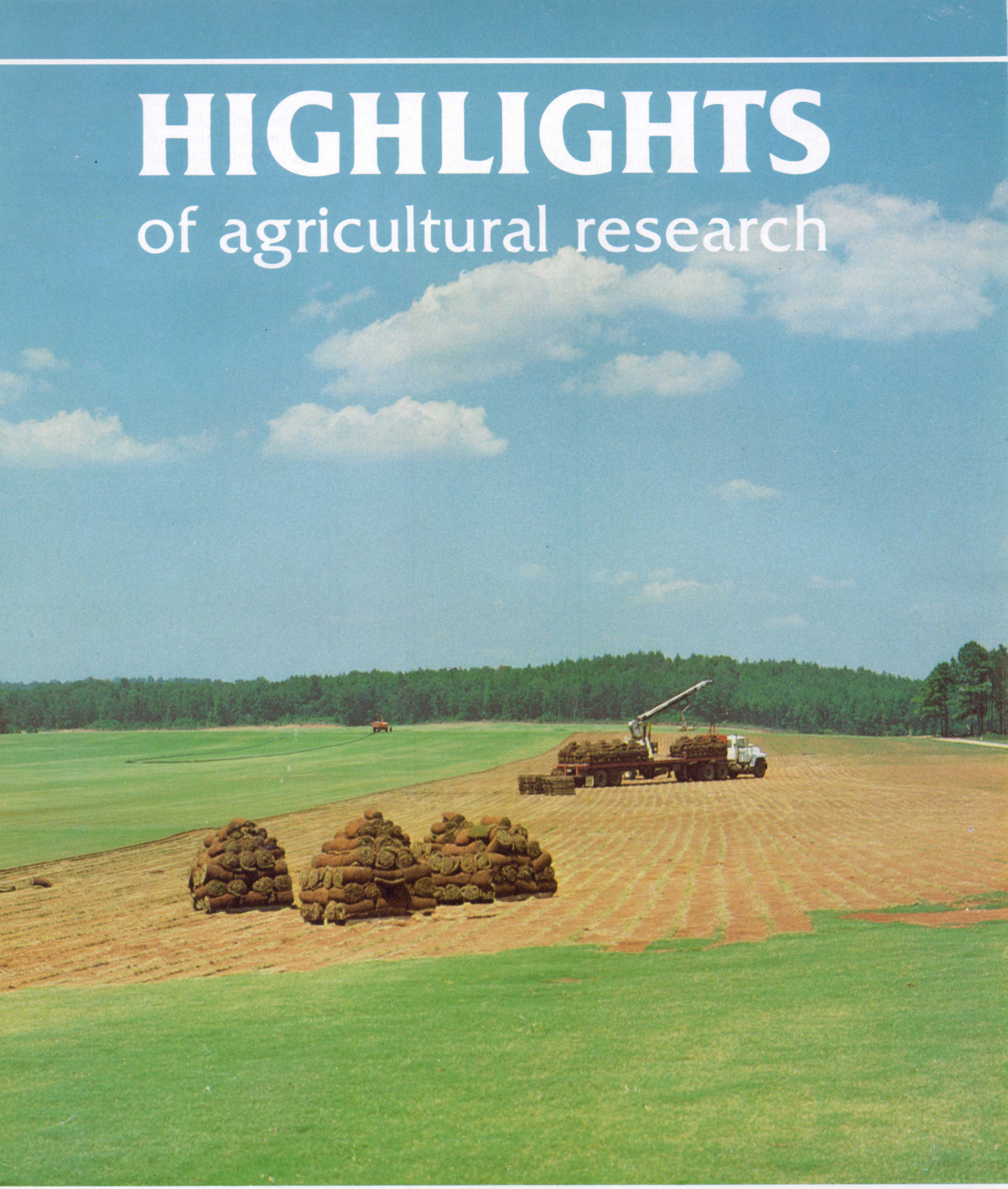
HIGHLIGHTS
of agricultural research



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AGRICULTURAL EXPERIMENT STATION
GALE A. BUCHANAN, DIRECTOR

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AUBURN UNIVERSITY
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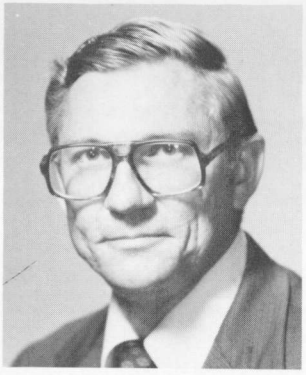
DIRECTOR'S COMMENTS

THE IDENTIFICATION of important and relevant researchable problems is a crucial step in any effective research program. Double-digit inflation and greater demands on public monies make it necessary to rank problems according to importance and address them in order of greatest need.



GALE A. BUCHANAN

The Alabama Agricultural Experiment Station, like those of other Land-Grant universities, has a definite mission—one that was established by law. This mission is to provide research support for agricultural and forestry activities for the people of Alabama. While it must contribute to Auburn University's overall mission of serving all people of Alabama, major attention must continue to be directed towards agriculture and forestry. Any advances made in production and marketing of agricultural and forestry products directly benefit the consuming public, so when the Agricultural Experiment Station carries out its primary mission, it serves all citizens.

Since research needs far outstrip available funds for research, the first responsibility of the Experiment Station is to establish priorities to assure that major attention is given to problems of greatest importance. This procedure establishes a continuity of effort, designed to obtain long-range solutions, thereby avoiding the disorganized approach that is commonly known as putting out "brush fires," which is jumping from one immediate problem to another.

Individual scientists play a major role in priority establishment, since they are in a position to sense needs in their specific areas of interest. But many other individuals and groups are involved in problem identification. Input from farmers, foresters, Extension Service personnel, commodity organizations, and other interested citizens plays a vital role in directing the focus of Alabama Agricultural Experiment Station research.

With information about needs gathered from many sources, decisions about projects are made on the basis of such questions as:

1. Which problem would, if solved, provide the greatest benefit?
2. Is the problem solvable?
3. Are Auburn scientists qualified by training and experience to undertake the research?
4. Do we have the equipment, facilities, time, and money to do the research?
5. Does the research in one area complement and enhance that in another area or another state?
6. Has the problem already been solved or is being solved by other agencies which will provide answers for our problem?

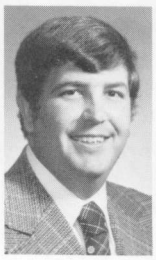
Special attention is being given to coordinated research by scientists in several different fields. Problems are often too complex to be solved by a single discipline, so the interdisciplinary approach involving scientists of widely different training is necessary to obtain a practical solution. For instance, our "integrated pest management" concept is making progress towards overcoming crop losses that result from a complex of several different kinds of pests including insects, fungi, nematodes, and weeds.

We at Auburn are alert to needs for new programs that address future problems in agriculture and forestry, as well as general societal concerns. While needs can be identified by special interest groups, the Agricultural Experiment Station must make the hard decisions that finally determine which needs are addressed in research.

We challenge everyone involved in agriculture, forestry, and related industries to assist us in directing resources where the benefits will be the greatest.

may we introduce . . .

Dr. John L. Adrian, associate professor in the Department of Agricultural Economics and Rural Sociology. Dr. Adrian is a native of Centre, Alabama, Cherokee County and joined the Auburn faculty on July 1, 1974.



Dr. Adrian received a B.A.A. in aeronautical administration and M.S. in agricultural economics from Auburn University, and a Ph.D. in agricultural economics from the University of Tennessee. His principal fields of specialization are marketing, price analysis, and resource economics. He does both teaching and research in his present position. Dr. Adrian is a member of Phi Kappa Phi, Gamma Sigma Delta, American Agricultural Economics Association and the Southern Agricultural Economics Association. He belongs to other professional organizations and has authored and coauthored numerous journal articles and Station publications.

HIGHLIGHTS of Agricultural Research

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ON THE COVER: A commercial turfgrass farm in survey. See story, page 3.

Commercial Turfgrass Production in Alabama

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Economics and Rural Sociology

ALABAMA'S COMMERCIAL TURFGRASS-SOD INDUSTRY is relatively young. Development of the industry in the State began in the early 1940's with introduction of several improved turfgrass species. The industry grew slowly in the 1940's and 1950's. Rapid growth of the industry started in the late 1960's when acreage expanded from 500 in 1968 to 3,300 in 1979.

Lack of information concerning the status and economic nature of commercial turfgrass production has been recognized as a major problem affecting the industry. To correct this situation, Auburn University's Agricultural Experiment Station initiated an economic analysis of the industry. A list of 40 growers was developed by contacting county extension personnel throughout the State, the Division of Plant Industry of the Alabama Department of Agriculture and Industries, and individual sod producers. From this list, 26 bonafide turfgrass farms were identified. Nurseries with less than 10 acres of turfgrass or which resold sod strictly on a retail basis, stripper operations which sold pasture grass, and new turfgrass operations which were not in production in 1978 were excluded from the analysis. Fifteen producers participated fully in the study by supplying detailed information about production, harvesting, and marketing.

In 1979, turfgrass production had expanded to include 30 growers in 19 counties in the State. Largest concentrations of acreage and the majority of these producers were located in counties situated within or bordering major population centers. Fifty-eight percent of the total output of the industry in 1979 was cultivated in Lee, Shelby, and St. Clair counties.

Growers marketed approximately 4.4 million sq. yd. of turfgrass from approximately 1,100 acres in 1979. Gross farm income was estimated to be $4.2 million wholesale, excluding delivery and installation charges. Bermudagrass was the most important sod species in terms of acres grown (70%) and gross farm income (60%). Centipedegrass and zoysiagrass comprised 15% each of the acres sold and 18 and 22% of gross farm income generated, respectively.

Landscape contractors were primary buyers of turfgrass with almost two-thirds of total sales. Garden center operators, homeowners, and golf course operators purchased 18, 12, and 4%, respectively. Seventy-eight percent of all sod produced in Alabama was sold within the State. The Birmingham and Tuscaloosa areas were major sales regions, with Huntsville, Mobile, and Montgomery being important markets. Out-of-state sales went to contiguous states plus Arkansas, with Georgia receiving over three-fourths of the volume, primarily in the Atlanta area.

Average investment per acre for sod producing firms was $1,670, with land, equipment, and buildings comprising 37, 60, and 3% of the total, respectively. Investment allocations to land were lessened by the fact that on the average growers rented almost 50% of the acreage maintained in sod. On a size of operation basis, average investment per acre for small (less than 100 acres), medium (100 to 250 acres), and large (more than 250 acres) farms was $2,440, $1,610, and $1,690, respectively. Small acreage producers had the highest average per acre investment in land and buildings plus irrigation and maintenance and establishment equipment. Large operations had the largest average per acre investment in trucking and harvesting equipment. Land investment was highest for small growers because they owned 90% of the land utilized for turfgrass.

Average investment per farm for small, medium, and large operations was $81,000, $298,000, and $932,000, respectively. Equipment investment per acre for each size category varied widely , especially for small farms.

Fixed costs for such factors as insurance, taxes, depreciation, interest on fixed capital, rent, and management and land charges averaged $260 per acre for all growers. This charge varied little among size categories. Depreciation on equipment and buildings was the major fixed cost item, comprising approximately one-third of the total.

