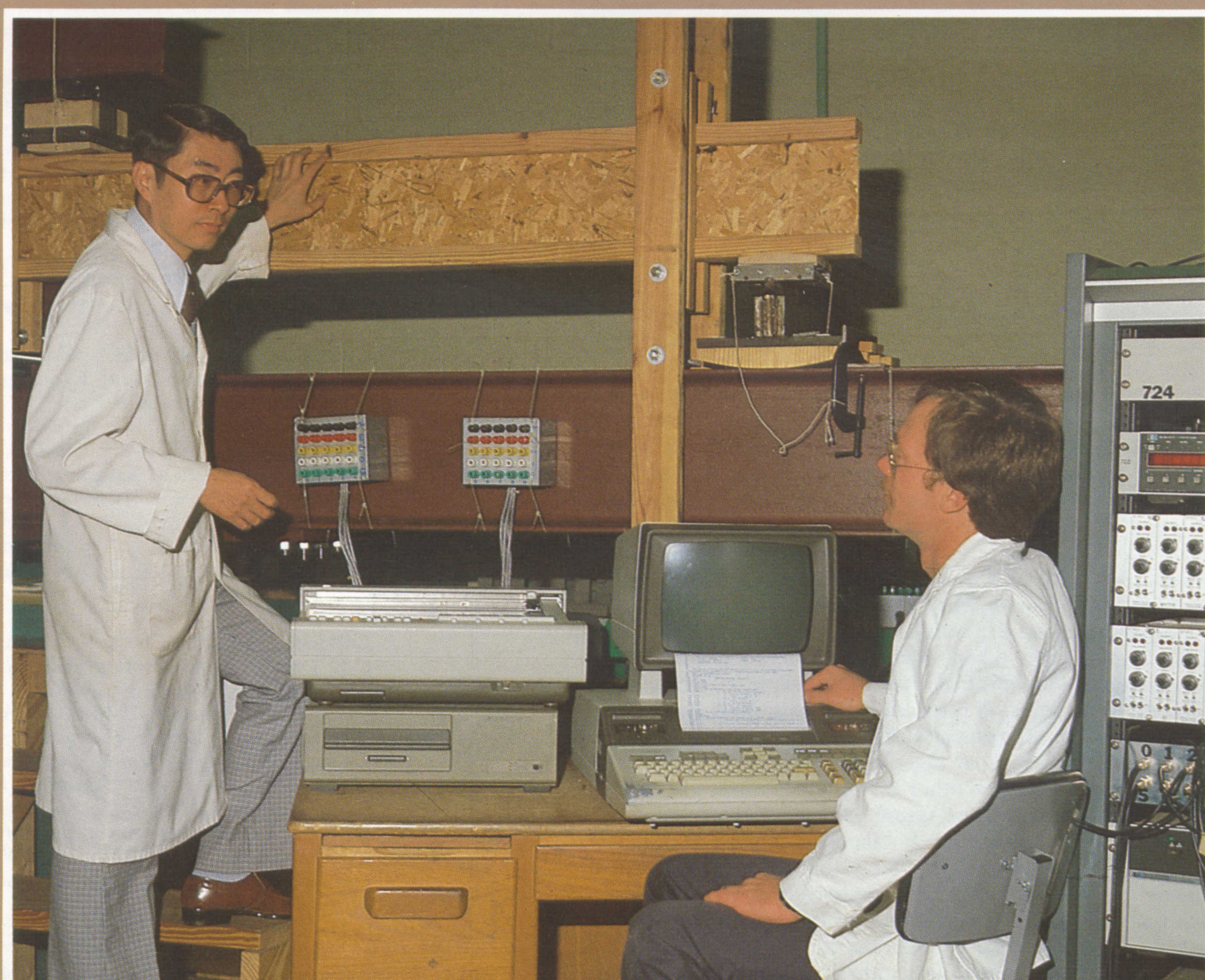
HIGHLIGHTS
of Agricultural Research



ALABAMA AGRICULTURAL EXPERIMENT STATION
GALE A. BUCHANAN, DIRECTOR

AUBURN UNIVERSITY
AUBURN UNIVERSITY, ALABAMA

DIRECTOR'S COMMENTS

PROVIDING FUNDS for agricultural research is one of the soundest investments that can be made with public monies. The profitability of such funding has been well established by an interregional cooperative study of agricultural research that involved many scientists from various parts of the United States. A report of this study stated: "Average rates of return to public sector agricultural research investments oriented to the aggregate U.S. farm sector have been 30 to 50 percent annually since the late 1930's, well above the 10 to 15 percent return (above inflation) that private firms consider adequate to attract new investment."


GALE A. BUCHANAN

Agricultural research as an investment is even more attractive when it is realized that the population as a whole shares in the benefits of such efforts. This is an important point, since too often it is perceived that agricultural research benefits only farmers, especially in times of commodity surpluses. Unfortunately, the issues are far more complicated in that agriculture is a dynamic enterprise that is constantly changing, with new and different needs arising on a regular basis. Not only must these practical problems be addressed when they arise, but the basic research component of such research programs must look to the future to provide scientific information that will lead to solutions to future problems.

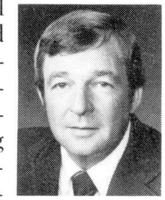
The particularly high rate of return to investment in agricultural research can be accounted for in part by the highly unified system of agricultural and forestry research in the United States. Because of this cooperative system, findings from research done in one state or region often have far-reaching implications in neighboring states and regions, and even in other nations. For example, the new AU-Triumph tall fescue variety recently developed by the Alabama Agricultural Experiment Station stands to benefit not only Alabama cattlemen but livestock producers throughout the Southeast, in other U.S. regions, and in many nations of the world. By the same token, Alabama farmers and forestry producers regularly benefit from research done in other states.

The spill-over effect of research benefits is illustrated by information from the interregional study mentioned earlier. The report notes that for every $1 of benefits accruing to a region where research is done, value to other U.S. regions totals $4. Thus, the highly effective interlocking system of research assures full value to the entire nation from publicly supported research conducted at any location. The report also notes that a major share of the spill-over effects in the past has gone to consumers in the form of lower real food costs. Lower income groups receive greater benefits from low food costs in relation to family income and tax contributions that support agricultural research than do higher income groups.

The system of publicly supported agricultural research is something the United States cannot afford to compromise. To maintain productivity and continued economic development, we must place more emphasis on adequate financial support for agricultural research.

may we introduce . . .

Dr. David H. Teem, who joined the Auburn University faculty June 1, 1984, as assistant dean and assistant director of the Alabama Agricultural Experiment Station. In this administrative position, Teem will participate in the overall planning, developing, and carrying out of the Experiment Station's research programs and have specific responsibilities for outlying units and research operations. He will provide leadership for the 11 substations and 3 experiment fields, and be responsible for research operations work in maintenance of buildings, land, and facilities for which the Experiment Station is responsible and providing of services required for the research program.



Teem comes to Auburn from the University of Florida where he served as assistant professor and then associate professor of weed science in the Agronomy Department.

A native of Foley, Teem earned the B.S. in zoology (1967), M.S. in weed science (1971), and Ph.D. in weed science (1976), all from Auburn University.

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ON THE COVER. Structural value of the Auburn-developed composite I-beam was determined in lab tests by R.J. Leichti (right) and R.C. Tang.

If the Squash Is Bitter, Don't Swallow It

K.S. RYMAL, O.L. CHAMBLISS, and D.A. SMITH, Department of Horticulture
M.D. BOND, Alabama Cooperative Extension Service

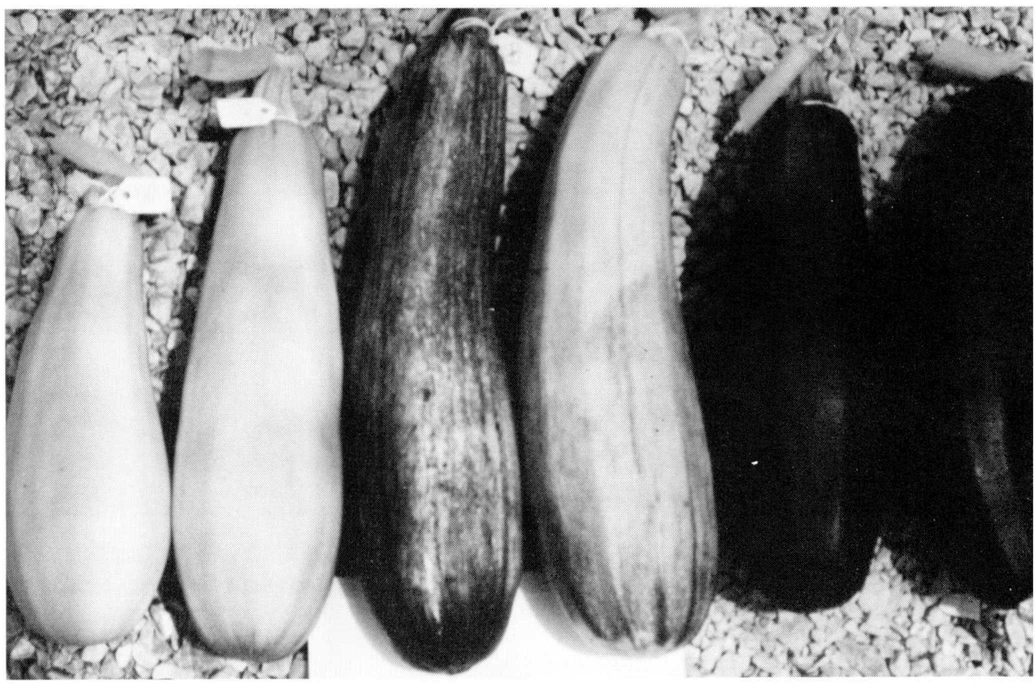
BITTER SQUASH reported in Alabama, California, and Queensland, Australia in 1981 were found to contain a naturally occurring toxin called cucurbitacin E. Though the existence of this compound and other cucurbitacins in wild species of the plant family Cucurbitaceae has long been known, their presence in the fruit of cultivated species has been rare.

In Alabama, the bitter squash were found in home gardens and reported to Extension Service agents in Fayette and Tallapoosa counties. Seed of the varieties planted (both yellow straightneck types) were from two different seed companies. Fruits of the bitter squash were analyzed during the summer of 1981 at the Alabama Agricultural Experiment Station.

Also during the summer of 1981, the quality control department of a large commercial cannery in California found bitter fruit in a zucchini planting. The zucchini seed had been purchased from a third seed company. Both canned and fresh zucchini samples were sent to Auburn for analysis.

During the same period, 22 cases of food poisoning traceable to commercially canned zucchini were reported to Public Health Service authorities in Queensland, Australia. Twenty-one of the cases were traced to seed from a fourth seed company and the 22nd case was from the same cultivar as grown in California. The same compound, cucurbitacin E, was found to be responsible for the bitterness in all the squash samples. The quantities found in both squash types were potentially hazardous to humans if consumed.

In the home gardens in Alabama where bitter fruit were found, only one plant in the garden had bitter fruit. In California, it was estimated that only one plant in 3,000 was bitter. The entire lot of the commercially canned zucchini in California had to be destroyed, however, because one small piece of bitter zucchini in a can made the entire can extremely bitter and there was no way to tell which cans contained bitter zucchini. The plants that produced these bitter fruits probably resulted from a mutation to an ancestral condition or from a chance pollination (outcross) with a wild species.



Bitter zucchini analyzed by the Alabama Agricultural Experiment Station.

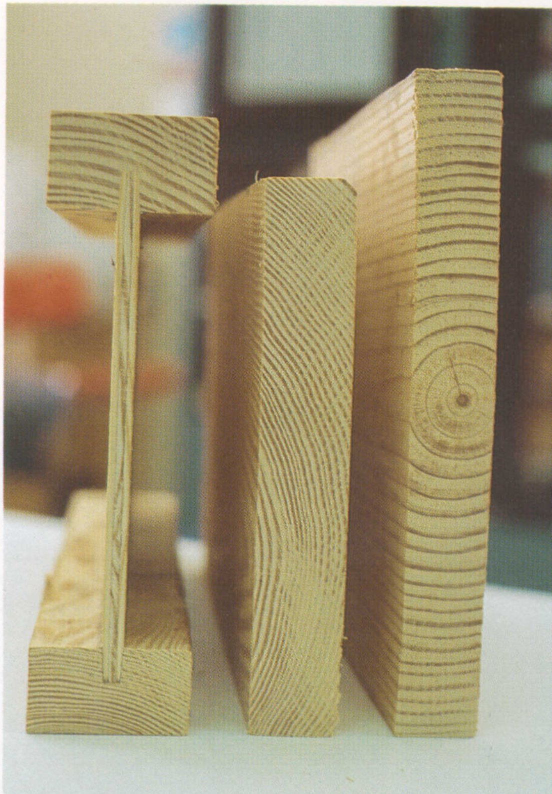
There was no difference in appearance between the bitter and non-bitter plants or fruit of the yellow straightneck squash in the Alabama garden. The gardener destroyed these plants before seed could be obtained. However, seed from the same commercial source that resulted in the bitter yellow straightneck squash were planted in the greenhouse at Auburn. Cotyledons from over 300 of the seedlings were tasted and no bitterness was detected in any of them. Seeds were saved from one of the bitter zucchini fruit in the California planting. Plants grown from these seed were segregated for bitter and non-bitter plant and fruit type.