Average variable cost per acre was $665 for all turfgrass producers. Hired labor, fuel and lubrication, and fertilizer and lime were major variable cost outlays at 53, 17, and 10% of the total, respectively. When evaluated on the basis of size, average variable costs per acre declined between the small ($660) and medium sized ($446) categories but increased between the medium and large ($742) categories.

Total costs per acre averaged $926 for all producers. Small operations had an average total cost of $929 per acre, while medium and large sized firms had costs of $701 and $1,003 per acre, respectively.

Net return to overhead and risk from the sale of turfgrass averaged $391 for all producers. Firms having 100 to 250 acres of sod reported the highest net returns of $427 per acre, while large and small firms had average net returns of $404 and $246 per acre, respectively. These values represented conservative estimates of return because they were based at the farm level and did not include delivery charges. Delivery charges varied widely both in method of charging and rates. Larger producers generally charged by the load ($150 to $180) or by the loaded mile ($0.45 to $1.80). Smaller growers generally charged from $0.10 to $0.20 per square yard for delivery. Since large producers delivered approximately three-fourths of their product, delivery income was an important factor affecting their returns.

Net returns to turfgrass production indicate that this enterprise can be a feasible production alternative. However, it represents a high risk venture which requires a large capital outlay. An important factor affecting the success of sod farming is availability of viable markets. A guaranteed market for sod does not exist in Alabama, and the demand for sod can be highly variable. Producing a quality turfgrass at minimum cost does not ensure the profitability of a sod farm. If demand for sod decreases or if markets do not exist near the operation, the chance for success is greatly reduced.

CHEMICAL THINNING OF PEACHES

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THINNING PEACHES while they are still small is essential for the fruit to grow large enough to meet market demands. Although this can be done by hand, it is expensive and requires extensive labor.

Many chemicals have been tried in recent years, but none has provided consistent, acceptable thinning of all peach varieties. But now there is renewed hope for chemical thinning. An experimental material, CGA 15281, currently being developed by Woolfolk Chemical Co., has given good results in recent-year tests by Auburn University Agricultural Experiment Station.

First-Year Experiment

The first year of the test (1978), CGA 15281 was applied to 7-year-old Loring trees on Lovell rootstock. Treatments consisted of one, two, or three applications of 240 and 360 p.p.m. sprays and one or two applications of 480 p.p.m. sprays at 7-day intervals. Sprays were applied with an air blast sprayer at 300 gal. per acre on April 21 and 28 and May 5. Seed lengths on those respective dates were 8.8, 10.8, and 15 mm.

Three applications of 240 and 360 p.p.m. sprays at weekly intervals overthinned and reduced yields, table 1. A single application of 240, 360, or 480 p.p.m. adequately thinned the fruit, leaving sufficient fruit that could be spaced better and clusters that could be reduced by supplemental hand thinning. Two applications of 240, 360, or 480 p.p.m. removed too many fruit to permit proper spacing with subsequent hand thinning. Yields were not reduced by either one or two applications, and individual fruit weights were equal to those on hand-thinned trees.

Second-Year Test

In 1979, CGA 15281 was applied to 4-year-old Loring trees on Lovell rootstock at rates of 240, 360, or 480 p.p.m. Single application treatments of these rates were applied April 28 at a seed length of 13.9 mm. A 480-p.p.m. single application treatment also was applied April 20 at a seed length of 8.5 mm. Repeat applications of 240 or 360 p.p.m. treatments were applied April 20 and May 4 at seed lengths of 8.5 and 17.5 mm, respectively. The sprays were applied with a hand gun to the point of runoff (2 gal. per tree).

Two applications of 240 or 360 p.p.m. 2 weeks apart when seed lengths were 8.5 and 17.5 mm, respectively, and one application of 360 or 480 p.p.m. when seed length was 13.9 mm overthinned and reduced yields, table 2. A single application of 480 p.p.m. applied a week earlier (at seed length of 8.5 mm) did not thin as much fruit or reduce yield.

With two applications of 240 or 360 p.p.m. sprays, a greater percentage of the thinning occurred following the second application. There was no yield reduction from single applications of either 240 p.p.m. applied at a seed length of 13.9 mm or 480 p.p.m. applied at seed length of 8.5 mm. Sufficient fruit were removed, and a minimum of follow-up hand thinning was required.

Two applications of either 240 or 360 p.p.m. sprays removed most fruit from the trees, resulting in larger, but fewer, fruit.

Sensitivity to Chemical

Foliage injury was evident in 1978 on the 7-year-old trees but not in 1979 on the vigorous trees. The injury consisted of leaf yellowing and dropping of basal leaves. Injury decreased with concentration and number of applications. The remaining leaves developed normal coloration following an application of nitrogen.

In 1980, sensitivity to treatments of CGA 15281 varied depending on variety. Springold was more sensitive and thinned easier than Springbrite. Fruit sensitivity was found to increase as the fruit increased in size. The variety Redtop showed no thinning at a seed length of 6 mm, was adequately thinned at seed length of 8-10 mm, and had overthinning if seed were 15 mm or longer.

The chemical thinner CGA 15281 is not currently available to growers, but registration is anticipated in the near future.

TABLE 1. RESPONSE OF SEVEN-YEAR-OLD LORING PEACH TREES TO CHEMICAL THINNING, 1978

CGA 15281 treatment[1]	Chemical thinning rating[2]	Fruit per tree		Fruit weight per tree	Weight per fruit	Foliage injury rating[3]
		Removed by hand	Harvested			
		No.	*No.*	*Lb.*	*Lb.*	
None	—	789	470	113	0.24	—
240 p.p.m.-1 application	2.3	174	542	120	.22	1.8
360 p.p.m.-1 application	2.8	106	461	102	.22	1.9
480 p.p.m.-1 application	5.5	111	463	99	.21	2.4
240 p.p.m.-2 applications	4.9	36	435	96	.22	2.6
360 p.p.m.-2 applications	5.1	14	387	92	.24	3.4
480 p.p.m.-2 applications	6.1	0	349	88	.25	3.3
240 p.p.m.-3 applications	9.7	0	67	20	.30	4.5
360 p.p.m.-3 applications	9.5	0	160	44	.28	5.0

[1]First application April 21 (average seed length 8.8 mm); second application April 28 (average seed length 10.8 mm); third application May 5 (average seed length 15.0 mm). Temperature was 68°, 77°, and 75°F at respective treatments.
[2]0 = no fruit removed; 10 = all fruits removed.
[3]0 = no injury; 5 = severe yellowing and drop.

TABLE 2. RESPONSE OF FOUR-YEAR-OLD LORING PEACH TREES TO CHEMICAL THINNING, 1979

CGA 15281 treatment[1]	Fruit per tree			Yield per tree	Weight per fruit
	Removed by chemical thinning[2]	Removed by hand thinning	Harvested		
	No.	*No.*	*No.*	*Lb.*	*Lb.*
None	—	77	349	126	0.36
240 p.p.m.-April 20, May 4	233	1	66	30	.46
240 p.p.m.-April 28	51	43	293	115	.39
360 p.p.m.-April 20, May 4	257	1	35	17	.48
360 p.p.m.-April 28	92	31	239	100	.42
480 p.p.m.-April 20	50	29	294	114	.39
480 p.p.m.-April 28	185	25	252	98	.39

[1]Seed lengths at time of application were: April 20, 8.5 mm; April 28, 13.9 mm; May 4, 17.5 mm. Temperatures for the three dates were 71°, 68°, and 69°F, respectively.
[2]Fruits removed chemically were determined by counting fruit on each tree before and after treatment application, as well as the dropped fruit.

2 harvests from 1 planting

First crop grain sorghum nearing harvest.

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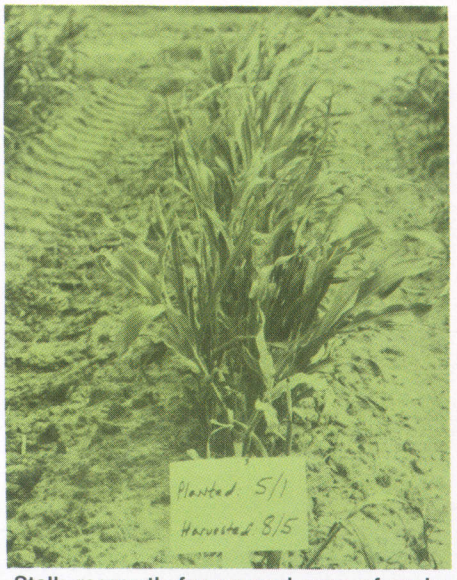

Stalk regrowth for second crop of grain sorghum.

GRAIN SORGHUM is increasing in popularity as a grain crop in Alabama. Hot-dry summers in recent years have left corn producers with little grain to show for their efforts. Interest in grain sorghum has increased because of its tolerance to drought and its versatility in fitting into different cropping schemes. Another trait of grain sorghum that enhances its attractiveness is its inherent ability for regrowth, allowing the plant to produce a second crop after the first crop has been harvested. The second crop is referred to as a ratoon crop that originates as a shoot from an already established stubble. Ratoon crops are common in sugarcane and forage sorghums.

In order to determine the yield potential of grain sorghum hybrids currently grown in Alabama, an unirrigated grain sorghum hybrid test was planted at the Auburn University Agricultural Experiment Station's Wiregrass Substation, Headland, during the 1980 season. The test was planted April 18. One hundred and twenty lb. nitrogen per acre were applied to the first crop in a split application. Phosphorus and potassium were applied according to soil test recommendations. The test was treated with the herbicide, propazine (Milogard®) and cultivated as needed. Two applications of ethyl-parathion were made for midge control during the bloom stage.

By August 1, the grain was mature. Grain was harvested on August 5, with a plot combine. Stalks were then cut to 4-6 in. in height. Approximately 70 lb. of nitrogen per acre were sidedressed beside the stubble. The ratoon crop was harvested on December 5. The yields shown in the table were obtained from this hybrid test. Rainfall was adequate early in the season, but was extremely low during the final months of the growing season. No irrigation was used.

The 10 highest yielding hybrids, which produced 19-25 bu. per acre from the second crop, indicate the potential of ratoon cropping sorghum. This does not mean that all hybrids are adapted to ratoon cropping. In tests at other locations, ratoon crop yields have been as high as 40-50 bu. Keep in mind that the results reported are from only 1 year of experimentation. Many facets of this cropping scheme still need investigation.

YIELDS OF THE FIRST AND THE RATOON CROP FOR THE TOP TEN GRAIN SORGHUM HYBRIDS GROWN DURING 1980 AT THE WIREGRASS SUBSTATION, HEADLAND

Brand name/hybrid	Yield[1] per acre first crop	Yield per acre ratoon crop	Yield per acre total
	Bu.	*Bu.*	*Bu.*
Dekalb D 42A	70	25	95
Funk's G-522A	71	24	95
Coker 7737	64	25	89
Ring Around 733GB	66	22	88
McNair 550	61	24	85
Funk's G-522DR ..	58	24	82
Surgro ORO-T XTRA	61	20	81
Surgro ORO XTRA	61	19	80
Funk's G-550	54	25	79
Northrup King 2779	57	20	77

[1]Yields are adjusted to 14% moisture and 56 lb. per bushel.

Ratoon cropping grain sorghum holds a potential advantage over corn or a double crop of corn and grain sorghum in that the ratoon crop reduces the cost per bushel of grain produced. Ratoon cropping grain sorghum is most feasible in southern Alabama because of the longer growing season. The key factors for successful grain production are: planting the crop between April 1-25, proper cultural practices (fertilization, weed, and insect control), harvesting of the first crop at 16-20% grain moisture, cutting stalks to 4-6 in. with a sharp sickle bar type mower (in order not to shatter or uproot stubble), and a sidedress application of 50 to 80 lb. of nitrogen per acre to the stubble.

Weed control in the second crop may require post-directed sprays and/or light cultivations. The sorghum midge is the primary insect causing economic damage to grain sorghum, especially on the ratoon crop. Midge damage occurs during the flowering period. Grain from the second crop can be harvested at 14-20% grain moisture. Freezing temperatures will help to hasten drying of mature grain. Grain moisture should be no higher than 14% for safe storage. Given a long growing season and an even distribution of rainfall, one should expect to obtain about 30 to 50% of the first crop from a ratoon crop.

Effect of Coccidiosis in Broilers on Digestion of Nutrients

GEORGE JENG and S. A. EDGAR, Department of Poultry Science

COCCIDIOSIS is perhaps the most prevalent and important disease of poultry. The economic losses encountered from the disease and from prevention annually cost the industry in the United States more than 100 million dollars, 60-80 million dollars for drugs alone.

There are nine species of coccidia that cause coccidiosis in chickens reared on litter. Moderate to severe infection by at least eight species may cause death and/or morbid losses such as depressed growth and impaired feed efficiency. The morbid losses in broilers because of the importance of feed efficiency are more costly than the usual low mortality with present methods of control with anticoccidial drugs. It has been estimated that one point in feed efficiency (difference between e.g. 2.00 and 2.01) of growing broilers was worth approximately 16 million dollars to the broiler industry in the United States in 1980. It is well known that a low grade infection by one or more of eight species can cause 1 to 50 or more points loss in feed efficiency for a flock of broilers or a severe drop in egg production of laying hens.

During recent years, several researchers have reported poor absorption of nutrients during coccidial infections with several species. None, however, reported the effect of this disease on digestion, or that poor digestion might be one of the underlying reasons for poor absorption. Proteins must be broken down to amino acids and the polysaccharides of carbohydrates to monosaccharides before they can be absorbed. It had been observed by the junior author during the past 40 years that a good deal of undigested food passes in the feces of chickens during the peak of infection especially from those with moderate to mild coccidiosis.

Thus, the purpose of this study was to determine the digestion of feed during coccidiosis by analysis of protein and carbohydrate in the feces.

Five-week-old, battery-reared broilers were used in three trials. They were infected with coccidia at 4 or 5 weeks of age and their lower intestinal contents and/or feces were analyzed for protein and carbohydrates. Analysis included gross, microscopic, and chemical tests. Chemical tests included determination of protein and carbohydrates. The ration was a standard broiler starter consisting of corn-soy mash with 21.5% crude protein and 1,440 calories per lb.

TABLE 1. EFFECT OF COCCIDIOSIS ON WEIGHT GAIN AND FEED EFFICIENCY OF BROILERS

Treatment	Bird weight[1] in grams		D to D+10	
	D	D+10	Grams gain	Feed conversion
Control	989[a2]	1,353[a]	448[a]	2.42[a]
E. acervulina[3]	1,006[a]	1,205[b]	258[b]	3.20[b]
E. maxima[4]	1,017[a]	1,198[b]	206[b]	3.95[b]

[1]Mean of 4 reps., 6 birds per replication.
[2]Different letters in same column signify significant differences ($P < .05$).
[3]1,000,000 oocysts per bird.
[4]100,000 oocysts per bird.

TABLE 2. THE EFFECT OF COCCIDIOSIS ON CARBOHYDRATES DIGESTED BY BROILERS

Treatment	Percent[1]					
	D+3	D+5	D+6	D+7	D+8	D+10
Control	91.5[a]	89.3[a]	90.4[a]	89.5[a]	89.6[a]	91.3[a]
E. acervulina	90.3[a]	85.3[b]	81.4[b]	87.1[a]	87.2[a]	89.8[a]
E. maxima	90.0[a]	81.0[c]	81.9[b]	76.3[b]	81.6[b]	90.5[a]

[1]Days 4 and 9—no data.

TABLE 3. EFFECT OF COCCIDIOSIS ON AMOUNT OF UNDIGESTED FOOD PARTICLES IN FECES[1]

Treatment	Particle counts				Washed feces, pct.[1]		
	Size (mm)	D+6	D+7	D+8	D+6	D+7	D+8
Control	1	72	96	88	33.5[a]	34.3[a]	32.5[a]
	2	25	104	80			
	3	4	14	8			
E. acervulina	1	48	96	120	34.5[a]	45.1[b]	32.4[a]
	2	44	128	120			
	3	4	28	6			
E. maxima	1	56	72	80	32.5[a]	38.6[a]	36.4[a]
	2	40	64	100			
	3	2	24	12			

[1]Fecal sample washed with 100 mesh sieve; each value mean of 8 replications.

Birds were weighed daily and daily water and feed intake and feces passed were determined. The rate of passage of food through the digestive tract was determined with the aid of inert dyes. Protein was measured with a Kjeldahl and carbohydrate determined by extraction.

Results of but one of the three experiments are reported here which was representative of the other two.

Growth of birds and feed efficiency were depressed significantly during *Eimeria acervulina* and *E. maxima* infections, from day 5 through 7 and 5 through 8 postinoculation, respectively, table 1. Feed consumption decreased greatly. Analysis of digested protein in feed is expressed as the percentage of protein ingested less the protein passed in feces, divided by the protein ingested. The *E. acervulina* infected chickens digested significantly less protein on days 5 and 6 than uninfected birds. The effect of *E. maxima* infection from day 5 through 10 was more severe than the *E. acervulina*.

Digested carbohydrates were calculated as above. *E. acervulina* infected chickens experienced significantly less carbohydrate digestion (10% less) than uninfected birds on days 5 and 6 and for *E. maxima* infected ones (10 to 15% less) from day 5 through 8, table 2.

Both coccidia infected groups had more large feed particles in their feces than the uninfected controls, table 3. These data agreed with the chemical analysis for protein and carbohydrates in the feces, table 2.

Results show that poor digestion of food may be as responsible for the suppressed growth and poor feed efficiency as poor absorption. Therefore, the problem of poor digestion during the infection should receive further consideration.

ROTATE PEANUTS WITH CORN

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J. G. STARLING and H. W. IVEY, Wiregrass Substation

IT IS GENERALLY AGREED that peanuts should not be grown continuously on the same land, but should be rotated with other crops, such as corn. Now available are well documented results showing the magnitude of potential yield increases from rotating as compared with continuous cropping. These data are from an Auburn University Agricultural Experiment Station experiment conducted at the Wiregrass Substation.

The experiment compared continuous cropping of peanuts and corn with rotating the two crops. It also was designed to measure response of both crops to fertilization with phosphorus (P) and potassium (K) and to compare application of all the fertilizer to corn with halving it into annual applications to both crops. Only in the second instance did rotated peanuts receive direct fertilization. The experiment was conducted on the same plots of Dothan fine sandy loam from 1965 through 1979. The soil in 1965 was **Very High** (210)[1] in P and **High** (100) in K. Lime was applied as needed to maintain the pH above 5.7.

Peanuts Respond to Rotation

Valuable peanut yield increases resulted from rotation, as shown in the table. Peanut yields increased with each successive 5-year period, due to improved varieties and cultural practices. Average yields of rotated peanuts in the 1975-79 period were more than 3,100 lb. per acre.

Response to rotation during the first 5 years was small, as was expected. Yields were low during this period and several years were required before the rotation began to affect yields. After the first 5 years, the increase from rotation averaged 550 lb. per acre over the next 10 years. In the two highest yielding years, when yields were over 4,200 lb. per acre, rotation increased the yield 750 lb. per acre.

Corn Yields Not Affected

Both continuously grown and rotated corn received 120 lb. per acre of nitrogen. Corn that was rotated with peanuts averaged 75 bu. per acre over the 15-year period. Continuous corn produced about 5 bu. less, but this difference was not consistent enough to be statistically significant.

Corn yields were not increased by either P or K fertilizer, even though some plots received none for 15 years. Corn yields varied, depending primarily on rainfall, from less than 20 bu. per acre in 1969 to more than 130 bu. in 1972. Corn following peanuts produced about 30 bu. more in 1972 than did the continuous corn plots.

Peanut Yields and P and K

Although peanuts remove large amounts of nutrients from the soil, they respond little to direct fertilization. Peanuts are efficient in removing nutrients from the soil, so it is generally recommended that they be grown in rotation with other well fertilized crops, and not directly fertilized.

Differences in peanut yields from varying rates of P and K were not statistically significant. No response to P was expected at the soil test level of this soil.

However, it is surprising that no response to K was shown. Instead, the data indicate that the highest rate of K tended to decrease the yield, especially on continuous peanuts.

Splitting the application of P and K between the two crops, instead of applying all to corn in alternate years, did not change the yield. The highest yielding treatment throughout the 15 years received 40 lb. per acre of P_2O_5 and K_2O to corn in alternate years. These data support recommendations now being made by the Auburn Soil Testing Laboratory, where no P or K is recommended at **High** soil test levels.

During the 15 years of the experiment, plots receiving no P dropped gradually from **Very High** (210) to **Medium** (100) in soil test P. The 20 lb. per acre rate of P_2O_5 used was not high enough to maintain P at the original level. Part of this decrease was most likely due to deeper plowing in recent years, which diluted P in the surface soil with the subsoil, which is **Very Low** in P. Plots receiving 40 lb. per acre of P_2O_5 every 2 years were in the **High** range from year 3 through year 15.

Plots receiving no K dropped only slightly from **High** (100) to **Medium** (80) after about 5 years and remained at this level for the next 10 years. Application of 40 lb. of K_2O annually maintained the soil at about the original level. The highest rate of 80 lb. K_2O annually increased the level of soil test K in the surface soil.

EFFECT OF ROTATIONS AND RATES OF PHOSPHORUS AND POTASSIUM FERTILIZATION ON YIELD OF PEANUTS, WIREGRASS SUBSTATION, 1965-79

Average annual fertilizer rates		Yield of peanuts, 5-year averages						Increase from rotation			
		Continuous			Rotated						
P_2O_5	K_2O	'65-69	'70-74	'75-79	'65-69	'70-74	'75-79	'65-69	'70-74	'75-79	15-yr. '65-79
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
20	40	1,350	2,290	2,570	—	—	—	—	—	—	—
20	40[1]	—	—	—	1,710	2,420	3,130	360	130	560*	350*[2]
0	40	1,380	1,940	2,450	—	—	—	—	—	—	—
0	40[1]	—	—	—	1,620	2,600	2,960	240	660*	510	470
20	0	1,430	2,140	2,800	—	—	—	—	—	—	—
20	0[1]	—	—	—	1,500	2,690	3,050	70	550	250	290*
20	80	1,400	1,780	2,220	—	—	—	—	—	—	—
20	80[1]	—	—	—	1,650	2,650	3,090	250	870*	870*	660*
20	20[1]	—	—	—	1,760	2,830	3,320	—	—	—	—
20	40	—	—	—	1,610	2,260	3,120	—	—	—	—
		NS[3]	NS	NS	NS	NS	NS				

[1]All P and K applied to corn in alternate years.
[2]Asterisk indicates that increase from rotation was significant at the 5% level.
[3]NS indicates that differences due to P and K rates or time of application were not significant.