The fruit from bitter zucchini seedlings showed variations in size, shape, and coloring, see figure, while normal yellow straightneck and normal zucchini were uniform. A complete genetic study is being conducted with seed from these fruit to determine the genetic basis for the occurrence of bitter squash.

The quantity of cucurbitacin E found in the bitter yellow straightneck squash fruit averaged 3.10 mg of the compound per gram of fresh fruit. The canned zucchini sample contained 0.93 mg per gram of can contents, and the fresh zucchini sample contained 7.20 mg per gram of flesh at the stem end with lesser amounts in other portions of the fruit. One of the zucchini fruit that was analyzed in Australia was reported to contain 1.12 mg per gram.

Despite cucurbitacins being among the most bitter compounds known to man, with a taste detection threshold of 10 parts per billion, at least 22 people reported illness from consuming bitter canned zucchini. Characteristic symptoms of the Australian victims included stomach cramps, diarrhea, and occasionally collapse. It may be assumed that one would not consume much of an intensely bitter squash serving, but the cucurbitacins are highly toxic with only a small amount being harmful to man.

While the occurrences reported here are rare, it is well to be alerted that, "If the squash is bitter, don't swallow it."



Composite I-beam Compares Favorably with Traditional Solid Sawn Lumber

R.J. LEICHTI and R.C. Tang, Department of Forestry

Light frame structural elements tested were, left to right, composite I-beam, 2 x 10, and 2 x 12.

THE FOREST RESOURCE that provides solid sawn timber products traditionally employed for light frame and agricultural construction systems in this country is changing. Saw log quality and quantity are slowly declining. The larger and longer sections needed for floor and roof framing, such as 2 x 10's and 2 x 12's with 20-ft. lengths in structural grades No. 2 and better, are becoming less available and more expensive. In addition, although lumber is graded, there is increasing evidence that the grading system does not effectively distinguish lumber quality.

A possible solution to the problem, and one that could have economic advantages for Alabama, involves the use of composite I-beams to replace solid sawn beams. Such composite beams, fabricated from smaller, less valuable timber, proved suitable for construction use in Alabama Agricultural Experiment Station tests. Use of such materials could provide a market for heretofore unused wood products while filling a need for building materials.

The Auburn study was developed to establish more efficient methods of using available forest resources in structural application. Specifically, it investigated the relative performance of composite I-beams in comparison to traditional solid sawn lumber.

Improved technology has made available a new generation of woodbased panels manufactured from otherwise unusable and less desirable trees, especially the broad-leaved species. Because these panel products are characterized by several outstanding qualities, they have found application as shear webs in built-up structural elements. These built-up members have been used as substitutes for traditional sawn lumber.

The experimental composite I-beams were fabricated in 20-ft. sections with butt joints in the webs at 4-ft. intervals. The web materials were (1) 3/8-in., three-ply southern pine structural-1 plywood, (2) 3/8-in. oriented strand board (OSB), and (3) 3/8-in. waferboard, see photo. Both the OSB and waferboard were composed primarily of aspen. The length of the panel used as web materials was perpendicular to the beam axis.

Flanges were southern pine lumber of select structural grade with suitable machine-stress rating for stiffness. Flange lumber contained finger joints at random intervals greater than 72 in. A phenol formaldehyde adhesive, which is highly water resistant, was used in the flange-web joint and butt joints. All beams were cut to 16-ft. length for static bending tests.

Solid lumber specimens tested were No. 2 southern pine 2 x 10's and 2 x 12's purchased in 20-ft. pieces. No quality selection was done at time of purchase, other than to specify each piece had to be grade stamped. The lumber was cut to 16-ft. lengths by trimming each end. No attempt was made to relocate natural defects or improve grade by trimming.

All I-beams and lumber were tested statically under a 1/3-point bending load on a 15-ft. span at the Experiment Station's Forest Products Laboratory. A computer controlled data acquisition system scanned remote instrumentation for load and deflection data. Four pieces of each fabricated beam type and solid sawn lumber were tested.

Maximum load capacity of the 20 structural elements averaged about 5,700 lb., and differences among the five types were not statistically different. The statistical variation of maximum load was found to be extremely small for all three types of manufactured I-beams. The solid sawn lumber demonstrated variations typical of wood in static bending tests.

Serviceability in structural design is often governed by deflection, and this characteristic varied significantly among the test products. Further inspection showed the primary variation was between the OSB-webbed I-beams, which were the stiffest, and the lumber 2 x 10's, which were the least stiff.

Even though web material did not appear to affect engineering performance, web substrate did influence the failure traits of the I-beams. Failures in the I-beams were most often within the webs and the web/flange joints. These usually originated in the vicinity of web butt joints in regions of maximum shear. The lumber fractures were characterized by splintering fractures, which generally began at natural defects, such as knots or grain deviations, within the region of maximum bending moment.

The preliminary research reported provides three specific conclusions regarding I-beam performance and that of traditional sawn lumber:

1. Increased load capacity and decreased deflection should not necessarily be expected by substitution of the 2 x 12 for a 2 x 10 in the No. 2 grade of southern pine.

2. The composite I-beam is a good alternative to traditional elements with respect to maximum load and deflection criteria.

3. Manufactured I-beams show less variation than solid sawn lumber in mechanical properties.

Success of the fabricated I-beams indicates a strong potential for improved utilization of Alabama's total forest resource.

Influence of Conservation Tillage Systems on Corn and Soybean Yields

D.L. THURLOW and J.H. EDWARDS, Department of Agronomy and Soils
J.T. EASON, Sand Mountain Substation

CONSERVATION TILLAGE is a system of managing crop residue on the soil surface with minimum or no tillage. With the development of effective chemical weed control and suitable planting equipment, use of conservation tillage systems has increased considerably in Alabama. Several minimum and no-tillage systems have been developed that produce corn yields equal to or higher than those obtained with conventional tillage. However, additional information is needed on conservation tillage systems for soybeans or soybeans in rotation with corn.

A recent study by the Alabama Agricultural Experiment Station showed that soybean yields were increased by conservation tillage practices and crop rotation. Conventional tillage systems were compared to minimum and no-tillage systems on soybeans, corn, and wheat on a Hartsells fine sandy loam soil on the Sand Mountain Substation at Crossville, from 1981 to 1983.

The minimum tillage treatment consisted of planting corn and soybeans over 8- to 9-in.-deep chisel slots; the no-tillage treatments were planted with a double-disk opener planter directly into the untilled soil surface. Row spacing was 36 in. Cropping sequences were continuous soybeans; continuous corn; corn-soybeans; and corn-wheat for grain-soybeans. Wheat was on all plots as a winter cover, including those plots not used for grain crop. The wheat was killed on the winter cover plots 10 days before planting corn or soybeans.

Continuous soybean yields were increased 16% with the no-till and in-row chiseling tillage systems over conventional tillage in 1981 and 1982, and 52 and 34% by the no-tillage and in-row chiseling tillage, respectively, in 1983. The 3-year average yield of soybeans in 2-year rotation with corn, across all the tillage systems, was 23% higher than under continuous soybeans, table 1.

This reduction of soybean yield under continuous soybeans may be caused by a soybean cyst nematode (SCN) population found in September 1983, table 2. SCN counts were lower in plots where soybeans were rotated with corn than in continuous soybeans, except with conventional tillage. The nematode numbers were further reduced in a double-cropped system with wheat for grain. It is speculated that the reduced time the land was cropped to soybeans is the reason for this reduction in nematode count.

Corn yields in 1983 were 14% higher when rotated with soybeans than when corn was grown continuously, and 8% higher for the 3-year average across all tillage, table 1. Yields in 1983 were 10% lower on conventional tillage than other tillage systems when averaged across all cropping systems, and 7% lower for a 3-year average. SCN was not found in plots where continuous corn was grown. The conventional tillage had higher SCN counts than other tillage treatments. The number of stunt nematodes found under corn in conventional tillage was significantly higher than under other tillage systems. The stunt nematode count under corn was not affected by rotation with soybeans.

The results of this study show that soybean yields were increased by conservation tillage practices and crop rotation. Further, the results suggest that cultivating soybeans exclusively will result in the buildup of soybean cyst nematodes, and cultivating corn exclusively will result in the buildup of stunt nematodes. This may be a factor contributing to lower yields of these crops.

FROM TOP: Soybean growth by August 8, 1983, when planted by conventional tillage, chisel tillage, or no tillage in a continuous soybean cropping system.

TABLE 1. EFFECT OF TILLAGE SYSTEMS AND CROPPING SEQUENCE ON YIELDS OF CORN AND SOYBEANS, 1981-1983

Cropping sequence[1]	Per acre yield by treatment			
	Conventional	Chisel under row	No-tillage	Av.
	Bu.	*Bu.*	*Bu.*	*Bu.*
3-year av. soybean yield				
Soybeans continuous . . .	20.8	27.3	31.8	26.6
Soybeans-corn . .	31.0	32.9	33.8	32.6
Corn-wheat for grain-soybeans . .	33.9	31.2	27.5	30.9
Average.	28.6	30.5	31.0	--
3-year av. corn yield				
Corn continuous . . .	117	110	108	111
Corn-soybeans . .	111	127	118	118
Corn-wheat for grain-soybeans . .	114	127	122	121
Average.	114	121	116	--
2-year av. wheat yield				
Wheat	32.6	31.1	28.7	30.8

[1]Wheat was on all plots as a winter cover, including those plots not used for grain crop.

TABLE 2. EFFECT OF TILLAGE SYSTEMS AND CROPPING SEQUENCE ON SOYBEAN CYST NEMATODE COUNTS FOUND IN SEPTEMBER 1983, AFTER 3 YEARS OF CROPPING

Cropping sequence[1]	Count per 50 cc soil			
	Conventional	Chisel under row	No-tillage	Av.
	Soybean cyst larvae and cyst counts under soybeans			
Soybeans continuous . . .	460	806	498	598
Soybeans-corn . .	1,090	143	21	418
Corn-wheat for grain-soybeans . .	246	13	2	95
Average.	598	321	189	--
	Soybean cyst larvae and cyst counts under corn			
Corn continuous . . .	1	1	1	1
Corn-soybeans . .	100	23	4	42
Corn-wheat for grain-soybeans . .	54	39	3	31
Average.	51	21	2	--

[1]Wheat was on all plots as a winter cover including those plots not used for grain crop.

Ammoniation of Fungus-infected Fescue Hay Improves Weight Gain of Steers

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L.A. SMITH, H.W. GRIMES, and J.L. HOLLIMAN
Black Belt Substation

TREATING LOW-QUALITY FORAGES with anhydrous ammonia has been shown to boost feed intake by cattle by 15 to 20% and to increase digestibility (and therefore available energy) by 8 to 15%. Research done at the Alabama Agricultural Experiment Station (see Fall 1983 issue of *Highlights*) also showed that ammoniation of over-mature johnsongrass hay improved intake by steers 10.1 to 17.6% and increased the total digestible nutrients (TDN, a measure of utilizable feed energy) by 9%.

Previous research had demonstrated that the gains of steers grazing fungus-infected tall fescue pastures were reduced 40% compared to steers grazing fungus-free tall fescue, and that this difference was even larger when steers fed fungus-free hay during hot weather were compared to steers fed fungus-infected hay. No data were available, however, showing the effects of fungus infection on cattle fed fescue hay during the winter months or if ammoniation would overcome the detrimental effects of the fescue fungus.

It was of interest to scientists at the Experiment Station to find that ammoniation of fungus-infected fescue hay dramatically improved its nutritional value for beef cattle.

Kentucky 31 tall fescue at the Black Belt Substation that was either infected with or free of the fungus, *Acremonium coenophialum*, was harvested as hay in large round bales. Half the bales of each type (fungus-infected or fungus-free) were stacked end-to-end in separate stacks, two bales on the ground and one on top, and covered with 6-mil black polyethylene. The edges of the plastic were covered with gravel to seal in the ammonia. Anhydrous ammonia was injected under the plastic, near the middle of each stack, at the rate of 3 lb. per 100 lb. of hay. The treated bales remained covered from the time of ammoniation (August 4) until 3 days before being fed to cattle, at which time bales were removed one at a time as needed. Untreated bales remained outdoors, uncovered, as is normally done with large, round bales.

Beginning November 3, a 47-day drylot feeding trial was conducted using 32 head of steers averaging 562 lb. each. The steers were divided into four groups and the hay was offered free-choice in feeders. Water, salt, and minerals were available at all times.

Results from this experiment are summarized in the table. Ammoniation increased the percent crude protein in both the fungus-free and fungus-infected hay.