[1]The number in parenthesis following the soil test rating is the soil fertility index (the percentage of the amount of the nutrient in the soil that is adequate for top yields).

Common Wood Borers Associated With Hardwood Timber

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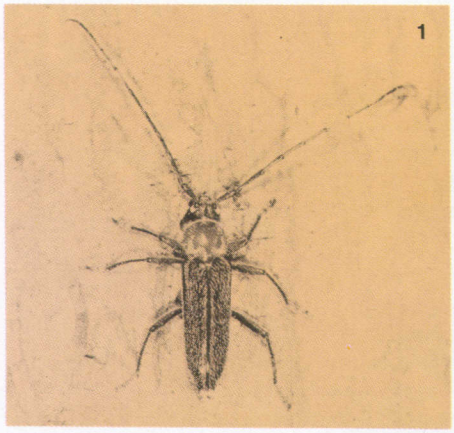
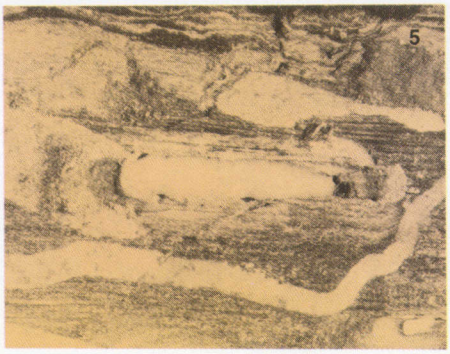
LONG-HORNED WOOD BORERS, Cerambycidae, are some of the most abundant and important wood borers occurring in Alabama. For this reason, borers of this group associated with hardwoods have been subjects of study at the Auburn University Agricultural Experiment Station for the past 2 years.

The insects of this family are correctly classified as "wood borers" in that wood is the primary tree part attacked in at least some stage of the insect's developmental cycle. In general, cerambycid adults are cylindrical, elongate, long-legged beetles, varying greatly in size and coloration by species. Many species possess long conspicuous antennae, figure 1, thus the name long-horned wood borers. Adults are active during warm months (Mar.-Oct.)—some throughout, others limited to single or periodic peaks of activity as determined by species, adult longevity, and number of generations per season. Adults exhibit various feeding behaviors, feeding on pollen, tree sap, vegetation, or not at all.

Eggs, figure 2, are deposited under bark flakes, in bark crevices, in niches chewed into bark, or on exposed wood of host trees. Larvae, figure 3, are whitish, cylindrical, often legless, and usually conspicuously segmented. Newly hatched larvae promptly bore in and begin to tunnel in inner bark, sapwood, heartwood, or throughout, depending on the species. Points of entry by small larvae are essentially undetectable; consequently, external signs of infestations are practically nonexistent. Larval tunnelling is often so extensive, figure 4, that much tissue is reduced to powder, weakening the structural integrity and destroying cosmetic value of the wood. Thus, the larval stage in most cases is exclusively responsible for the damage. Pupation, figure 5, occurs within the wood or beneath bark. New adults chew through remaining wood and bark to emerge. A few species have 2 or 3 generations per year; however, most require at least 1 year to complete the life cycle and some require 2-5 years or longer.

Some cerambycid species attack apparently healthy trees, but most are more commonly found in weakened stressed trees and fresh-cut logs. Use of sticky-type traps on various species of girdled and felled hardwoods in the Auburn vicinity has resulted in collection of 55 species. The greatest number of species were taken from water oak, hickory, and persimmon. Species most abundant were: *Neoclytus acuminatus* (red-headed ash borer); *N. scutellaris; N. mucronatus; Euderces pini; Xylotrechus colonus* (rustic borer); *Elaphidion mucronatum; Urographis fasciata; Ecyrus dasycerus; Leiopus punctatus; Elaphidionoides* spp. (twig pruners); and *Stenosphenus notatus*. One of the most common species was the red-headed ash borer, figure 6. Detailed biology studies on this borer indicate that it prefers stressed or dying trees and fresh-cut logs, may have a wide range of hosts, and may complete 3 generations per year in east central Alabama.





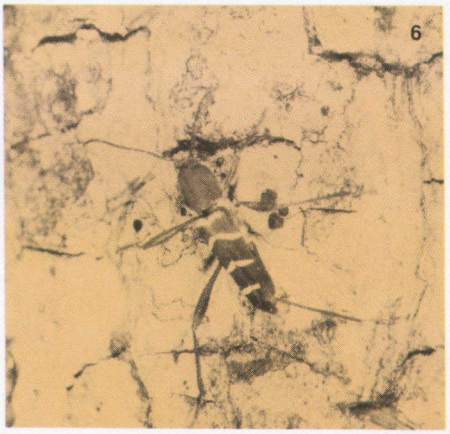


FIG. 1. Typical long-horned adult; FIG. 2. Eggs of red-headed ash borer; FIG. 3. Full-grown larva of red-headed ash borer; FIG. 4. Larval tunnels; FIG. 5. Pupa of red-headed ash borer; FIG. 6. Red-headed ash borer adult.

Legal Knowledge Possessed by ALABAMA FARMERS

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THE ECONOMIC WELL BEING of Alabama farms is affected by the complexities of a rapidly changing society. One such complexity is the expansion of those areas of law directly affecting agricultural production. It is recognized that there is a need for all farmers to be more aware of their legal rights and responsibilities. A determination of which areas bear additional emphasis is important to both educators and practitioners.

Statutory and case laws were used to prepare a questionnaire for survey purposes. The questionnaire was used by researchers in the Department of Agricultural Economics and Rural Sociology, Agricultural Experiment Station, to survey personally 202 Alabama farmers to determine the extent of knowledge of legal rights and responsibilities. The questionnaire contained a general data section and 50 fact situations in question form.

The extent of knowledge of Alabama farmers of various legal situations was measured and tabulated from information obtained from the questionnaire. Each farmer was presented 50 fact situation questions regarding diverse legal subjects. The questions were divided into fact situation groups and each was assigned a subject name describing the fact situations. The 50 fact situations were grouped into 13 subject area groups. The percentage of farmers giving the correct response for the subject area is indicated in the table.

The subject area of *Contracts* had nine fact situations. The farmers averaged 62% correct answers for Contracts, ranging from a low of 28% to a high of 93% correct. They averaged below 50% in only two situations, thus indicating that Alabama farmers have a fairly good working knowledge of contracts.

Offers and Mistakes, which are usually part of contracts, but were separate in this study, had four fact situations.

PERCENTAGE OF FARMERS GIVING RIGHT ANSWER WITH RIGHT REASON, BY FACT SITUATION AND SUBJECT AREA, 202 FULL-TIME FARMERS, ALABAMA, 1979

Fact situations	Subject areas	Percent
1-9	Contracts	62
10-12	Offers	17
13	Mistake	52
14-15	Negligence	71
16-22	Farm visitors	55
23	Attractive nuisance	57
24-25	Bailment	50
26-30	Employees	36
31-38	Animals	50
39	Mineral rights	83
40-45	Estate planning	39
46-48	Land	54
49-50	Water rights	55

Farmers scored very low on the three fact situations for Offers, ranging from a low of 10% correct to a high of only 31% correct. They did better on Mistakes, scoring an average of 52% correct on the one fact situation used. These results indicated Offers, which is an essential part of a contract, is the most misunderstood subject covered in this study. Farmers definitely need more educational work in this important area of contracts.

Farmers scored very well on the subject area of *Negligence*, averaging 71% correct answers on the two fact situations used. They scored 85 on one fact situation and 56% correct on the other, indicating a fairly high level of knowledge in the area of Negligence.

The legal aspects of *Farm Visitors* were covered in seven fact situations. The farmers averaged only 55% correct answers, with a low of 29 and a high of 84% correct. They scored below 50% on two of the seven fact situations, indicating additional education or training is needed in this area.

Attractive Nuisance was covered by only one fact situation, since this is not an area in which farmers are subject to incur loss very frequently. The farmers indicated a fair level of knowledge on this subject as indicated by the score of 57% correct.

Bailments were covered in two fact situations. The farmers averaged 50% correct but had a wide difference with a score of only 14% correct on one and 85% correct on the other fact situation. The fact situation on which farmers scored the lowest had some contractual elements in it, thus indicating again that farmers are not well aware of the different legal aspects of contracts.

The subject area of *Employees* had five fact situations. The results indicated Alabama farmers are not well aware of their legal responsibilities to their employees, scoring only an average of 36% correct, ranging from a low of 22% to a high of 85%. The fact situation on which the farmers scored only 22% correct dealt with an aerial spray company hired by a farmer.

The area of *Liability for Farm Animals* was covered in eight fact situations. The farmers scored an average of 50% correct answers, ranging from a low of 12% to a high of 93%. Rulings in recent cases have changed farmers' liability for animals on highways and contributed to the low score of only 12% correct. Farmers scored only 27% correct on a fact situation dealing with a farmer's responsibility for maintaining an adequate legal fence to prevent liability for animals on highways.

The subject *Mineral Rights* had only one fact situation, and farmers scored 83% correct on this situation, indicating adequate knowledge.

Estate Planning had six fact situations, and the farmers scored only 39% correct answers, ranging from a low of 21%, to a high of 65% correct. Farmers scored very low, 21% correct, on a situation dealing with rights of a widow with a lifetime interest in the farm her husband owned. They also scored only 21% correct on a situation dealing with who would inherit 100 acres of land when a farmer died intestate.

The broad area of *Land* had three fact situations. The farmers averaged 54% correct, with two low at 31 and 27%, and one high with 95% correct answers. They scored low on fact situations dealing with acquiring land through adverse possession and a landlord's rights in a crop produced on his land by a tenant.

The last subject area was *Water Rights*. There were two fact situations used in this area and farmers scored an average of 55% correct. This indicated a fair level of legal knowledge on Water Rights. This subject will probably become more important in the future as more Alabama farmers use water for irrigation of crops.

This study indicates an important need on the part of all professional agricultural workers to aid farmers in becoming more aware of their legal responsibilities and rights. There is a need for lawyers to specialize in agricultural law or to become more familiar with the legal problems faced by farmers so they can more adequately assist them in estate planning and other specialized areas where they have legal needs. For additional information write Research Information Auburn University for Bulletin 526.

The Relationship of Fertility to Shell Quality

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IT IS WELL DOCUMENTED that the male can play a major role in fertility problems associated with broiler breeder flocks. However, recent studies conducted by Auburn University's Agricultural Experiment Station have shown that a female plays a much greater role in percentage fertility than once thought.