EFFECTS OF AMMONIATION OF FUNGUS-INFECTED AND FUNGUS-FREE KENTUCKY 31 TALL FESCUE HAY

Item	Infected, untreated	Infected, ammoniated	Fungus-free, untreated	Fungus-free, ammoniated
Hay analysis (dry matter basis) when fed				
Crude protein, pct.	8.9	14.3	6.7	10.0
Equivalent urea, pct.	0	1.87	0	1.84
Crude fiber, pct.	39.1	38.9	41.2	42.6
Cell wall constituents, pct.	75.2	73.9	78.2	74.2
Dry matter loss from baling to feeding, pct.	6.2	0	9.5	0
Animal performance				
No. animals	8	8	8	8
Daily dry matter intake, lb.	11.3	14.6	11.3	14.2
Increased intake, pct.	--	29.2	--	25.7
Av. daily gain, lb.	.68	1.43	.81	.97
Hay dry matter per lb. gain, lb.	16.6	10.2	14.0	14.6

Crude protein is determined by measuring total nitrogen and multiplying by 6.25. It should be emphasized that this ammoniation procedure adds nonprotein nitrogen (NPN) to the hay, that this is not natural protein, and that the added nitrogen (shown as urea in the table) has little nutritional value for cattle fed only hay and no grain.

The crude fiber and cell wall constituent values show that the fungus-free hay was more mature than the fungus-infected hay. Hay loss during storage was also reduced for the ammoniated hay, probably a result of being covered with plastic.

Steers fed ammoniated hay consumed 29.2 and 25.7% more than those fed untreated hay. This response was greater than expected based on other feeding trials. Ammoniation of the fungus-infected hay resulted in a doubling of the daily gains of steers. Most of the increased gains can be accounted for by the increased consumption; however, it was calculated that the digestible energy value of the fungus-infected hay had to be improved approximately 5% to account for all the increased gains.

The increased gains observed for steers fed ammoniated, fungus-free hay were not as large as expected based upon other feeding trials. Also, as indicated by the feeding efficiency values, there was no improvement in energy digestibility. The lack of increased gains proportional to the increased intake for the ammoniated, fungus-free hay is unexplainable. Comparing the untreated hays, it was found that infection of tall fescue by the *A. coenophialum* fungus decreased cattle performance in cool weather as well as warm weather.

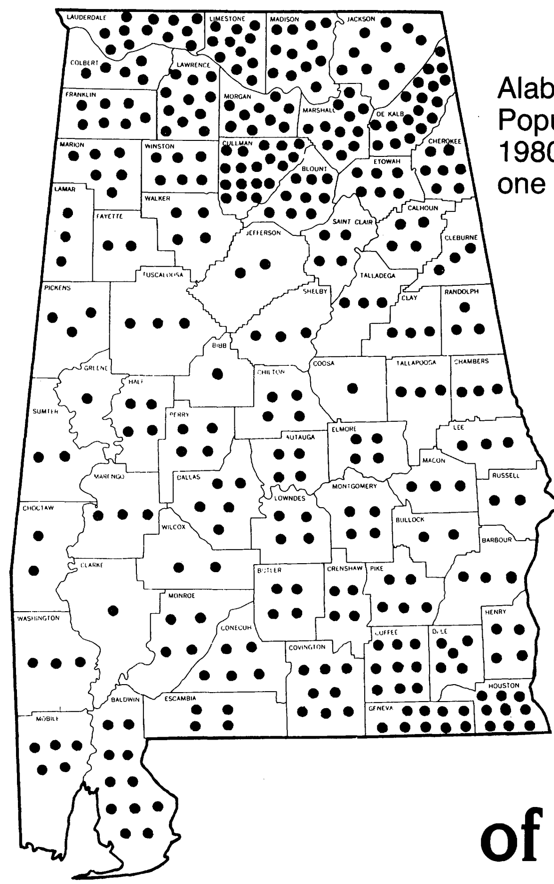
Hay can be ammoniated anytime. In general, the reaction of the ammonia with the lignin and cellulose in the plant takes 7 to 10 days during hot weather and 30 to 45 days during cold weather. Moisture is important for the reaction, with 8 to 10% moisture being adequate but 15 to 30% more desirable. It is recommended that the treated hay remain covered with plastic until 3 to 7 days before being fed.

No toxicity problems have been reported in any cattle fed low quality forages that have been ammoniated. However, researchers in Kansas recently reported that calves nursing cows fed high-quality ammoniated sorghum-sudan hay became hyperexcitable and that some of the calves died. Until more information is available, cow-calf producers should refrain from feeding ammoniated, high-quality hay to cows with nursing calves.

When working with anhydrous ammonia, keep equipment and gauges well maintained, work upwind from the ammonia, wear goggles and rubber gloves, make sure tears and holes in the plastic are taped before application, and have water nearby in case of contact with skin or eyes.

60 Years of Change in Alabama's Farm Population

J.J.MOLNAR
Department of Agricultural Economics and Rural Sociology



Alabama's Farm Population Distribution 1980
one dot = 250 rural farm residents

POPULATION DATA tell a dramatic story about the efficiency of Alabama agriculture. In 1920 there were 1.33 million people living and working on farms in the State. By 1980 the number had plummeted to 87,471, but this efficient group was producing the raw materials to support an agricultural industry that is a major contributor to Alabama's total economy.

The farm population is identified only in rural areas and includes all persons living on places of 1 acre or more from which at least $1,000 worth of agricultural products were sold in the previous year. Thus, owner-operators living in urban places and individuals residing on acreages that did not meet the sales criterion are excluded from the farm population.

The table, reporting data used in Alabama Agricultural Experiment Station research, shows trends in Alabama's farm population over the last 60 years. Some changes in definition occurred over the span, but the figures remain generally comparable. For the State as a whole, about 2.3% of the population is classified as rural farm (87,000 out of 3.9 million). Total population grew steadily over the 60-year period, going from 2.3 to 3.9 million.

The decline in the number of rural farm people is largely similar among whites and nonwhites, although in the last 2 decades the nonwhite rural farm population has dropped even faster. Until the 1960's, a higher proportion of nonwhites tended to be farm residents, but in 1980 only 0.5% of the nonwhite population was classified as rural farm compared to 2.9% of the white population. Nonwhites now represent about 5.7% of the State's rural farm population compared to 38.6% in 1920.

The map shows the distribution of rural farm persons across Alabama. This segment of the population tends to be clustered in the northern and southeastern parts of the State. Cullman and DeKalb show the largest number of rural farm people, more than 4,500, reflecting the many small and part-time farms found in these counties. Madison, Lauderdale, and Limestone have around 3,000, and Lawrence, Morgan, Marshall, Blount, Baldwin, Coffee, Geneva, and Houston have more than 2,000 rural farm residents each. Clarke, Wilcox, Bibb, Greene, Bullock, and Coosa counties each have fewer than 500 rural farm residents.

Although not shown in the table or map, counties also can be compared on the percentage of their population that is rural farm. DeKalb, Cherokee, Lawrence, and Geneva counties have the highest proportion of rural farm residents, more than 8% each. Four central-city metropolitan counties—Montgomery, Jefferson, Mobile, and Calhoun—and Lee County have less than 1% rural farm residents.

The shrinking number of rural farm people has important implications for the conservation, wise use, and productive development of the State's fundamental natural resource, the land (about 27% of the State's land area is in agriculture and more than two-thirds is forested). Fewer people are using increasingly potent technology to make significant decisions about larger sets of natural resources. These decisions can protect our soil and water assets for the future and generate employment for many people today, or result in waste and a legacy of lost opportunity. Education and research efforts must reach a narrower segment of the population with effective solutions to current and long-range problems to generate more jobs, business activity, and income from the agricultural economy, as well as assure well-being for all Alabamians.

Farmers may be small in numbers, but they continue to be a vital force in Alabama's economy.

TRENDS IN ALABAMA'S RURAL FARM POPULATION BY RACE, 1920-80

Year	White			Nonwhite			Total population
	Total	Farm population		Total	Farm population		
	No.	*No.*	*Pct.*	*No.*	*No.*	*Pct.*	*No.*
1920	1,447,032	819,162	56.6	900,562	515,082	57.2	2,347,594
1930	1,700,844	839,531	49.4	944,834	496,542	52.6	2,645,678
1940	1,849,097	860,687	46.5	983,290	477,767	48.6	2,832,387
1950	2,079,591	641,908	30.9	982,152	318,585	32.4	3,061,743
1960	2,283,617	278,024	12.2	983,123	124,831	12.7	3,266,740
1970	2,535,823	128,997	5.1	903,000	30,482	3.4	3,438,823
1980	2,873,289	82,500	2.9	996,283	4,971	.5	3,869,572

Application System Critical for Effective Cole Crop Insect Control with *Bacillus thuringiensis*

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COMMERCIAL FORMULATIONS of *Bacillus thuringiensis* (Bt) have been, for many years, standard recommended materials for the control of the moth and butterfly caterpillar pests of cole crops such as cabbage, collard, and broccoli. As early as 1969, excellent results were obtained in controlling cabbage looper and imported cabbageworm on collards in Alabama.

Alabama Agricultural Experiment Station researchers have continued to test new formulations of Bt and other biological insecticides against this pest group. To more efficiently evaluate these materials, various types of application equipment have been used in different years. Equipment was sought which would allow rapid treatment of plots, minimization of drift, and use in small plots, while simulating the coverage provided by systems used by commercial growers.

In some years, Bt did not provide the near complete reduction of looper and cabbageworm populations seen in previous years. The possibility of insect resistance to the products was considered. This, however, was believed unlikely because there were no reports of resistance to Bt in other agricultural areas where its use had been much heavier than in Alabama. It was considered, therefore, that application techniques might be responsible for the variations seen in the effectiveness of annual treatments with Bt, and a field trial was established at the North Alabama Horticulture Substation to test this hypothesis.

Four application techniques which had been used during previous years of testing were compared by applying equal rates of Dipel®, a commercial Bt product, and spray additives. Application volume varied with type of application, as did plot size. The four application techniques were as follows: Super Blue Boy 6000 high clearance sprayer; John Bean Air Crop RC 20 Airblast Sprayer; B&G hand pump, compressed air sprayer; carbon dioxide (CO_2) pressurized hand sprayer with a three-nozzle boom.

The air-blast sprayer, used in earliest tests, delivered 90 gal. per acre with almost hurricane force and action over the plants, causing them to bend under the 550 lb. per sq. in. directed spray blast.

The high clearance sprayer delivered spray to the collards through three hollow cone nozzles—one over the top and two on drops directed into the sides of the plants at a 45° downward angle. This machine was operated at 250 lb. per sq. in. and delivered 90 gal. per acre.

The B&G hand pumped sprayer, pumped uniformly for each plot, sprayed and delivered 20 gal. per acre by spraying each row three times—once over the top and once into each side of the plants while walking down the rows.

The CO_2 pressurized boom sprayer had three hollow cone nozzles, one over the top and two on drops angled toward the sides of the plants. It delivered 13 gal. per acre under 40 lb. per sq. in. Coverage was monitored by including an agricultural spray dye in each system.

Treatments were applied August 13, one week after transplanting collard seedlings, and were continued at weekly intervals for 5 weeks until the plants were of harvestable size. Insect counts and plant damage determinations were made at intervals during the spray period.

During the middle of the spray period, September 2, insect counts indicated that larvae were being reduced more effectively by the air-blast and hand pump systems, see table. These differences disappeared by September 23, as populations were reduced by a naturally occurring virus infection, see table. Average damage ratings did not reflect differences among application techniques, although they do indicate that all techniques protected the plants.

Observations of the dye deposits on treated leaves indicated that the air-blast and hand pump systems provided the most uniform coverage. These application techniques deposited high amounts of formulation to both upper and lower leaf surfaces, while the high clearance and CO_2 pressurized systems deposited spray to upper leaf surfaces only.

Since the cabbage looper normally feeds on the lower leaf surface, it appears that systems which place the spray on the undersides of the leaves will be the most effective. Gallonage is less important than coverage. Commercial growers would be encouraged to invest in an application system which can deliver insecticides uniformly to both upper and lower leaf surfaces.

CABBAGE LOOPER LARVAL COUNTS PER PLANT AND PERCENT DEFOLIATION OF COLLARDS FOLLOWING WEEKLY TREATMENTS BEGINNING AUGUST 13, 1981, WITH DIPEL AT 1.0 LB. PER ACRE[1]

Application method	Total loopers		Pct. defoliation		
	Sept. 2	Sept. 23	Sept. 2	Sept. 16	Sept. 23
High clearance	4.21	0.91	3.98	3.51	2.16
Air blast	.96	.52	3.27	2.21	1.55
Hand pump	1.75	.98	2.58	3.20	2.29
Carbon dioxide	3.46	1.18	3.54	5.18	3.53
Control	5.38	2.10	9.12	16.94	12.39

[1]All spray mixes contained 0.1% Chevron Spreader.

Carryover Residue Levels of Alar in Apple Trees Sprayed the Preceding Spring and Summer

W.A. DOZIER, JR., K.S. RYMAL, and J.W. KNOWLES, Department of Horticulture

DAMINOZIDE (ALAR®) applied as foliar sprays has been used as an aid in overcoming certain physiological problems associated with apple production. Daminozide decreases vegetative growth and enhances flowering and fruiting of young trees when applied 21 days after bloom. Daminozide applied 8 weeks prior to harvest increases fruit firmness and red color development, delays maturity, prevents fruit drop, reduces scald, and delays the development of water core. These effects are of great economic advantage to apple growers.

Recently, however, there has been concern over the use of daminozide because of its implication in the production of tumors in mice, and because its hydrolysis or thermal breakdown product, 1,1-dimethyl-hydrazine (UDMH), has been shown to be a carcinogen.

Recent research work at the Alabama Agricultural Experiment Station has shown that daminozide, when used properly, presents no residue problem. The EPA tolerance level of 30 p.p.m. for daminozide residue is much greater than that found in treated fruit. Daminozide residues in fresh apples and daminozide residues and UDMH in processed applesauce were found to be low and well below the EPA tolerance levels when daminozide was applied at recommended rates and time of application.

However, some questions were raised about the carryover of daminozide in treated plants and whether this carryover residue could accumulate in the fruit. A study was initiated to determine the daminozide residue levels in fruit and other plant parts the year following treatment application.

Daminozide was applied as foliar sprays in 1982 at the recommended amount of 1.5 lb. of daminozide in 100 gal. water (1,500 p.p.m.) and at excessive rates of 3,000 and 6,000 p.p.m. Sprays were applied 21 days after full bloom, 8 weeks before harvest, 2 weeks before harvest, and on the day of harvest. Residue levels were determined in spur buds, bark, and xylem, and terminal buds, bark, xylem, and lateral buds of current year's vegetative growth on December 20, 1982, and March 24 and August 25, 1983. Residue levels were determined in fruit samples collected at maturity on August 25, 1983.

Daminozide residues were found in all plant parts at each sample date and the levels of the residues were affected by both the rate and time of applicaton. In general, residue levels increased as rates were increased, but the response to rate was less when treatments were applied 21 days after bloom than when treatments were applied closer to harvest. Daminozide applied at the early application date had either dissipated or been diluted by tree and fruit growth over the summer so there were smaller differences in residues due to rate of daminozide. Residue levels were found to increase as treatments were applied closer to harvest.

On the December sampling date, the highest residue levels were found in the spur and terminal buds and spur bark and xylem, while the lowest residues were found in the stem bark and xylem. In March, residue levels increased in all buds (terminal, spur, and lateral); as buds began to swell, daminozide moved into them from other parts of the tree. By August 25, 1983, however, there were few differences between treatments, and residue levels were about the same for all plant parts. Contrary to previous reports for the South, daminozide residues in apple trees are persistent throughout the winter in Alabama.

Residues of daminozide were found in apple fruit harvested in 1983, a year after application of the growth regulator. However, residue levels were below 1 p.p.m. for all treatments except those at 3 and 6 lb. per 100 gal. applied on the day of harvest in 1982 which had residue levels of 1.4 and 2.4 p.p.m., respectively. Use of daminozide posed no problem with carryover residues in fruit when spray applications were made at the recommended rate and application dates. When daminozide was applied at 1.5 lb. per 100 gal. at the proper times, the residue levels in plant parts were present at low levels and did not differ significantly from check treatments.

Daminozide residues were found in all vegetative plant parts with the highest residue levels being in the buds. Daminozide residues persisted through the dormant season but had dissipated by harvest time the season following treatment application. Residue levels found in the fruit the season following application were very low. From this data, the use of daminozide would pose no problem with carryover residues in fruit when spray applications were made at the recommended rate and application dates.

DAMINOZIDE CARRYOVER RESIDUE LEVELS (P.P.M.) SAMPLED IN APPLE TREE PARTS AND FRUIT

Plant material sampled	Residue by application rate and treatment date					
	1,500 p.p.m.			6,000 p.p.m.		
	4-22	6-29	8-25	4-22	6-29	8-25
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*
			December 20, 1982			
Spur bud	9.5	35.2	149.9	24.9	148.6	496.2
Spur bark	3.1	17.5	64.7	11.4	71.8	164.0
Spur xylem	4.6	12.5	54.4	11.0	57.2	139.0
Terminal bud	17.0	28.2	153.7	21.8	155.1	621.7
Lateral bud	3.3	9.3	30.3	5.8	24.2	121.1
Stem xylem	2.4	3.1	12.1	3.8	10.5	39.3
Stem bark	2.2	4.1	17.8	4.3	16.1	60.3
			March 24, 1983			
Spur bud	10.9	55.9	262.1	38.4	235.4	746.2
Spur bark	3.2	9.4	55.3	8.4	51.5	166.8
Spur xylem	3.7	6.3	45.8	10.1	42.5	192.7
Terminal bud	25.4	41.5	306.7	34.5	201.9	1020.9
Lateral bud	10.4	15.0	118.5	11.9	53.2	441.9
Stem xylem	1.5	3.2	14.6	2.8	10.2	54.8
Stem bark	.8	5.2	23.0	3.1	16.0	91.0
			August 25, 1983			
Spur bud	16.2	17.1	14.9	13.2	10.9	31.2
Spur bark	13.7	11.1	17.5	11.6	18.5	33.1
Spur xylem	9.6	8.7	18.6	9.4	15.5	32.9
Terminal bud	44.4	37.4	41.1	32.7	18.2	42.9
Lateral bud	19.7	40.6	10.8	19.8	10.5	35.3
Stem xylem	3.3	6.2	6.4	6.1	14.0	10.6
Stem bark	7.9	9.3	14.7	13.0	15.2	15.4
Fruit	.4	.1	.6	.2	.6	2.4

MANAGING ALFALFA FOR HAY

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GETTING YOUR money's worth out of alfalfa calls for good management. This includes timing hay cuttings for top yield and quality and for long lasting stands.

Preliminary results of Alabama Agricultural Experiment Station research indicate that cutting once or twice at the bud stage, with other cuttings at early bloom, provides a good combination of yield and hay quality. Making all cuttings at the bud stage reduced total yield. How this cutting management—and date of last cutting—affects stand life will be determined as the project progresses.

The test plantings were made in October 1982, with Florida 77 alfalfa seeded at Shorter, Marion Junction, Fairhope, Brewton, and Prattville. All sites except Marion Junction had acid soil and were limed to bring the soil pH to 6.5. The Marion Junction test is on an alkaline Sumter soil. Plant nutrients were incorporated at 0-60-200 (lb. N, P, K) plus 4 lb. boron (B) per acre at all locations. The alfalfa seed were inoculated and broadcast on the surface at 20 lb. per acre and cultipacked to firm the seed to the soil.

Experimental cutting treatments began in spring 1983 to compare yield under different harvest schedules and to determine how date of final harvest affects stand longevity included:

Treatment	*Stage of cutting*
A	Bud[1], bloom[2] thereafter
B	Bloom, then bud alternating with bloom
C	Bud, then bloom alternating with bud
D	Bud continuously
E	Bloom continuously
F	Bud, bloom, bud, bloom (last cut in September)
G	Bud, bloom, bud, bloom, bloom (last cut in November)
H	Bud, bloom, bud, bloom, bloom, (last cut in December)

[1]Bud stage is characterized by a developed and swollen flower bud, usually 7-10 days before flowering.

[2]Bloom is when 10-25% of plants have flowers.

Treatment E represents the presently recommended hay management for alfalfa—harvested when 10% of plants have bloomed ("bloom stage"). At this growth stage the plants are still leafy and contain about 18-20% crude protein. After being harvested, it takes alfalfa about 30 days to again reach the bloom stage. This provides sufficient time for plants to store starch in their roots for a strong regrowth following the next cutting or after overwintering.

Yield of alfalfa hay averaged over all locations ranged from 10,750 lb. per acre for stands cut repeatedly at the bloom stage to 8,900 lb. when cut repeatedly at the bud stage. All other treatments were intermediate in yield, see table.

Harvesting alfalfa at the bud stage in early spring followed by four harvests at the bloom stage did not reduce yields below the recommended cutting management. However, harvesting more than one time each year at the bud stage reduced hay yield by slightly more than 1/2 ton per acre.

The reduction in yield from more frequent bud stage cuttings may be offset by the higher quality of hay obtained at this younger stage of growth. Hand separation of alfalfa plants into leaves and stems revealed that bud stage has 57% leaves, compared to approximately 50% for the bloom stage. Leaves of alfalfa contain higher percentages of crude protein, sugars, vitamins, and minerals than do the stems.

As might be expected, higher average hay yields during the first season were obtained from plots harvested the last time in November, as compared to September or October cuttings. It will take several seasons to fully assess the influence of late fall harvests on alfalfa persistence.

Among the experimental locations, highest per acre hay yields were obtained at Fairhope (15,500 lb.), followed by Prattville (12,750 lb.), Brewton (9,650 lb.), Marion Junction (8,300 lb.), and Shorter (4,300 lb.). Yields at Shorter and Marion Junction were restricted by low rainfall in August, September, and October.

At locations where high populations of the alfalfa weevil developed on the spring growth, plots harvested at the bud stage suffered less weevil damage and had higher yields than where the first harvest was delayed to the bloom stage. This relationship was noted at Marion Junction and Fairhope.

Since the alfalfa weevil affects only the first spring harvest, a logical approach to avoid use of pesticides is to harvest the first cutting at the bud stage. This will eliminate the weevil by taking away its food supply. Although taking the first cutting at the bud stage may reduce yield, the hay will be leafier and higher in quality than if cut at a more advanced growth stage.

In summary, the results of 1 year's comparison of different clipping frequencies show that alfalfa cut at the bud stage each time will result in a lowered yield. Alfalfa can be harvested in the bud stage once or twice annually if subsequent harvests are made at an early bloom stage. Since summer showers are a major problem with hay making, this schedule offers flexibility for fitting the cutting schedule with the weather.

While higher yields are usually obtained by delaying harvest to the bloom stage, cutting can be done at an earlier stage without fear of reducing total hay yield for the season. Serious alfalfa weevil damage can be avoided without the use of pesticides by making the first harvest of alfalfa each spring at the bud stage. This eliminates the weevil's feed source and provides a leafy, high quality hay.

EFFECT OF CUTTING MANAGEMENT ON ALFALFA HAY YIELDS

Treatment	No. of cuttings and hay yield/acre, by location										Av. yield, all locations
	Marion Jct.		Brewton		Shorter		Fairhope		Prattville		
	Cuttings	Yield	Cuttings	Yield	Cuttings	Yield	Cuttings	Yield	Cuttings	Yield	
	No.	*Lb.*	*No.*	*Lb.*	*No.*	*Lb.*	*No.*	*Lb.*	*No.*	*Lb.*	*Lb.*
A	5	9,700	6	10,400	5	4,050	6	16,100	6	12,800	10,600
B	4	7,400	8	9,400	5	5,050	6	14,450	6	15,350	10,350
C	5	8,950	8	8,850	5	3,400	6	15,450	6	12,150	9,850
D	5	6,600	8	8,400	6	4,450	7	14,350	6	10,750	8,900
E	4	7,400	7	11,600	5	5,050	7	15,250	6	14,450	10,750
F	5	9,100	5	8,800	5	4,250	7	15,000	6	11,700	9,800
G	5	8,250	7	9,300	5	4,000	6	16,800	6	12,750	10,200
H	5	9,200	6	10,500	5	3,950	6	16,750	6	12,100	10,500
Mean		8,300		9,650		4,300		15,500		12,750	

Herbicides an Essential Component for Profitable Weed Control Systems

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DEPENDENCE ON HERBICIDES for weed control in cotton is at an all-time high. Concurrently, there is less dependence on cultivating and hoeing. And there appears to be sound logic in this trend.

Results of Alabama Agricultural Experiment Station research leave no doubt that herbicides are essential for profitable cotton production. Cultivation alone provided unacceptable weed control and lost money in all cases. Hand-hoeing simply costs too much to be practical as a major weed control method. Herbicides alone or in combination with cultivating proved to be the most economical and affordable weed control method in the 4-year project at the Tennessee Valley Substation, Belle Mina.

Cotton for the test was planted in early April each year in replicated plots that consisted of 4 rows spaced 42 in. apart and 20 ft. long. Weed species present in the experimental, Decatur clay loam area were large crabgrass, redroot pigweed, annual morningglories, prickly sida, and common lambsquarters.

Treflan® preplant incorporated and Karmex® and Cotoran®/Lanex® preemergence were the herbicides tried (rates of 0.75, 1.0, and 2.0 lb. active ingredient (a.i.) per acre, respectively). Plots were left uncultivated or had 1, 2, or 3 cultivations following the herbicide.