Previous studies conducted at Auburn demonstrated that the shell quality of eggs produced by broiler breeders had a significant effect on overall hatchability and chick quality. In flocks with hatchability problems, it was observed that eggs with the best shell quality produced the highest percent hatches. Further, it was observed that in breeder flocks reporting egg shell quality problems, percentage fertility was dramatically affected as, of course, was hatchability. Flocks producing eggs with good shell quality consistently had higher fertility percentages than did flocks producing eggs with poor shell quality, and eggs with poor shell quality accounted for most of the major problems in fertility. No logical explanation for this phenomenon could be offered.

To verify these observations, tests were conducted in the field utilizing records from selected commercial flocks of broiler breeders varying in age from 6 to 15 months. Shell quality was determined by the use of the specific gravity method and eggs with a reading of 1.080 or above graded high, whereas those with a reading below 1.080 graded low. Data from this study are presented in the table. The difference in fertility between the good and poor shell quality eggs averaged 3%; however, in some cases, depending upon the severity of the shell quality problem, the difference ran as high as 8 to 10%. Significant differences were also noted between shell quality, hatchability, and early and late embryo death.

To verify results obtained in the field studies, further research was initiated. Broiler breeder females were selected and grouped according to their egg shell quality characteristics: one group consistently producing good shell quality eggs (1.080 specific gravity or above with an average of 1.091) and the other group producing poor shell quality eggs (specific gravity below 1.080 with an average of 1.073). The hens were artificially inseminated with pooled semen, thereby eliminating any male effect. The results of this experiment are presented graphically in the figure. Those females producing eggs with good shell quality maintained 100% fertility up to 7 days after insemination then declined gradually, whereas, those producing eggs with poor shell quality started declining 3 days after insemination. It was also observed that hens producing eggs with poor shell quality were considerably overweight. This problem was compounded as the age of females increased. As a breeder hen ages, egg shell quality normally begins to decline, body weight increases, and frequency of mating decreases.

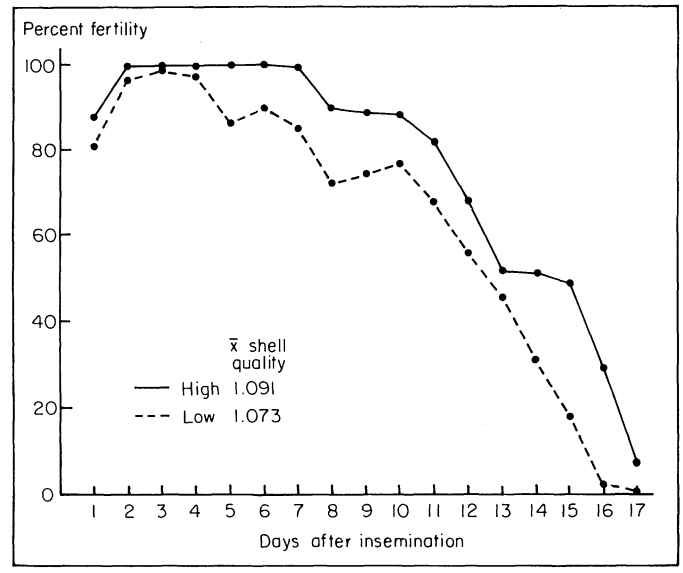
The aging effect, with regard to decline in shell quality and subsequent fertility and hatchability, seemed to be accelerated in overweight females. This, of course, can vary markedly with different strain crosses, feed formulations, and feed management programs. Feed management must be "fine-tuned" on a flock basis with regard to body weight and resulting percent production, fertility, and hatchability. Across the board feeding programs must be considered as guidelines only with adjustments by flock, made on the basis of experience and proper programs, relative to body weight, production, and strain cross.

Obviously, there is a great deal to learn with regard to managing heavy breeders (male and female) if efficient production in parent flocks is to be compatible with fast-growing, efficient, and profitable broiler progeny.

THE RELATIONSHIP OF SHELL QUALITY TO FERTILITY, HATCHABILITY, EARLY EMBRYO DEATHS, AND LATE DEAD OF SEVEN COMMERCIAL BROILER FLOCKS

	Specific gravity	Fertility	Hatch of fertile	Early dead	Late dead
Av. of seven flocks	≥1.080	94.3[a]	93.0[a]	4.2[a]	1.8[a]
	<1.080	91.5[b]	83.0[b]	10.1[b]	4.2[b]

Means which possess different superscripts differ significantly ($P \leq .01$).



Good Grazing Gains on Orchardgrass—Ladino Clover

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R. R. HARRIS, Dept. of Animal and Dairy Sciences
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COOL SEASON ANNUAL forages have long been the standard of quality for stocker steer pastures. But results of a new study at the Tennessee Valley Substation, Belle Mina, show that perennial pastures of orchardgrass-ladino clover can produce just as much steer gain as wheat grazing. Not only did the mixture of Hallmark orchardgrass and Regal ladino furnish steer average daily gain equal to that on wheat pasture (about 1 3/4 lb.) each year of the 3-year test, it also resulted in greater total gain per acre than from wheat.

In the Auburn University Agricultural Experiment Station experiment, 15 lb. of Hallmark orchardgrass and 3 lb. of Regal ladino were seeded on prepared land in September 1977. Six 4-acre paddocks were established on Humphries silt loam. Three of the paddocks were grazed during summer, while the other three were not grazed during July and August to determine if summer rest would improve persistence of the orchardgrass stands. No nitrogen fertilizer was applied.

Crossbred steers weighing approximately 500 lb. each were purchased each autumn and grazed on the pastures whenever there was sufficient forage. Poloxolene was fed to prevent bloat. During winter when grazing was insufficient, steers were moved to tall fescue pastures and supplemented as needed with corn silage and protein.

Nearly 3 months of grazing was provided in autumn and about 5 months in spring and summer by this pasture mixture, see table. Ladino clover stands remained excellent throughout the 3-year period, even during a severe drought the third year. Orchardgrass stands were weakened by the third year, but still adequate. The Hallmark variety has remained productive longer than most other varieties in yield trials.

Summer resting had no effect on orchardgrass stand or vigor. Over the 3-year test period, clover content of the forage generally ranged between 30 and 40%.

Steer average daily gain on orchardgrass-ladino clover was high, similar to that usually obtained on small grain pasture. Daily gains were highest in spring.

Beef gains per acre given in the table were those obtained when the pasture was grazed all summer. When grazing was terminated in late June, beef gains per acre were reduced approximately 100 lb.

Beef gain per acre the establishment year was lowest since no autumn forage was obtained. In the two subsequent years, beef gains per acre exceeded those normally obtained on small grain pasture. The orchardgrass-ladino clover also gave higher gain than normally achieved on tall fescue-ladino clover grazing. No bloat problems were encountered.

Results from the experiment clearly show that Hallmark orchardgrass and Regal ladino clover are an excellent combination for growing stocker cattle in northern Alabama. Animal daily gains and gains per acre were similar to those normally obtained on small grain pasture. A big advantage of the orchardgrass-ladino clover combination is its low cost in comparison with small grains, which require annual seeding and nitrogen fertilization. The perennial mixture requires no nitrogen and the pasture stand should persist 3 years.

STEER PERFORMANCE WHEN GRAZED THROUGHOUT THE SEASON ON ORCHARDGRASS-LADINO CLOVER, TENNESSEE VALLEY SUBSTATION

Dates of grazing	Days of grazing	Average daily gain	Beef gain per acre
	No.	*Lb.*	*Lb.*
First year, 1978			
Spring-summer (Apr. 10-Sept. 7) ..	150	1.68	295
Second year, 1978-79			
Autumn (Sept. 26-Dec. 19)	83	1.70	111
Spring-summer (Mar. 20-Aug. 30) .	163	1.88	419
TOTAL	246	1.84	530
Third year, 1979-80			
Autumn (Sept. 4-Dec. 5)	92	1.59	244
Spring-summer (Apr. 1-Aug. 27) ..	138	1.84	411
TOTAL	230	1.73	655

Too Much Cottonseed Meal, Soybean Meal Bad for Dairy Cows

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DURING RECENT YEARS the percentages of protein fed in dairy rations have been increased markedly in order to meet the protein needs of cows with high milk production potential. Cottonseed and soybean meals are supplements commonly used to increase the protein level of dairy rations.

The method used to process cottonseed and soybean meals affects the solubility and degradability of the protein in the rumen and the amount of residual oil in the meal. In addition, direct solvent processed (oil removed chemically) cottonseed meal has a higher level of free gossypol than that processed by the screw pressed method (oil removed mechanically).

The use of cottonseed meal containing high levels of free gossypol in rations of non-ruminants is limited due to its potential toxicity. Although gossypol toxicity had not been reported in mature ruminants fed cottonseed meal containing high levels of free gossypol, intravenous administration of gossypol resulted in toxicity symptoms similar to those in non-ruminants.

High Protein Rations Evaluated

The physiological effects of feeding high levels of cottonseed and soybean meal to Holstein cows with high milk production potential were studied at Auburn University's Agricultural Experiment Station. The 24 experimental cows were mature Holsteins that had produced over 65 lb. of milk daily at peak of a prior lactation and had calved 9 to 31 days prior to entering the experiment.

All cows were fed a standard ration for 2 weeks and then changed to one of three test rations in which 82% of the protein was supplied by protein supplement. Protein supplements were: (1) direct solvent extracted soybean meal (DSSBM), (2) direct solvent extracted cottonseed meal (DSCSM), and (3) screw pressed cottonseed meal (SPCSM).

The protein supplements were premixed with ground corn, molasses, minerals, and vitamins, and then blended with corn silage at the two daily feedings. Rations were formulated to provide 24% crude protein in the dry matter. Average concentrations of free and total gossypol in the DSCSM ration dry matter were 0.094 and 0.695%, compared with 0.016 and 0.616% in that of the SPCSM ration. The DSSBM ration contained no gossypol.

Cow responses to rations containing the different protein supplements were evaluated by measuring ration intakes, milk production and composition, and by sampling and analyzing blood, rumen contents, and liver tissue.

Cow Performance Varied

Average body weights, ration dry matter intakes, daily milk production, and milk fat percentages were compared among rations, table 1. During the first 6 weeks, average daily milk production was not affected by the ration fed. During the next 8 weeks (weeks 7-14), however, cows on the SPCSM ration produced more milk than those fed the DSCSM ration.

Levels of rumen ammonia nitrogen and blood ammonia were similar on the three rations, possibly reflecting the relative solubilities of the protein supplements. Ration effects on blood and liver components are given in table 2.

Temperature Effects Noted

Two of the eight replicates of cows on each ration were on the experiment through the month of July and were exposed to daily temperatures above 90°F. Those fed the DSCSM ration panted for air throughout most of the day, including early morning. In contrast, the respiration rate of cows fed the DSSBM and SPCSM rations was only moderately elevated.

One of the cows receiving the DSCSM ration during the hot weather collapsed while eating and died almost instantly. This cow was 7 years old, and 4 days prior to death had a very high respiration rate, low levels of hemoglobin and packed cell volume, and severe hemolysis of erythrocytes. Necropsy revealed areas of fatty degeneration of the liver and the highest level of total gossypol (264 μg per gram dry liver tissue) found in any cow on the experiment. Death appeared to be related to the high level of gossypol intake.