TABLE 1. EFFECTS OF CULTIVATING ALONE OR IN COMBINATION WITH HAND-HOEING ON NET RETURNS

Treatment		Returns to land, mgt./acre			
Cult.	Hoeing	1977	1978	1979	1980
		Dol.	*Dol.*	*Dol.*	*Dol.*
1	0	-166	-162	-170	- 89
2	0	-162	-142	-198	-170
3	0	-182	-170	-140	-154
4	0	-142	-190	- 81	-125
1	1	-259	-182	- 69	-194
2	2	69	101	- 24	- 32
3	3	134	121	259	141
4	4	69	57	198	- 8
0	0	- 93	-125	-158	-142

In addition to the herbicide plus cultivation treatments, combinations of cultivations (1, 2, 3, or 4) and hand-hoeings (1, 2, 3, or 4) were also tried. Cultivating began in May and continued bi-weekly until mid-July. Plots were hand-hoed at time of each cultivation to achieve weed-free status.

Gross receipts were determined for each plot based on a price of 70¢ per lb. for lint and $100 per ton for seed. Costs of production were determined by adding actual weed control costs to expenses listed in budgets prepared by the Alabama Cooperative Extension Service.

The cost of each herbicide treatment included application and chemical costs. Chemical costs were based on an average price quoted by six suppliers statewide: $7.94 per lb. for Treflan, $4.92 per lb. for Karmex, and $8.66 per lb. for Cotoran/Lanex (all a.i. basis). Total chemical costs per acre amounted to $4.95, $4.92, and $17.72, respectively, for Treflan, Karmex, and Cotoran/Lanex.

Cost of hoeing was based on a wage rate of $3.35 per hour, using a 4-year average of time required to clean plots.

Variable costs, harvest costs, fixed machine costs, and labor costs were adjusted according to yield, cultivations, and herbicide treatment. Based on these amounts, net returns to land and management were determined for each treatment. These returns reflect the weed control from each method.

Cultivation alone lost money all 4 years, table 1. At least two cultivations plus two hand-hoeings were needed to provide a positive net return. All cultivation or cultivation plus hand-hoeing treatments lost money in 1980, a year of low yields and high hand-hoeing costs.

Cotoran/Lanex was the only herbicide that produced a positive net return without cultivation, table 2, and adding cultivations did not increase returns. In contrast, Treflan and Karmex lost money when used without cultivation. As many as two cultivations were required for Treflan to be profitable. Karmex required at least one cultivation and sometimes three to provide full returns. On occasion, Karmex plus cultivations equaled the Cotoran/Lanex treatments. Returns from Treflan never reached the level of returns from the other herbicides, but returns were positive in most Treflan-cultivation systems.

Although its cost was three times that of Karmex or Treflan, Cotoran/Lanex provided the highest net return because of its superior control of the weeds present. Results could change, of course, if the weed spectrum becomes more or less susceptible to these herbicides.

Cultivations alone provided unacceptable weed control and thus lost money in all cases. Herbicides alone or in tandem with cultivation provided the most economical and affordable weed control method. With current cost and availability of hand labor, hand-hoeing appears cost prohibitive, although in combination with cultivations it provided profits in 3 of the 4 test years.

TABLE 2. EFFECT OF CULTIVATIONS PLUS HERBICIDE ON NET RETURNS

Treatment[1]	Returns to land, mgt./acre			
	1977	1978	1979	1980
	Dol.	*Dol.*	*Dol.*	*Dol.*
Cotoran/Lanex				
0 cult. . . .	178	267	332	231
1 cult. . . .	202	263	409	267
2 cult. . . .	214	287	332	263
3 cult. . . .	174	328	340	251
Treflan				
0 cult. . . .	-166	- 20	-101	-146
1 cult. . . .	40	81	154	- 53
2 cult. . . .	109	146	162	- 57
3 cult. . . .	81	121	368	11
Karmex				
0 cult. . . .	-133	- 8	- 61	- 40
1 cult. . . .	16	219	190	4
2 cult. . . .	36	259	275	235
3 cult. . . .	219	243	421	206
Untreated . . .	- 93	-125	-158	-142

[1]Herbicide rates (lb. a.i. per acre) were 2.0, 0.75, and 1.0, respectively, for Cotoran/Lanex, Treflan, and Karmex.

Litter Separation for Reuse or Fuel

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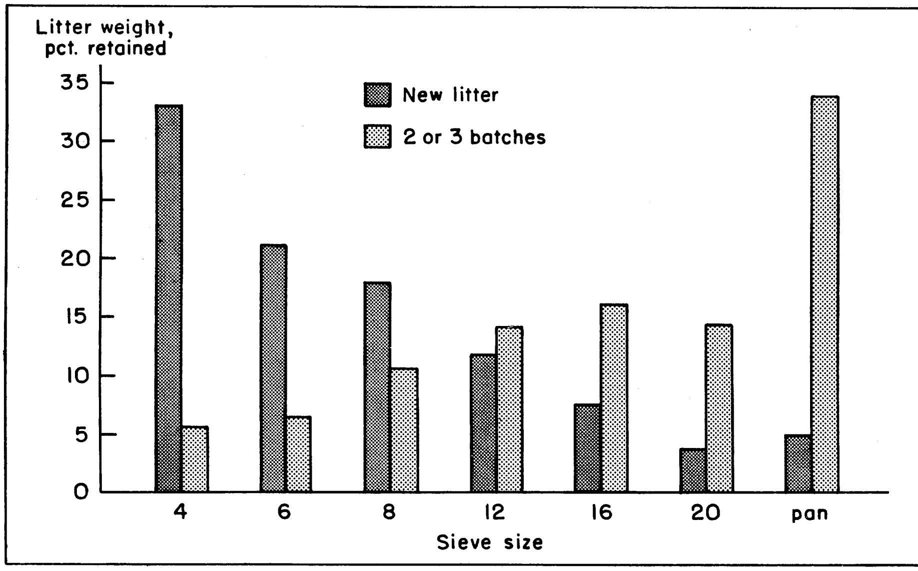

Various fractions held by different sieve sizes are shown for new litter and for litter that had been used for two or three batches of broilers.

BROILER PRODUCERS in Alabama depend mainly upon pine shavings and pine sawdust as a source of litter. Each year over 500 million broilers are grown on this litter and add approximately 2.5 billion lb. of manure (wet basis) to this litter. When broiler houses are cleaned, the shavings-manure mixture is used primarily for fertilizer and as a component of cattle feed. These uses generally require little or no processing.

There has been increasing interest in drying and separation of the larger wood particles from the manure and finer wood particles to increase the value and use potential of these components. Research at the Alabama Agricultural Experiment Station has centered around separation and characterization of these components to determine their potential for use as animal feed, fuel for heating, and for relittering poultry houses.

Initial studies were designed to determine the particulate makeup of pine shavings as they are received from the planer mill. Composite samples were taken from a truckload and separated using a Soiltest® brand shaker equipped with pan type sieves ranging from 4 mesh to 20 mesh (4.75 to 0.85 mm opening) screen sizes. A measured amount of shavings was added to the number 4 (top) sieve and shaken for 5 minutes. The litter fractions retained in each succeeding sieve were collected and weighed. The results of these tests are shown in the figure.

The large particle size consisted of all particles failing to pass the number 8 sieve. This determination was based on fine particle size considered compatible with manure to be pelleted or otherwise used as fertilizer or animal feed. The large particles could then be used for relittering of poultry houses or burning for fuel. Based on an average of multiple tests, the large particle fraction made up 72.1% of the sample and the fines 27.9% of the sample weight.

The second series of trials included litter taken from floor pens following two and three consecutive broods of broilers. When separated at moisture levels normally encountered in broiler houses, large particles made up 22.7% of the total and fines 77.3%. Further separation of the manure from the large particles would require additional processing. The various fractions held by sieves 4 through 20 and passing the 20-mesh sieve are shown in the figure.

This shift in percent of large and fine particles from new shavings represents the dried manure present in the sample. Preliminary separation trials on used litter from various sources point out the variability in consistency of litter and the effect of management factors on litter moisture during the growout. When the litter is allowed to cake during the growout, the large particles stick together, making accurate separation difficult. Along with drying, some type of agitation or grinding may be necessary to completely separate the manure from the large particles of wood.

As the number of successive broods grown on litter increases, the larger wood particles tend to break down, reducing the amount reclaimable for use as fuel or replacement litter. The percentage of original large litter particles reclaimed after 3-4 successive broods is approximately 50 to 70%. This large particle fraction would amount to approximately 6 tons from a 12,000-sq.-ft. broiler house. The fines plus manure would amount to approximately 74 tons.

When predicting relative values of these materials, allowance must be made for planned use and the value of new materials replaced. As poultry litter, the large particle portion of 6 tons would replace new shavings, and would have a value of $150. If this portion were burned in a furnace or boiler, based on relative B.t.u.'s generated and a burning efficiency of 50%, it would replace 466 gal. of LP gas having a value of $359. The fine portion would have a value of approximately $2,590 when mixed into cattle feed and would be worth approximately $740 as fertilizer. Particle size of this fine portion is small enough to blend well with other feed ingredients and would not interfere with the pelleting process, should it be used.

Broiler production trials using unseparated pine shavings, large particles, or fines as litter indicated no major difference in litter management requirements. Although birds grown on large particles had slightly better feed conversions on new litter, no significant differences in feed conversion or weight gain were found, see table. More research is needed to determine how poultry litter may be better utilized and the economics of use.

EFFECT OF LITTER PARTICLE SIZE ON GROWTH AND FEED CONVERSION IN BROILERS

Treatment	4-wk.-old birds		6-wk.-old birds	
	Av. wt.	Feed conv.	Av. wt.	Feed conv.
	Lb.		*Lb.*	
Trial 1[1]				
1-control....	1.70	1.69	3.69	2.12
2-large......	1.74	1.61	3.71	2.04
3-fine.......	1.69	1.61	3.71	2.10
Trial 2A[2]				
1-control....	2.09	1.57	3.89	1.88
2-large......	2.08	1.51	3.89	1.86
3-fine.......	2.09	1.54	3.84	1.88
Trial 3B[3]				
4-control....	1.99	1.59	3.84	1.88
5-large......	2.01	1.54	3.86	1.79
6-fine.......	2.01	1.52	3.87	1.71

[1]Eight replicates per treatment.
[2]New pine shavings used.
[3]Second grow-out on litter.

Minimum-Till Peanuts

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PEANUTS are the number 1 cash crop on most farms in 11 counties in southeast Alabama. In 1983, farmers in these counties planted 183,000 acres of peanuts and produced an average yield of 2,510 lb. per acre.

The price received for peanuts by farmers has not kept pace with the increased cost of production. Profit or loss is often determined by the farmer's ability to control production costs. One way to control such cost is to reduce the number of times a tractor and its equipment passes over a field, particularly when the land is being prepared for planting. "No-till" and "minimum till" are popular terms for planting and growing crops without turning or cultivating the soil. If this technique has a place in peanut production, it offers an opportunity to reduce input costs.

To determine how peanuts might perform under reduced tillage systems, 10 Alabama Agricultural Experiment Station experiments were conducted on cooperating farmers' fields in 1982 and 1983. The Brown-Hardin Row-Till® was used for planting in small-grain stubble or residue (no-till treatment), and this was compared to adjacent, normally cultivated plots. Treatments were replicated four times. Each farmer chose his own herbicide program to control weeds, as well as all other cultural practices.

Researchers at Auburn University made monthly weed counts in each plot during June, July, and August. "White mold hits" were counted in all plots 1 week before harvest (a hit is 12 in. of row that has been killed by white mold). Soil samples were taken from each plot in August and assayed for nematode abundance. Finally, yields and grades were taken for all plots.

Findings from these 2 years of research are encouraging but not definitive. All farmers effectively controlled weeds by chemicals, and yields were unaffected by weed pressure. The major weed species that had to be controlled are listed, table 1. With the exception of horsenettle, carpetweed, wild turnip, spring amaranth, and wild mustard (all of which are controlled by cultivation), these same weeds are generally present in conventionally tilled peanuts.

In no case was white mold more severe in the minimum-tilled plots than in conventional plots. Nor was there any difference in nematode counts between reduced tillage and conventional tillage.

Although weeds, white mold, and nematodes did not appear to affect yield, yield was sometimes affected by tillage, table 2. In 1982,a slight yield increase for minimum tillage occurred at site 2 and a severe yield loss occurred at site 4. In 1983, yield was somewhat higher at site 4 and slightly lower at site 2 with minimum tillage. The reasons for these yield effects are not known. Contradictory yield effects were obtained with peanuts planted in wheat or rye stubble (1983) and in paraquat-killed boot-stage rye (1982).

Clearly, minimum tillage research with peanuts needs to be continued. Whereas reducing tillage on the sandy soils of southeast Alabama seems feasible, eliminating all tillage does not. These sandy soils readily compact, even under the impact of raindrops, and land turning will be needed sometimes during the year to loosen the surface soil to allow for freer movement of air and water into the soil.

TABLE 1. MAJOR WEED SPECIES CONTROLLED IN MINIMUM-TILL PEANUTS, 1982-1983

Site number	Farmer	Soil series	Weed species controlled
			1982
1............	R. & B. Price	Fuquay ls	sicklepod, yellow nutsedge, horsenettle
2............	J. Harden	Orangeburg ls	Florida beggarweed, yellow nutsedge, sicklepod
3............	H. Lee	Norfolk sl	horsenettle, crabgrass
4............	H. Lee	Norfork ls	crabgrass, carpetweed, yellow nutsedge
5............	K. Harden	Bonifay ls	Florida beggarweed, crabgrass
			1983
1............	H. Raley	Varina sl	cowpea, wild turnip, Florida beggarweed
2............	G. Crowley	Dothan sl	crabgrass, spiny amaranth, barnyardgrass
3............	R. Holland	Lucy ls	nutsedge, false morningglory, sicklepod
4............	G. Croft	Fuquay ls	buffalograss, crabgrass, Florida beggarweed
5............	J. Harden	Bonifay sl	Florida beggarweed, nutsedge, wild mustard

TABLE 2. CONVENTIONAL AND MINIMUM-TILL PEANUT YIELDS, 1982-1983

Tillage treatment	Per acre yield by site number				
	1	2	3	4	5
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1982					
Conventional	3,940	4,200	3,980	5,100	4,260
Minimum-till	4,170[3]	4,860[3]	3,770[3]	3,650[3]	4,050[3]
1983					
Conventional	2,800	4,860	2,420	3,370	5,410
Minimum-till	2,600[2]	4,220[1]	2,540[1]	4,370[1]	5,260[1]

[1]Peanuts planted in rye or wheat stubble.
[2]Peanuts planted in oats killed in preboot stage with paraquat.
[3]Peanuts planted in rye killed in boot stage with paraquat.

The Hidden Costs of Income Taxes for Alabama Farmers

G.D. HANSON, Department of Agricultural Economics and Rural Sociology

KEY INCOME TAX provisions and tax rates are currently receiving much attention at both the federal and state legislative levels. It is important to recognize both the advantages and disadvantages of the present tax system as it affects farmers.

Many of the disadvantages of the income tax system are "hidden," not showing up as a cash charge in farm ledgers. To examine these issues, a questionnaire from the Alabama Agricultural Experiment Station addressing income tax issues was mailed to a random sample of 1,000 Alabama farmers in the early spring of 1983.

TAX PREPARATION COSTS: PREPARATION FEES AND HOURS TIME SPENT

Question	Response					
1. Did you prepare your taxes last year?	Yes 84	No 433				
2. What was your tax preparation fee? (dol.)	0-100 272	100-300 112	300-500 27	More than 500 31	Average cost $141	
3. Hours spent on financial record keeping, tax analysis and tax filing? (hr.)	0-39 216	40-79 149	80-119 79	120-199 21	200 or more 26	Average hours 61
4. Farm tax sheltering activity begins at what tax rate? (pct.)	0-9 111	10-19 139	20-29 106	More than 30 69		
5. Tax savings for each hour spent on tax management? (dol.)	0-3 72	3-6 67	6-9 57	9-12 38	More than 12 52	Average savings per hr. $6.50
6. Should tax management have a higher or lower priority?	Higher 376	Unchanged 30	Lower 14			

Survey Findings

Tax complexity problems were explored in several ways. First, individual farmers were asked to indicate their "familiarity" with key tax provisions such as capital gains deductions. Of the farmers responding, 61% expressed little or no familiarity with these key tax provisions. This is disturbing since farm taxpayers need to be well-acquainted with tax provisions to properly and efficiently file and manage their taxes.

Seventy-seven percent of the responses "strongly agree" that tax preparation requires outside assistance, and 60% "strongly agree" that too much tax assistance is needed. The third issue, that legislators should be concerned about the highly complex nature of managing and filing taxes, also received strong agreement from 61% of the farmers responding. Only 1 to 5% of respondents expressed disagreement with the tax complexity issue.

Tax complexity translates into increased tax management and record-keeping costs for farmers, as illustrated in the accompanying table. Only 84 of 517 farmers prepared their own taxes in 1982. Nearly 84% (433) received tax filing assistance.

For most farmers, the cost of tax preparation was less than $100 (line 2), while 112 farmers paid $100-300, 27 farmers $300-500, and 31 farmers paid more than $500 for tax preparation. Multiplying the average amount of each category times the number of responses in that category results in an average estimated tax preparation charge of $141. For farmers with more than 100 tillable acres, the estimated cost was more than twice as high, $288 per farm.

The true cost of tax preparation also includes the time spent keeping such records as sales receipts, cash costs, depreciation, investment credits, and capital gains. As shown in line 3 of the table, 216 of the 491 respondents spent less than 40 hours per year on tax management and record keeping. However, the remaining 56% of respondents spent from 40-79 hours to more than 200 hours.

The average estimated time spent managing taxes was 61 hours. For farms with more than 100 tillable acres, the average estimated time spent was 83 hours. Valuing this time at $5.00 per hour, the combined preparation fee and hours spent in tax management would be $446 for all farms and $703 for farms with more than 100 tillable acres. Time and tax preparation fee costs in the $446-703 range would undoubtedly be a significant share of average income taxes paid by many Alabama farmers (especially in recent low-income years). For those farmers with both high preparation fees and also large numbers of hours spent in record keeping and tax management, the average tax preparation costs would be substantially higher.

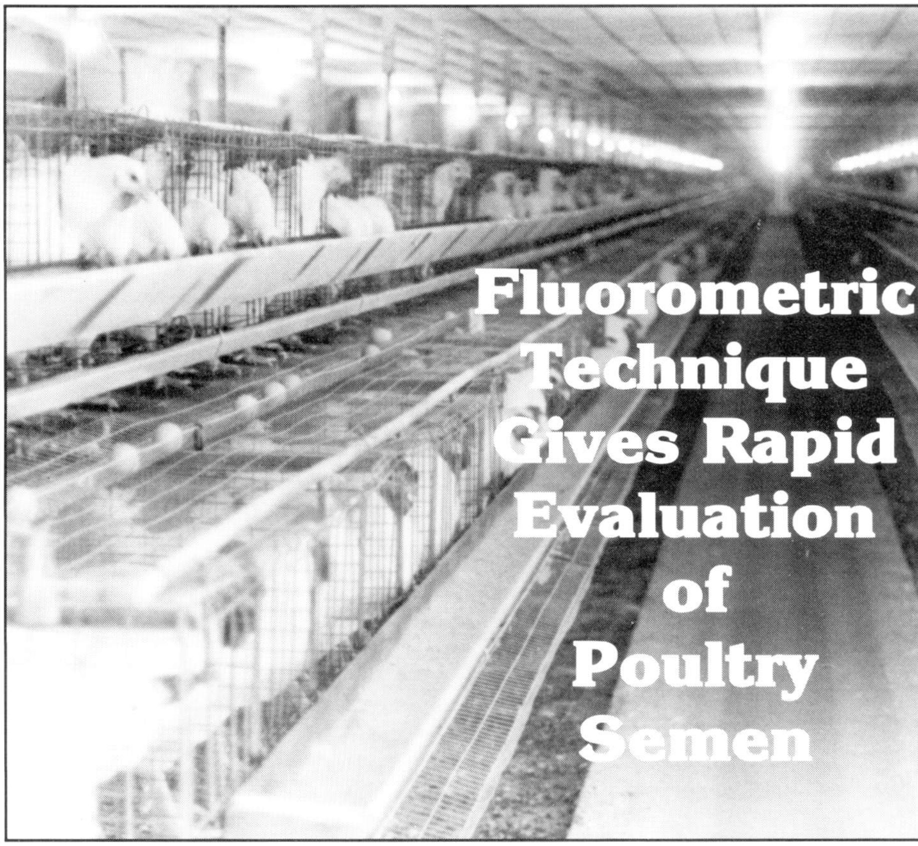
The reasons that tax record keeping and management require large numbers of hours are related to items 4 and 5, see table. First, farmers believe it pays to actively shield farm income at low marginal tax rates. This is shown in line 4 where 250 of the 425 respondents (or 59%) indicated they shield income from taxes in the 0 to 9% and 10 to 19% marginal income tax brackets.

These are relatively low levels of tax rates and this perhaps signifies that tax sheltering strategies are widely available in farming. Supporting this conclusion, item 5 in the table shows that most farmers believe they can achieve more than $6.00 in tax savings for each hour spent managing taxes. That is, 147 of the 286 respondents estimate tax savings are in the range of $6.00 to $8.99 to more than $12.00. For those farmers with more than 100 tillable acres, the average estimated savings per hour was $8.77. Given this relatively high level of tax savings in tax management, it is not surprising that an overwhelming number of farmers, with an opinion on this issue, suggested a higher priority for tax management was suitable (376 of 420 responses).

A final "hidden" cost of the tax system has to do with tax influences on farmer investment decisions. Capital investments can provide immediate tax savings in the form of investment credits, depreciation, and interest deductions. Because of this short run, tax planning may influence farmers to undertake investments to save current tax dollars. However, often such investments weaken the financial health of the firm by "loading" the farm business with higher costs of production and long-term loan repayment commitments. The influence of taxes on investment decisions was tested for in the survey.

There is widespread agreement among respondents that the tax system encourages farmers to substitute machinery and capital for labor (93% agreement), encourages machinery purchases in years of high income (85% agreement), and provides incentives to purchase land to lower taxes (84% agreement). Disagreement with the first two statements was less than 5%, and for the third statement, 16% moderately or strongly disagreed.

The above suggests that tax management has a strong influence on investment decisions. While taxes are an important management factor, economic efficiency (maintaining low-cost production) should be a much more important goal for farmers.



Fluorometric Technique Gives Rapid Evaluation of Poultry Semen

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FERTILITY of the male chicken in a breeder flock is of great concern to the poultry producer. In commercial breeder flocks, sterile males or males with low fertility can be unnoticed due to their normal and healthy appearance. The result is reduced hatchability and lowered income.

Periodical examination of the semen of males and elimination of those producing low quality semen can improve the overall fertility of the flock. Evaluation of the semen quality of males also helps genetic selection programs of the primary breeders by providing them selection criteria to improve fertility.

Various characteristics have been utilized to evaluate semen quality. Concentration and viability of the sperm cells are two important semen quality parameters that have been frequently measured. Sperm concentration can be determined by: (1) direct visual counting using a microscope; (2) measuring the light absorbing capacity (optical density); (3) determining sperm cell volume with rapid centrifugation (spermatocrit); and (4) using automatic cell counters.

Sperm cell viability (or percentage of dead sperm cells) is usually determined by vital stains. Various stains (eosin and nigrosin, bromphenol blue and nigrosin, congo red and nigrosin, trypan blue) have been utilized to differentiate dead sperm from live sperm. Most of these techniques are time-consuming, and their accuracy is easily influenced by stain characteristics, preparation techniques, and by the subjectivity of the examiners. However, a new method, called the fluorometric technique, proved to be reliable and practical in research at the Alabama Agricultural Experiment Station.

Several trials were conducted to determine the applicability of a fluorometric technique for the simultaneous determinaton of concentraton and viability of avian spermatozoa. The technique is based on the ability of a fluorescent dye (ethidium bromide) to enter the dead sperm cells and emit fluorescence upon binding to sperm DNA. An aliquot (10 ul) of semen is added into a test tube containing the dye dissolved in physiological solution. The test tube is then placed in a fluorometer, and the initial fluorescence of the mixture is recorded. The intensity of the initial fluorescence is proportional to the amount of dead sperm cells in the solution.

The total sperm concentration of the mixture is determined by adding digitonin into the test tube. Digitonin allows the dye to penetrate into all the sperm cells in the solution, and the intensity of this second fluorescent peak is proportionate to the total sperm concentration of the mixture. A standard curve is used to relate fluorescent units to sperm concentration, figure 1. The percentage of dead sperm cells in the sample is calculated by taking the ratio of first and second fluorescence readings.

In one trial, the accuracy of fluorometry in determining total sperm concentration was compared with that of spermatocrit and optical density methods. Fluorometric determinations were highly accurate and correlated well with spermatocrit and optical density methods.

In a second trial, fresh pooled semen from White Leghorn males was mixed with various proportions of killed sperm, and the percentage of dead sperm cells in each mixture was determined by fluorometry. The actual percentages of dead sperm cells in each mixture (as determined by fluorometry) agreed closely with predicted theoretical percentages, figure 2.

This fluorometric technique of evaluating avian semen was found to be simple and easily performed. Fluorometry requires a small amount of semen sample and provides a rapid, simultaneous, and accurate determination of avian sperm viability and concentration. Thus, the method may prove valuable for use in breeder flocks.

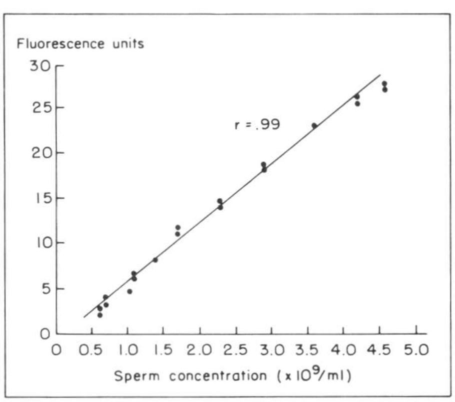

FIG. 1. Relationship between fluorescence and sperm concentration.