The levels of protein fed in this experiment are higher than the 13-15% recommended for normal herd use. The presence of gossypol in plasma and livers of cows fed high levels of cottonseed meal (DSCSM and SPCSM rations) indicates that the capacity of the rumen to detoxify ration gossypol is limited. Further, the results suggest that gossypol intoxication is possible in high producing dairy cows in which most of the high protein requirement is met by a protein supplement containing a high level of free gossypol. Experience suggests that all protein supplements fed in this experiment are safe when fed at conventional levels in which total crude protein content of the ration dry matter is 18% or less.

TABLE 1. MEAN BODY WEIGHT, RATION INTAKE, AND MILK PRODUCTION AND MILK FAT PERCENT OF COWS BY RATION GROUPS

Response	Results, by ration		
	DSSBM	DSCSM	SPCSM
Body weight, lb.	1,324	1,298	1,194
Ration DM intake/cow/day, lb.	45.8	49.5	49.3
Daily milk production/cow, lb.[1]			
Weeks 1 to 6	62.9	65.2	65.6
Weeks 7 to 14	49.2	44.9	54.2
Average, weeks 1 to 14	55.1	53.5	59.1
Milk fat, pct.	3.5	3.5	3.2

[1]Covariance adjusted to take into account initial differences among cows.

TABLE 2. RELATIONSHIP OF RATION FED TO CONCENTRATIONS OF SELECTED COMPONENTS OF BLOOD AND LIVER

Component	Result, by ration		
	DSSBM	DSCSM	SPCSM
Toxic lymphocytes in blood, incidence	0.4	0.7	0
Erythrocyte fragility (50% hemolysis)[1]	.51	.59	0.57
Hemoglobin, g/100 ml blood[2]	11.3	10.1	10.6
Plasma, bound gossypol, μg/ml	0	1.9	1.7
Liver, free gossypol, μg/g dry tissue	0[3]	94	59
Liver, bound gossypol, μg/g dry tissue	0[3]	136	80

[1]Buffered salt concentrations at which 50% of cells lysed, 98th day.
[2]Samples from 9th week.
[3]An interferring compound, not gossypol, gave low apparent levels by method used. Liver samples from 98th day, all rations.

Nitrogen Economy with Nitrification Inhibitors?

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INCREASED EFFICIENCY of fertilizer nitrogen has long been an attractive goal. But this is even more important with increasing cost for nitrogen.

One approach to increased efficiency is to reduce nitrogen losses, such as from leaching and denitrification. Use of proper rates and time of application continue to contribute to efficiency, but now there is interest in using chemicals that inhibit the conversion of ammonium nitrogen to nitrate by soil bacteria by a process called nitrification. The potential advantage of this is based on the fact that while both ammonium and nitrate forms of N are readily taken up by plants, leaching and denitrification losses occur almost exclusively from the nitrate form.

Most fertilizer N is applied as ammonium, or it releases ammonium after hydrolysis in soil (urea). Therefore, it would seem advantageous to use a nitrification inhibitor to keep nitrogen in the ammonium form for crop uptake. Two products for this purpose—N-Serve® and Dwell®[1]—have been evaluated for 3 years by Auburn University's Agricultural Experiment Station. These products are applied either in the fertilizer or incorporated with it in the soil at rates of ½ to 1 lb. active per acre.

The two inhibitors were evaluated with corn in field experiments at the Gulf Coast Substation in 1978, 1979, and 1980 and at the Sand Mountain Substation in 1980. Experiments with cotton were carried out in 1979 and 1980 at the Tennessee Valley Substation. Nitrogen sources were ammonium sulfate and urea, applied at three rates to define the crop response to nitrogen. Either sodium nitrate or calcium nitrate was included at the same N rates to provide an all-nitrate comparison.

Nitrification inhibitors were mixed with the nitrogen in solution, then broadcast and incorporated immediately before planting. Soil samples were collected from the plow layer at intervals after application to measure the extent of nitrification and available nitrogen remaining.

Dwell and N-Serve effectively slowed the nitrification process, as shown by larger amounts of residual ammonium and wider ratios of ammonium to nitrate in soil. Immediately after application of ammonium fertilizer, the ratio of ammonium to nitrate is high. As nitrification proceeds, the ammonium decreases while nitrate increases, causing the ratio to narrow.

Results at the Tennessee Valley Substation in 1979 showed the inhibitors functioned for 4 weeks, holding a larger proportion of nitrogen in the ammonium form than was the case without inhibitor. At the Gulf Coast Substation, the inhibitors persisted for 10 weeks after application in 1979, as shown in the following table:

Week	*Ratio of ammonium N to nitrate N*		
	With Dwell	*With N-Serve*	*Without inhibitor*
Tennessee Valley Substation			
1	8.7	5.1	4.1
2	3.9	3.7	1.9
3	2.9	2.8	.8
4	2.1	1.7	.5
10	.4	.3	.2
Gulf Coast Substation			
4	1.5	1.0	.7
5	1.3	.6	.3
10	.6	.4	.2

In both experiments, however, inhibitors did not hold more available N in the soil, they simply delayed the change of N to nitrate.

Results at the Sand Mountain Substation in 1980 showed some conserving effects of inhibitors, but only small amounts of N were saved. Residual nitrogen in the upper 12 in. of soil 5 weeks after application of 178 lb. N per acre was greater with inhibitors than without, as shown below:

N source and inhibitor	*Ammonium N plus nitrate N, lb./acre*
Calcium nitrate	
No inhibitor	37
Urea	
No inhibitor	45
Dwell (0.56 lb./acre)	67
N-Serve (0.56 lb./acre)	54
No N, no inhibitor	6

Corn and cotton yields responded to applied nitrogen, but there were no differences as a result of nitrogen sources or nitrification inhibitors. Yields shown in the table are averages across three rates of applied nitrogen. The equality of the all-nitrate source also shows that nitrification inhibition was not needed in the cropping situations reported here. There may be conditions under which nitrification inhibitors could be advantageous, but no advantage has been found to date in the Alabama experiments.

[1]N-Serve [2-chloro-6-(trichloromethyl) pyridine] is a Dow Chemical Co. product; Dwell, an Olin Chemical Co. product, contains 5-ethoxy-3-(trichloromethyl)-1, 2, 4,-thiadiazole, the active ingredient in Olin's registered soil fungicide, Terrazole.

YIELD OF CORN AND COTTON WITH DIFFERENT NITROGEN SOURCES AND NITRIFICATION INHIBITORS, AVERAGES ACROSS NITROGEN RATES

N source[1]-inhibitor	Corn grain/acre				Seed cotton/acre,	
	Gulf Coast Substation			Sand Mt.	Tenn. Valley Sub.	
	1978	1979	1980	Sub., 1980	1979	1980
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*
Sodium nitrate-none	127					
Ammonium sulfate-none	127					
Ammonium sulfate-Dwell	130					
Ammonium sulfate-N-Serve	123					
Sodium nitrate-none		149			2,714	
Ammonium sulfate-none		155			2,799	
Ammonium sulfate-Dwell		151			2,766	
Ammonium sulfate-N-Serve		159			2,831	
Urea-none		153			2,861	
Urea-Dwell		159			2,761	
Urea-N-Serve		157			2,720	
Sodium nitrate-none			90	67[2]		2,646
Urea-none			91	62		2,782
Urea-Dwell			90	62		2,766
Urea-N-Serve			90	61		2,777

[1]Sodium nitrate, $NaNO_3$, is commonly known as nitrate of soda; ammonium sulfate, $(NH_4)_2SO_4$, is called sulfate of ammonia.

[2]Calcium nitrate, $Ca(NO_3)_2$, was applied at the Sand Mountain Substation in 1980.

What's Happening to Farm Costs and Expenditures by Farmers?

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ONE OF THE MOST PERPLEXING PROBLEMS facing farmers in the 1980's is rising costs. Escalating prices paid for the many items farmers buy are a part of the overall inflation complex that prevails in the economy. The question arises, what has happened to farm costs and what are some of the implications?

Changing Structure

The changing structure of agriculture has made farmers more vulnerable to risks associated with fluctuations in prices paid. Over the years there has been a dramatic decline in the labor inputs and farm-produced items used in production. This has been offset by increased use of capital goods, such as fertilizer, machinery, and associated fossil fuels. Farms have become larger in acreage and in volume of business.

In 1950, labor accounted for almost 40% of the value of resources used in farming; by 1977 it had declined to 14%. In 1950, capital (machinery, chemicals, etc.) accounted for 25% of the resources used in farming; by 1977 it had increased to 43%. Thus, today's farmers depend on purchased farm inputs.

The mix of capital inputs purchased in recent years has also changed. Most capital goods used on farms in the 1950's are obsolete today. Until the 1970's there was rather strong incentive to substitute capital for labor because of the increase in wage rates. In more recent years, increases in the cost of fertilizer, land, chemicals, fossil fuels, and interest rates have changed incentives to substitute capital for labor.

The major effects of inflation on the input side of farming are that input costs rise and farmers tend to accelerate the purchases of capital goods. They reason that prices paid are likely to increase further. Thus, they buy larger machines in an attempt to increase efficiency. With rising land values and costs, there is also a tendency for lenders to make credit available even without full utilization of the resource immediately. With more debt and increased costs of operation, the problem of "cash flow" has hit many farmers.

TABLE 1. FARM PRODUCTION EXPENSES AS A PROPORTION OF CASH RECEIPTS FROM FARM MARKETINGS, PER FARM BASIS, UNITED STATES, SELECTED YEARS

Year	Cash receipts from farm marketings per farm	Farm production expenses per farm	Expenses as a proportion of receipts
	Dol.	*Dol.*	*Pct.*
1940	1,320	1,080	82
1945	3,631	2,189	60
1950	5,039	3,445	68
1955	6,337	4,764	75
1960	8,643	6,908	80
1965	11,729	10,026	85
1970	17,138	15,064	88
1975	31,879	27,417	86
1976	34,617	30,362	88
1977	39,752	37,482	94
1978	47,477	42,528	90
1979	56,348	50,844	90

The Squeeze

The squeeze in farming today is illustrated by the proportion that farm production expenses take of cash receipts from marketings on a per farm basis, table 1. Until 1976, average per farm production expenses took 88% or less of cash receipts from farm marketings. Since 1976, it has required 90% or more of cash receipts from farm marketings to cover production expenses as an average for the United States.

This growing demand on receipts to cover costs has provided incentive for farmers to expand production—to get larger and to borrow more money. For other farmers the squeeze has caused them to consider non-farm sources of income in order to continue to farm or to give up farming altogether. Since the latter part of the 1960's, income of farm operator families per farm from off-farm sources has exceeded that from farm sources.

Since the squeeze has led to expansion of farm production on individual farms through added acreage, the demand for farm land increased. Potential purchasers of farmland by farmers include those with income from non-farm sources. In many cases this group can outbid those with income from farm sources only. Therefore pressure is created for farm real estate prices to rise. Commodity programs and tax policies also affect this situation.