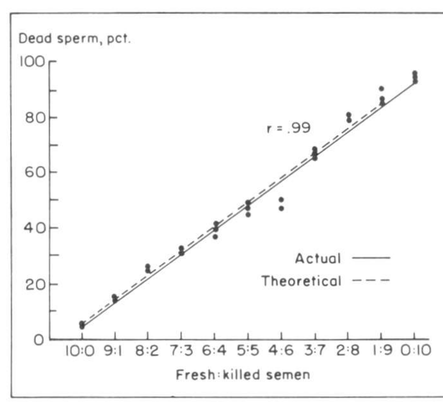

FIG. 2. Percentages of dead sperm cells determined by fluorometry.

Long-Time Yield Trends Present Challenge to Alabama Agriculture

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IN THE EARLY 1950's, 60% of cash farm receipts to Alabama farmers were from crops. In recent years, crops accounted for only about 45% of cash farm receipts. This change came about with growth and development of the livestock and poultry industries to the point that these two segments accounted for a large share of cash farm receipts in the State.

This trend does not indicate declining importance of crop production to Alabama agriculture. To the contrary, crops are of increasing importance as the basis for enhanced livestock and poultry production. Crops will continue to be the basis for a major part of Alabama's total agricultural output. However, there is a need to improve yields to take advantage of the potential for expanded production of certain crops.

Crop yields are important to producers because they generally indicate level of profitability and competitiveness with other producing areas. Such farm costs as interest on the real estate mortgage, depreciation, and taxes are fixed. These do not vary with quantity of production. Therefore, if yields can be increased, fixed costs per unit of production will decline. It is significant, however, that such fixed costs as interest and depreciation increased substantially in the 1970's.

Many variables affect crop yields. Some, such as crop variety, fertilization, and insect and disease control, are controlled by management. In contrast, such variables as soils, weather, and climate generally cannot be controlled.

Long-time yield trends, illustrated by the graphs, show that Alabama has lagged behind in yield improvements in corn, wheat, grain sorghum, soybeans, and potatoes. For the other crops illustrated, Alabama farmers boosted production in about equal proportions with other U.S. farmers during 1954-83.

Between 1954-63 and 1974-83, Alabama's average soybean yields increased only 1.6 bu. per acre, as compared with a 5.5-bu. increase for the United States. For corn, the yield boosts were 42 bu. per acre for the United States but only 21 bu. for Alabama.

The story was different for peanuts, cotton, and sweet potatoes, however, with Alabama yields increasing more than U.S. averages between the two periods. Alabama farmers boosted peanut yields 1,547 lb. per acre between 1954-63 and 1974-83.

Alabama yields were higher in 1982 than in any other year of the 30-year period for corn, oats, grain sorghum, cotton, peanuts, and sweet potatoes. Soybeans averaged the same as in 1971, 26 bu. per acre. Lowest yields for most crops during the 30 years were in 1954, a year of extreme drought.

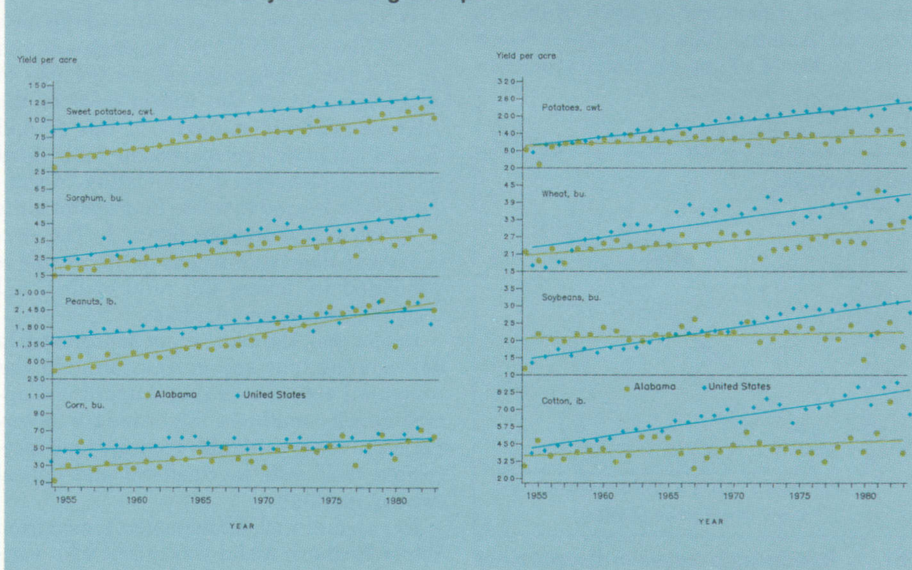
For all crops except peanuts, the average yields for 1974-83 were lower for Alabama than the U.S. average. Alabama is most competitive in production of peanuts, cotton, wheat, and sweet potatoes. With other crops, however, higher yields on individual farms indicate the potential for improvement.

Research of the Alabama Agricultural Experiment Station is giving special attention to overcoming the "yield barrier" that appears to be limiting soybean yields. High yields being recorded in experimental plantings indicate the potential for improvement. High grain sorghum yields are also being produced with practical production systems being used in research. Successful transfer of scientific technology from the Experiment Station to Alabama peanut growers, as illustrated by yield breakthroughs of the recent past, provide reason for optimism with other crops.

COMPARISON OF AVERAGE PER ACRE YIELDS OF MAJOR CROPS, UNITED STATES AND ALABAMA, 1954-63 AND 1974-83

Item	Corn	Oats	Wheat	Sorghum for grain	Soy-beans	Cotton lint	Peanuts	Pota-toes	Sweet pota-toes
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*
Alabama									
1954-63	30.0	32.0	22.7	22.4	20.6	393	927	104.5	55.5
1974-83	50.9	43.9	28.9	35.5	22.2	466	2,474	132.6	100.5
Difference	20.9	11.9	6.2	13.1	1.6	73	1,547	28.1	45.0
United States									
1954-63	53.3	40.4	22.9	33.2	23.0	434	1,108	183.1	71.3
1974-83	95.5	52.3	32.7	53.5'	28.5	489	2,460	263.6	115.8
Difference	42.2	11.9	9.8	20.3	5.5	55	1,352	80.5	44.5
Ala. yield as percentage of United States									
1974-83	53%	84%	88%	66%	78%	95%	101%	50%	87%

Trends in annual yields for eight crops in the United States and Alabama.



Effect of Trickle Irrigation, Nitrogen Rate, and Method of Nitrogen Application on Field-grown Japanese Holly

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Department of Horticulture

INCREASED NURSERY CROP production in the United States has caused nurserymen to seek more effective production practices. One way to produce higher quality plants in a shorter production cycle is with irrigation. Generally, however, irrigation is considered neither economical nor practical for field-grown nursery stock since conventional irrigation practices create heavy demands on available water supplies and are costly to install and maintain. An alternative is trickle irrigation—a more cost effective method for irrigating field-grown nursery stock.

Trickle irrigation is the daily watering of at least 25% of a plant's root system to prevent water stress. This method uses 60 to 70% less water than overhead irrigation as water is applied directly to the root zone at the base of the plant and not between plants and rows.

Diseases are reduced by preventing moisture on the foliage and weeds do not receive the benefits of water between rows. Previous research has also indicated that restricting water to a specific area directly around the plant produces a more compact and fibrous root system. Other possible advantages of trickle irrigation for nursery producers are the injection of fertilizers, preemergence herbicides, and systemic pesticides, thus reducing labor requirements.

The objectives of this Alabama Agricultural Experiment Station study were to determine the effects of trickle irrigation, four nitrogen (N) rates, and three methods of N application on field-grown Compacta Japanese holly. Growth, foliar nutrient content, livability, and visual ratings were measured.

On April 30, 1982, uniform liners of Compacta Japanese holly were planted in a Marvyn loamy sand soil at Auburn University. Plants were spaced 3 ft. within rows and rows were 3 ft. apart. Liners were watered at planting, fertilized according to soil test recommendations except for N, and thereafter maintained according to conventional nursery practices.

Three methods of N application were evaluated at four N rates each. Applications of N consisted of ammonium nitrate (NH_4NO_3) broadcast with and without trickle irrigation, and injection of NH_4NO_3 solution into the irrigation system. The four N rates used were 30, 60, 120, and 240 lb. per acre split equally among four applications during each growing season. These rates were based on the Alabama Cooperative Extension Service's general recommendation of 120 lb. N per acre for field-grown nursery stock.

Trickle irrigation lines of ½-in. black PVC plastic pipe were run to two-thirds of the plants in the study. A Rain Bird J10 pressure-compensating emitter (1 gal. per hour) was installed in the trickle irrigation line at the base of each plant. At the head of half of the irrigation lateral lines, fertilizer was injected by hydraulic displacement of fertilizer from a small plastic container. The fertilizer injection system consisted of a gate valve, two microtubes held in place by brass grommets, and a fertilizer solution container. The gate valve creates a pressure differential in the line forcing water into the solution container through a long microtube running from the main line below the gate valve. As water is forced through the tank, fertilizer is displaced by continual dilution of the fertilizer solution in the tank.

Daily rainfall and net evaporation from a class A pan were recorded throughout the 2-year study. Water was applied when net evaporation reached ½ in. or greater at the rate of 50% replacement of net evaporation. The system was operated from May to October of each year.

Holly growth significantly increased with trickle irrigation. Twelve weeks after initiation of the study, irrigated hollies had produced more new growth than nonirrigated hollies. The difference between the two increased throughout the duration of the study.

Root and shoot dry weights for irrigated hollies were double those of nonirrigated hollies after each growing season. The biggest root increase for the irrigated hollies over the nonirrigated hollies was inside an 8-in. root ball. Both primary and fibrous roots were increased by trickle irrigation in this 8-in. root ball. Fibrous roots were increased threefold for irrigated hollies over nonirrigated hollies. Trickle irrigation produced a higher quality plant that should transplant more successfully because of enhanced root growth, especially fibrous roots.

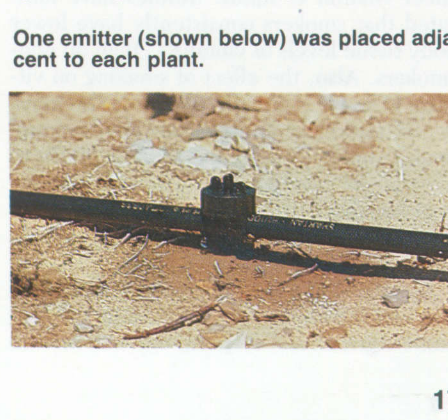
Livability of hollies was also increased by trickle irrigation. Irrigated plants had 24% greater livability the first year and 31% greater the second year than nonirrigated plants. The biggest decrease in percent livability for nonirrigated hollies occurred over the winter. A visual inspection in the fall of the first year revealed nonirrigated plants to have more chlorosis and dieback. This indicates that nonirrigated plants were more stressed by cold weather.

A row of irrigated Japanese holly.

Plants receiving surface-applied N had similar growth compared to those receiving injected N by the end of the 2-year study. No difference was found in visual rating, dry weights of roots and shoots, livability, and foliar nutrient content with method of N application. However, by injecting the fertilizer, less fertilizer was used because less area was fertilized and less labor was required. Consequently, injection of N fertilizer is an effective method of fertilizing field-grown nursery stock.

As applied N rate increased, regardless of method of application or irrigation rate, the plant N content increased. But, N rate had little effect on growth, livability, or visual rating. Nitrogen applied at 60 lb. per acre produced as high a quality plant as higher N rates, indicating that lower N rates are adequate for production of Japanese holly.

One emitter (shown below) was placed adjacent to each plant.



Inadequate Vitamin C Nutrition Found in Smoking Adolescent Females

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Department of Home Economics Research

ADOLESCENT FEMALES frequently are a high risk group as related to nutritional status. Because of their rapid growth, adolescents generally have greater nutrient requirements than adults.

Various dietary surveys have indicated that many adolescents obtain less than two-thirds of the recommended dietary allowance for vitamin C. Vitamin C is necessary for many important functions in the body, such as the proper utilization of iron, the detoxification of many drugs and chemicals, the production of various hormones, and healing of wounds. Deficiency of vitamin C can cause easy bruising, swollen and inflamed gums with possible loss of teeth, anemia, muscle pain when touched or moved, poor wound healing, fracture of bones, increased infections, depression, and eventual death if the deficiency is serious enough.

Cigarette smoking is known to adversely affect vitamin C status. Studies have indicated that smokers consistently have lower body tissue levels of vitamin C than do nonsmokers. Also, the effect of smoking on vitamin C levels is directly related to the number of cigarettes smoked per day. Several recent studies report that 15-20% of 15- to 17-year-old teenage girls are regular cigarette smokers, indicating a potential problem of vitamin C deficiency in this nutritionally vulnerable population group.

In light of these considerations, the objective of the present investigation at the Alabama Agricultural Experiment Station was to assess the vitamin C status of a group of smoking and nonsmoking adolescent females. This objective was met by evaluating the dietary intake and plasma vitamin C levels in these girls.