Differential Expense Increases

Some expenditures by U.S. farmers have increased considerably more than others in the past 10 years, table 2. These figures reflect both the changes in prices paid for production items as well as quantities purchased.

The largest percentage increase occurred in interest paid on the non-real estate farm debt. In 1979, non-real estate interest paid was more than four times that of 1969. The next two items of farm production expenses which were not greatly different in their percentage increases were the cost of seed and interest on the farm mortgage debt. Other expenses that increased 200% or more in the 10-year period were repairs and operation of capital items and livestock purchased. Included in repairs and operation of capital items were expenditures for petroleum fuel and oil used on the farm which showed a substantial increase.

Among the expense items showing the smallest increases from 1969 to 1979 were those for lime, taxes on farm property, and hired labor.

Since interest costs on non-real estate and real estate debt were among the leaders in production expense increases in the past 10 years, the change in average farm debt per farm was determined. As of January 1, 1980, non-real estate debt per farm in the United States averaged $30,619, compared to $7,178 on January 1, 1970, according to USDA figures. Comparable figures for average real estate debt per farm were $35,567 and $9,896.

The cost and farm structure changes that have occurred over the years and the farm cost situation faced by farmers today present a challenge like that never faced before for top farm financial management.

TABLE 2. CHANGE IN FARM PRODUCTION EXPENSES, UNITED STATES, 1969 TO 1979

Item	1969	1979	Change
	Mil. dol.	*Mil. dol.*	*Pct.*
Feed purchased	7,100	17,004	139
Livestock purchased	4,225	12,684	200
Seed purchased	871	3,400	290
Fertilizer	2,209	6,533	195
Lime	103	159	54
Repairs and operation of capital items	4,507	13,665	203
Hired labor	4,152	9,239	123
Interest on non-real estate debt	1,434	6,576	359
Interest on farm mortgage debt	1,625	6,260	285
Depreciation	6,574	18,954	188
Taxes on farm property	2,456	4,259	73
Net rent to non-farm landlords	2,061	5,320	158

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EFFECT OF MATERNAL DIET ON MILK COMPOSITION

Graduate student milking rat.

In recent years Americans have been encouraged by food advertisements and various health professionals to partially replace saturated fat in their diets with polyunsaturated fats. Vegetable oils commonly consumed are high in the polyunsaturated fatty acid, linoleic acid. This fatty acid can be made only by plants, and because it is needed for normal cell function, linoleic acid is an essential component of the human diet.

Many commercially available sources of polyunsaturated vegetable fats are prepared by the process of partial hydrogenation. While this process confers certain desirable properties on the finished product, it also results in the formation of nonphysiological compounds called *trans*-fatty acids. The *trans*-fatty acid content of hydrogenated products varies from 0-15% in salad oils to greater than 60% in some margarines.

A shift in the American diet from predominantly saturated animal fat, such as butter and lard, to vegetable fat, such as margarine and shortening, results in increased consumption of both polyunsaturated fat and *trans*-fatty acids. The nutritional and biological consequences of this changing pattern of fat consumption in the United States are largely unknown.

One group of the American population for which these changes may be particularly significant is the rapidly developing infant sustained only by its mother's milk. A small amount of the fatty acid, linoleic acid, is known to be required for proper development, and some scientists believe that polyunsaturated fatty acids in the infant diet may help to reduce cardiovascular disease later in life. On the other hand, *trans*-fatty acids are known to inhibit the function of essential fatty acids in the body and increase the essential fatty acid requirement. The infant's tissue stores of essential fatty acids are minimal at a time when neural tissue is undergoing rapid development, requiring a constant and adequate supply of essential fatty acids. It is therefore important to know how different types of fat in the maternal diet influence the composition of human milk.

Researchers in the Department of Home Economics Research of the Auburn University Agricultural Experiment Station have recently investigated this problem by using lactating rats as an animal model for the nursing mother. At parturition, seven groups of rat dams were placed on diets which contained different amounts of linoleic acid. Another group of rats was fed a diet containing 10% of total fat as *trans*-fatty acids from hydrogenated soybean oil. At 16 days postpartum, the rats were milked with a simple vacuum device (see photograph). The fatty acid composition of the milk was determined. The volume of milk produced by a rat on day 16 of lactation was measured by weighing the rat pups before and after six 1-hour suckling periods during a 24-hour period.

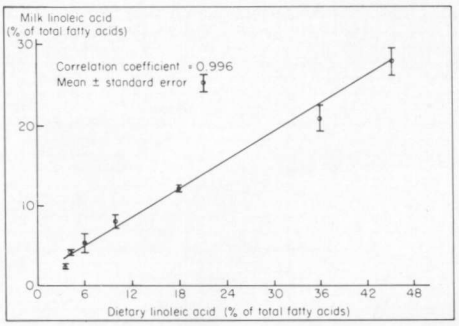
Rat dams fed diets low in linoleic acid produced milk which was also low in this essential fatty acid. Rat dams fed diets high in linoleic acid produced milk high in this fatty acid. In fact, there was a direct, linear relationship between the amount of linoleic acid fed and the amount which appeared in the milk, see figure. This result suggests that a mother consuming a diet rich in polyunsaturated fat will produce human milk higher in polyunsaturated fat than a mother consuming a diet comprised of mainly saturated fat.

Milk from rat dams receiving a diet containing hydrogenated soybean oil as a source of *trans*-fatty acids was compared to milk from rat dams fed diets containing the same amount of total fat but no *trans*-fatty acids. Only the milk from rat dams fed hydrogenated fat contained *trans*-fatty acids. As shown in the table, 39% of *trans*-fatty acids in the maternal diet was transferred to the milk. Thus, this study suggests that nonphysiological *trans*-fatty acids can be transferred from the maternal diet to the offspring through milk. The effect, if any, of these compounds on the young, rapidly developing animal needs further investigation.

Relationship of Partially Hydrogenated Fat in the Maternal Diet to *Trans*-Fatty Acids in Rat Milk

Maternal dietary *trans*-fatty acids		Milk *trans*-fatty acids		Transfer from
Percent of total fatty acids	Amount consumed per day	Percent of total fatty acids	Amount in milk per day*	maternal diet to milk
Pct.	*g.*	*Pct.*	*g.*	*Pct.*
10.3	0.82	7.1	0.32	39

*Calculated on the basis of 27.7 milliliters milk produced per day by a rat nursing eight pups on day 16 postpartum.



Control of Horn Flies with Ear Tags

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HORN FLIES continue to be the most serious fly pests of cattle throughout Alabama and the Southeast. During the summer months, population levels often increase to several thousand flies per animal in untreated herds.

Several years ago, entomologists began experimenting with insecticide-impregnated tags as a means of reducing horn fly numbers. These tags, formulated to slowly release small quantities of insecticide over prolonged periods, were found to be most effective when attached to the ears. In 1979, Rabon® (vapona), became the first commercially available ear tag for fly control on cattle. Following the manufacturer's recommendations of two tags per animal, one in each ear, horn flies could be effectively controlled up to 3 months before tags needed to be replaced.

Two new synthetic pyrethroid insecticides may soon be available which show promise of good control for even longer periods. The Ectrin® tag (6% fenvalerate) has been approved by EPA and should be marketed by Diamond Shamrock Corp. in time for this year's fly season. This product will replace the company's Rabon Cattle Ear Tag which is currently being phased out. Atroban®, a permethrin product of the Burroughs Wellcome Co., has not yet been registered.

Research entomologists working at the Experiment Station's Black Belt Substation, Dallas County, conducted field tests to evaluate these two ear tags for control of horn flies on beef cattle. Nine groups of cattle were utilized in this study.

The genetic composition of groups 1 to 6 were as closely matched as possible with approximately one-half Angus-Hereford and one-half Simmental-Hereford crosses. Three groups were treated with Ectrin and three groups with Atroban at tagging ratios of one tag every animal, every second animal, and every third animal, excluding calves. In addition, a mixed Hereford-Angus-Simmental-Charolais brood herd (group 7) was treated with Atroban with one tag installed per every second cow. A similar brood herd (group 8) in an adjacent pasture was left untreated throughout the study as a control. Rabon tags were installed, two tags per head, in 24 of 48 Hereford-Angus steers (enclosed four steers per plot) in a row of 12 adjacent 2-acre plots. All tags were installed between April 23 and May 8 with no other means of treatment applied during the season. Fly counts were made at weekly intervals from late April to mid-October by visually estimating (with field binoculars) the number of horn flies per animal.

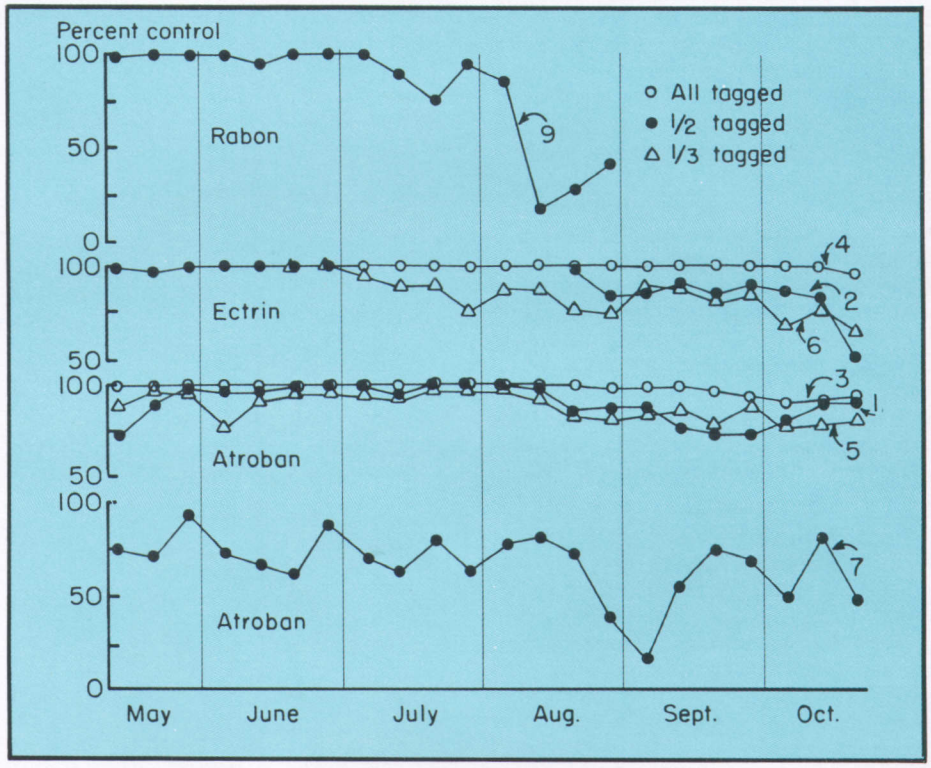
When all cows in a herd were tagged (groups 3 and 4), both Ectrin and Atroban provided excellent fly control for 5 to 6 months, see figure. Although tagging only one-half or one-third of the cows in a herd was not as effective, horn fly numbers were still dramatically reduced, especially earlier in the season. Tagging only one in three animals generally did not provide as good control as tagging every second animal.