The population sample for the study included 69 adolescent girls (11 smokers, 58 nonsmokers) aged 14 and 16 years in Lee and Chambers counties, Alabama. Two 24-hour diet recalls were obtained from subjects with an interval of at least 2 weeks occurring between recalls. The first diet interviews were conducted in the subjects' homes.

For the second recall, the girls were transported to Auburn University where data on their smoking habits and blood samples were obtained. The dietary records were analyzed for intake of vitamin C using nutrient composition tables. The blood samples were analyzed in the laboratory for vitamin C content.

The smoking girls consumed an average of one-half pack of cigarettes per day. This group ingested less vitamin C and had lower plasma levels of the vitamin when compared to the nonsmoking group, table 1.

To exclude the effect of dietary intake on plasma vitamin C levels, a subgroup of nonsmoking females (23 girls) who had dietary vitamin C intakes approximately equal to those of the smoking group was selected, table 2. When smokers and nonsmokers were matched for dietary vitamin C intake, the plasma vitamin levels of the smokers were still significantly reduced in comparison to nonsmokers. These findings with regards to smoking and vitamin C status are consistent with reports on adults. When compared to current recommended dietary allowances, the nonsmokers as a group had a good intake of vitamin C while the smokers' intakes would be rated as poor. Plasma vitamin C levels of the nonsmokers were good, but the plasma levels of the smokers would be classified as low.

The smokers in the present study were from a low-income level, which may have contributed to their reduced vitamin C intakes. Also, many of the smokers were age 16, and these older teenagers have more direct control over their diets and have more opportunity to eat away from home at eating establishments which serve foods that are typically low in vitamin C. Smoking has also been reported to reduce appetite, which may be another factor contributing to the reduced dietary intake of vitamin C by the adolescent female smokers.

Although vitamin C intake may differ between smokers and nonsmokers, other factors may be involved in vitamin C nutrition. When a subgroup of nonsmokers was selected to have vitamin C intakes in the same range as the smokers, there was still a significant reduction in plasma vitamin C levels in the smoking group. This finding suggests that cigarette smoking is in some fashion interfering with the absorption and/or utilization of vitamin C in this group of smoking teenagers.

In summary, nonsmoking teenagers in the present study showed good status with respect to vitamin C intakes and plasma levels. However, smoking teens had poor intakes of vitamin C and extremely low plasma levels of the vitamin, which could contribute to health problems. These findings provide another compelling reason for abstaining from smoking.

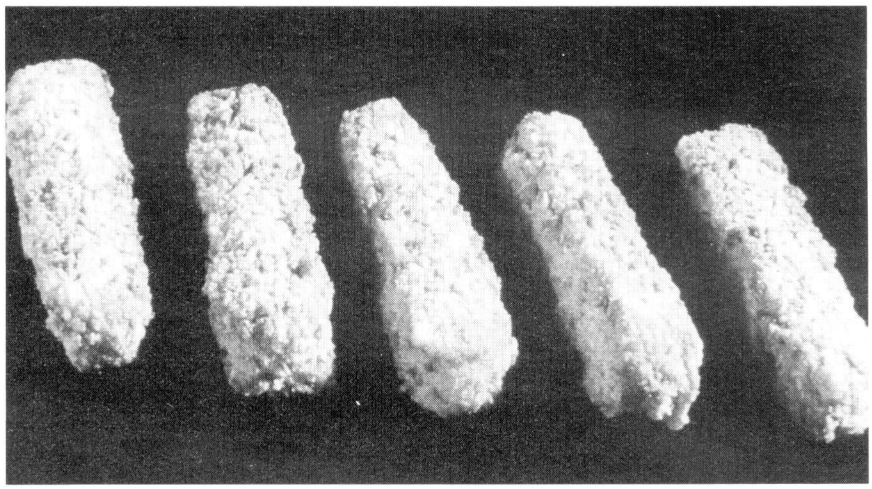
TABLE 1. AVERAGE DIETARY INTAKE AND PLASMA VITAMIN C LEVELS IN SMOKING AND NONSMOKING ADOLESCENT FEMALES

Group	Vit. C intake, mg/day	Plasma vit. C, mg/100 ml
Smokers	32	0.3
Nonsmokers	88	1.2

TABLE 2. COMPARISON OF AVERAGE PLASMA VITAMIN C CONCENTRATONS OF SMOKERS AND NONSMOKERS ON MATCHED DIETARY INTAKES OF VITAMIN C

Group	Vit. C intake, mg/day	Plasma vit. C, mg/100 ml
Smokers	32	0.3
Nonsmokers	39	1.0

Long Storage Life Possible for Restructured Beef Nuggets



D.L. HUFFMAN, M.H. STANLEY, and J.C. CORDRAY
Department of Animal and Dairy Sciences

THE AUBURN-DEVELOPED "restructuring" process for meats promises an improved market for Alabama beef, pork, and poultry. Such products as restructured breaded meat and poultry nuggests are uniquely suited to both the fast foods and retail meats industries, and these products are making a major impact on meat marketing.

The restructuring process makes good use of under-utilized meats, such as pasture-finished beef and other lower value beef and pork carcasses or portions of carcasses. This results in a moderately priced product and an increased variety of meat items, which appeal to consumers. Thus, this development benefits both producer and consumer.

Latest Alabama Agricultural Experiment Station meats research has been involved in the quality of restructured meat nuggets (beef, pork, and chicken). This research is addressing concerns of the meat industry about maintenance of sensory and physical properties of the restructured products during extended freezer storage. Methods are being sought that will extend the storage life of the products without affecting their acceptability by consumers.

Phosphate additives are known to prevent oxidative rancidity in many meat products, and safety of phosphates is already established. Findings of the Experiment Station research indicate that phosphates can be used to good advantage with beef nuggets, prolonging storage life without compromising sensory acceptability or physical or chemical properties of the product.

Beef nuggets used in the experiment were manufactured in the following manner: USDA Good beef rounds and chunks were separated into two approximately equal lots comprised of a lean component free of both fat and connective tissue and a trimming component. The lean component was passed through a blade tenderizer and ground through a 1-in. plate, while the trimming component was passed through a high speed flaking machine (Comitrol®).

The primary batch was then divided into three treatments: (1) no phosphate-0.75% salt, (2) 0.25% phosphate-0.75% salt, and (3) 0.50% phosphate-0.75% salt. Each treatment batch was mixed in a paddle mixer for 7 minutes, formed into a nugget shape on a Formax forming machine, breaded and battered, cooked to 160°F, frozen to -10°F, packaged in polyethylene-lined, waxed cartons, and stored at -10°F for subsequent analysis.

Nuggets were evaluated by a six-member sensory panel for flavor, texture, and juiciness and for oxidative rancidity when first manufactured and at 28-day intervals for a 6-month frozen storage period.

Addition of phosphate did not significantly change the composition of the beef nuggets, as shown by analysis data in the table. The sensory panel found no change in flavor and juiciness of the product as a result of the phosphate. In fact, the textural integrity of the nugget was improved.

The test for oxidative rancidity (TBA test) clearly showed the beneficial effect of phosphate addition. There was a 75% reduction in the degree of rancidity for treated batches over the untreated control. No difference in degree of rancidity was noted between the two phosphate treatment levels.

The effect of increasing phosphate level on the texture of the nuggets was linear over storage time, while increasing the level of phosphate increased the textural acceptability. Juiciness declined with increasing time of storage, but there was no difference among treatments. The degree of rancidity increased linearly with weeks of storage.

These findings established that an acceptable restructed beef nugget can be manufactured using phosphates to extend storage life. The 0.5% phosphate level, which is a level permitted by USDA regulations, improved the textural integrity and reduced oxidative rancidity of fully cooked, breaded and battered beef nuggets without affecting their sensory acceptability.

Phosphates can be used to extend storage life of such restructured products as beef nuggets or sticks.

EFFECT OF PHOSPHATE LEVEL ON QUALITY OF BEEF NUGGETS

Item	Rating, by phosphate level		
	0	0.25%	0.50%
Composition			
Protein, pct.	14.0	12.7	14.9
Moisture, pct.	51.9	50.1	50.3
Crude fat, pct.	20.5	20.8	21.3
Sensory panel[1]			
Texture	5.1	5.6	6.0
Flavor	7.0	7.2	7.0
Juiciness	5.7	5.8	5.7
TBA rancidity test, mg/kg[2]	.90	.25	.22

[1]Scale of 1-8, where 1 = extremely undesirable and 8 = extremely desirable.
[2]The higher the number, the more rancid.

FIG. 1. Channel catfish showing clinical signs of no blood disease: white gills and pale internal organs.

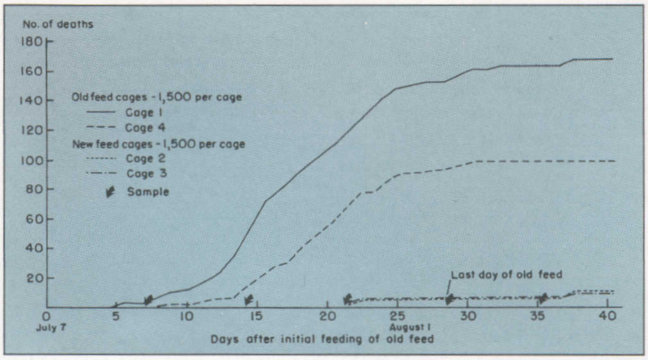


FIG. 2. Differences in mortality between fish fed old feed and new feed showed up in study of no blood disease.

Feed Related to "No Blood Disease" of Cultured Catfish

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FROM APRIL TO NOVEMBER 1983, approximately 70 cases of severe anemia and deaths occurred in cultured catfish in Alabama and Georgia. The disease, referred to as "no blood disease," was diagnosed at the Alabama Fish Farming Service Center at Greensboro, and the Southeastern Cooperative Fish Disease Laboratory at the Alabama Agricultural Experiment Station at Auburn University.

Infectious diseases, pesticides, heavy metals, and water quality were eliminated as causes of the anemia. It was noted, however, that when farmers changed feeds, used fresh feeds, or stopped feeding, the anemia and mortality ceased.

Mortalities were generally low among affected fish, which ranged in size from 0.2 lb. to 3 lb. All dead or dying specimens had extremely pale gills, livers, kidneys, spleens, and intestines, figure 1. Blood of severely anemic fish was light pink to colorless and the percentage of red blood cells (hematocrit) of sick fish ranged from 1% to 9%, whereas blood from less anemic fish in the same population had hematocrits near 20%. The hematocrit of healthy channel catfish ranged between 30% and 40%.

In one instance, no blood disease occurred in channel catfish raised in cages that were fed 1-year-old feed. After changing to fresh feed the problem ceased. To permit testing of the feed effects, the farmer agreed to feed two cages of fish with the old feed again for 4 weeks.

Fish from old feed and fresh feed cages were removed at weekly intervals for 5 weeks and their size, hematocrits, and other blood characteristics measured. In the experiment, a total of 269 of 3,000 fish (9%) fed the old feed died during the 35-day study period. Only 15 of 3,000 fish (0.5%) died in the two fresh feed cages, figure 2. Fish began to die 5 days after being changed back to old feed and showed the described signs of no blood disease.

During the study, the hematocrits of fish receiving old feed were significantly less than those of fish receiving fresh feed. Of the 83 individual fish tested which were fed old feed, 32% had hematocrits less than 26; none of those fed fresh feed had hematocrits below 26. Hemoglobin concentrations in blood of fish receiving old feed were less than the hemoglobin concentrations of fish receiving fresh feed. Clotting time of whole blood from fish fed the old feed was approximately twice that of fish fed the fresh feed. Growth rate of fish fed the old feed was also less than that of fish getting fresh feed.

In this study it was clear that the feed was responsible for the anemia and other changes in blood components of the channel catfish. However, the toxic agent causing the problem has not been identified. Fungal toxins were suspected since some have been shown to destroy the blood producing tissues of fish; however, analyses of the feed ruled out the known mycotoxins and also heavy metals, pesticides, and peroxides from oxidation of lipids. Although the toxic agent in the feed was not identified, a substance toxic to brine shrimp was isolated in a crude extract from the fish feed. The effects of some mycotoxins on fish have been reported, but they do not exactly parallel the clinical signs in this problem. Thus, an unidentified mycotoxin is a possible source of the problem.

Whether the same substance resulted in all anemia cases is not clear. Circumstantial evidence in terms of clinical signs (pale gills and other organs and infolding of intestines) points to a similar toxin in all instances. The mortality pattern was similar in most cases. Although a low percentage of fish usually died, it is not known how many fish in the population were anemic.

Feed-related anemia in cultured channel catfish is of concern to the fish farmer and feed manufacturer. Most cases of anemia were associated with old feed or feed that had become damp during storage. To reduce the possibility of something growing on the feed and producing an anemia-causing toxin, the following feed handling procedures are suggested: (1) do not allow old feed to accumulate, (2) store bagged feed in a dry area, and (3) prevent bulk storage containers from "sweating," which leads to damp feed and clumping.

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