The level of fly control achieved in the brood herd in which one-half the cows were tagged with Atroban (group 7) was noticeably lower than that obtained for the heifers and smaller groups of cows and calves at the same tagging ratio. The degree of control in the brood herd was also more erratic. This may be explained in part by the fact that the Atroban-treated brood herd was located adjacent to the untreated control herd and thus experienced much greater fly pressure. Whereas tagging every second animal may be effective in smaller, more isolated herds, a consistently high level of control in herds exposed to untreated cattle may be achievable only by tagging each individual.

Comparisons with Rabon-treated steers clearly demonstrated the longer-term effectiveness of both Ectrin and Atroban in controlling horn flies. This alone promises to be a significant time- and labor-saving factor for cattlemen who can tag their herds early in the year and expect virtually season-long control without having to replace old tags.

EAR TAG FIELD TESTS

Group no.	Group composition	Group size	Treatment	Tagging ratio (excl. calves)
1	cows/calves	48	Atroban	1:2
2	cows/calves	48	Ectrin	1:2
3	heifers	23	Atroban	1:1
4	heifers	23	Ectrin	1:1
5	heifers	23	Atroban	1:3
6	heifers	23	Ectrin	1:3
7	cows/calves	60	Atroban	1:2
8	cows/calves	60	Control	-
9	steers	48	Rabon	1:2



Optimized Design of Anaerobic Digestion of Animal Waste Through Computer Simulation

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AT AUBURN UNIVERSITY'S Agricultural Experiment Station, a computer model of digestion has been assembled and programmed to optimize the design of digesters based on operational data obtained from several large-scale methane fermentation plants. Given a set of simple input parameters, the model will analyze the animal production operation and produce a set of optimized design parameters for the digester. These optimized design parameters consist of detention time, volume of digester, influent solids concentration, and operating temperature.

After design of the digester has been completed, the model will then proceed to project operation of the methane production system, stepping through the year using animal production cycles common to the animal type. Output consists of projections of daily manure and nitrogen production, digester loading rate and detention time, daily total methane production, and net energy produced.

As an example of the use of this model, a typical animal production operation will be assumed and input data will consist of the parameters listed below:

Input Data for Assumed Example

Animal type ..... Poultry, broiler
No. of head 100,000
Average weight/head ..... 2.8 lb.
Digester thermal coefficients for wall, top, and base, respectively . .08, .10, .08 $\frac{\text{Btu}}{\text{ft.}^2\text{-}^\circ\text{F-hr.}}$
Average annual ambient temperature ..... 16.1°C
Average annual temperature amplitude ..... 10.0°C
Animal cycle starting date .. January 19

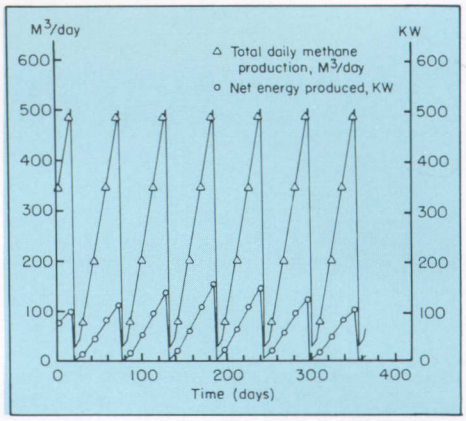
The annual temperature data assumed will be for a typical operation in the Birmingham, Alabama, area. The digester thermal characteristics would correspond to a digester sitting on grade with 2 in. of polyurethane insulation on the sides and top.

Running the model for this set of input data will first produce a set of design parameters for a digester optimized to produce the maximum daily net energy. Net energy consists of total energy produced minus the energy necessary to heat the digester. The digester designed by the computer for this animal production facility is summarized in the table shown. This optimized design is based on an average animal weight, in this case, 2.8 lb. per bird. The actual operation usually starts an animal cycle at .10 lb. per bird and ends at approximately 4.0 lb. per bird, thus the actual live weight and the manure production would constantly increase until the cycle ends. Since the digester has constant volume, the loading rate and detention time of manure in the digester constantly changes and the total methane and nitrogen production is a function of these changes.

The computer program now takes these dynamic changes into consideration by incorporating animal production cycle time and varying ambient temperatures. Using the optimum design parameters already calculated, the computer now produces a simulation of the production facility on an annual basis.

During digester operation, a liquid residue will be produced which must be disposed of. The usual practice for such disposal is land application. Thus, nitrogen becomes an important factor in the operation of these facilities. For this particular facility, available nitrogen will range from a low of 11.6 lb. per day at the beginning of the animal cycle to over 400 lb. per day at the end. It is essential to know the nitrogen production in advance with such a large increase (about 40 times) during the cycle.

The figure shown is a graphic output of the net energy produced in kW and the total daily methane production in m^3. The data in the figure show several important facts. The broiler cycle time is approximately 56 days. This means that manure, nitrogen, and methane production will peak at the end of this period. This can be seen happening starting on day 19. Total methane production varies during a cycle from approximately 23 m^3 per day to about 501 m^3 per day. The net thermal energy produced is affected by ambient temperatures since a portion of the methane would be utilized to maintain digester temperature of 32°C. This effect is seen on the net energy produced during the year. For January (day 0-31) the maximum net energy available is about 100 kW. This value rises to about 156 kW during July (day 180-210). But, also note that during July a flock replacement occurs and the net energy available drops to about 5 kW. During the colder months when animal replacement occurs, there are periods when essentially no energy is available for external use.



It is important for animal producers to know when, during the year, energy from the digestion facility will not be available. By moving the replacement cycle around, the periods when energy demand is greatest can also be matched with periods when methane production is greatest. Poultry operations usually demand more energy in summer due to ventilation requirements. As can be seen from the figure, this is when the yearly peak in available net energy from digestion of the waste also occurs. This trend would also be common in confined swine production, although the cycle time is markedly different. Dairy energy utilization and production would be much more constant during the year.

COMPUTER OPTIMIZED DESIGN PARAMETERS FOR ANIMAL PRODUCTION FACILITY DESCRIBED IN INPUT DATA

Parameter	Optimum value	Units*
Volatile solids feed concentration	38.0	g/l
Total solids feed concentration	5.42	pct.
Detention time	14.6	days
Operating temperature ..	32	°C
Volatile solids reduction	55.6	pct.
Loading rate	2.60	g vs/l vol-day
Methane productivity ...	0.724	1 CH_4/l vol-day
Volume of digester	584.2	m^3
Depth of digester	5.0	m
Diameter of digester	12.2	m

*Abbreviations in this column are: g-grams; vs-volatile solids; l-liter; vol-volume; CH_2-methane; m-meter.

Systems for Controlling Sicklepod in Soybeans

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SICKLEPOD HAS RAPIDLY moved to the top of the list of most troublesome weeds in Alabama row crops, especially in soybeans.

Research in Alabama and other Southeastern States has documented the various biological characteristics of sicklepod (*Cassia obtusifolia* L.) that contribute to its competitive ability. At the same time, its only identifiable weaknesses are its intolerance of shade and slower growth when temperatures drop below 75°F. Likewise, herbicides have been identified that provide various degrees of selective control in soybeans.

Information from this past research provided the foundation for research by Auburn University's Agricultural Experiment Station begun in 1978 to identify workable systems for controlling sicklepod in soybeans. Experiments were conducted at the Tennessee Valley Substation, Belle Mina, between 1978 and 1980, and at the Gulf Coast Substation, Fairhope, during 1980.

Essex soybeans were planted the first week of May during 1978-80 and Lee 74 the last week in June during 1979-80 at Belle Mina. The same control systems were used for each planting, thus providing information on effectiveness with early season vs. late season plantings. The three growing seasons over which the data were collected were all different. Growing conditions were fair to good in 1978, excellent in 1979, and poor in 1980.

The experiment at Fairhope was planted the first week of July 1980, with Ransom soybeans. Treatments were identical to those at Belle Mina.

Consistent control of sicklepod and better yields were evident with the more intensive control systems (treatments 3, 4, 9, 10, and 11 in the table) for both row spacings. With excellent growing conditions in 1979, however, less weed control inputs (numbers 1, 2, 7, and 8) provided good results, indicating the increased competitiveness of the soybeans.

Where growing conditions were less than optimum in 1978 and 1980, the less intensive control systems established trends toward better performance when used with the 10-in. row spacing (treatments 1 and 2 vs. 7 and 8). The narrow rows better compensated for the poorer soybean growth. Likewise, where no sicklepod control was applied (treatment 6 vs. 13) soybeans in 10-in. rows yielded more. Where plots were hand hoed (5 vs. 12), 10-in. rows influenced yield less.

Sicklepod control systems are available that producers can use and get yield comparable to production from hand hoeing, but at more economical weed control costs. Control of sicklepod should not be confined to chemical treatments only. Much can be gained by taking advantage of cultural practices—such as narrow row spacing—that produce maximum crop competition with the weed.

[1]The authors acknowledge the valuable assistance provided by W.B. Webster and V.H. Calvert II, Tennessee Valley Substation, and E.L. Carden and F.B. Selman, Gulf Coast Substation.

INFLUENCE OF SELECTED CONTROL SYSTEMS ON SICKLEPOD CONTROL AND YIELD OF SOYBEANS

Control systems—treatment number and lb. active/acre	Planting dates[1]	Belle Mina, 1978		Belle Mina, 1979		Belle Mina, 1980		Fairhope, 1980	
		Sicklepod control	Soybean yield	Sicklepod control	Soybean yield	Sicklepod control	Soybean yield	Sicklepod control	Soybean yield
		Pct.	*Bu.*	*Pct.*	*Bu.*	*Pct.*	*Bu.*	*Pct.*	*Bu.*
30-in. rows									
1. Tolban + Sencor-PPI (3/4 + 3/8)	May	23	30	66	66	3	16	-	-
	June/July	-	-	30	24	59	7	48	23
2. Lasso + Sencor-PRE (2 1/2 + 3/8)	May	15	30	95	64	0	16	-	-
	June/July	-	-	20	25	82	12	56	24
3. Lasso + Sencor-PRE cultivate; Lorox + Butyrac 200-PDS (2 1/2 + 3/8; 1/2 +1/4)	May	98	42	100	62	93	28	-	-
	June/July	-	-	87	32	100	13	97	34
4. Tolban + Vernam-PPI cultivate; Sencor PDS (1/2 + 2 1/2; 3/8)	May	-	-	98	62	89	31	-	-
	June/July	-	-	95	19[2]	95	13	95	32
5. Hand hoed check	May	100	29	98	65	92	23	-	-
	June/July	-	-	60	27	90	11	98	34
6. Non-treated check	May	0	25	0	56	3	10	-	-
	June/July	-	-	0	17	0	3	0	17
10-in. rows									
7. Tolban + Sencor-PPI (3/4 + 3/8)	May	92	37	80	59	18	21	-	-
	June/July	-	-	70	29	81	11	59	29
8. Lasso + Sencor-PRE (2 1/2 + 3/8)	May	96	33	100	60	12	24	-	-
	June/July	-	-	56	30	98	11	64	28
9. Lasso + Sencor-PRE; Toxaphene-POT (2 1/2 + 3/8; 3; 3)	May	-	-	100	62	92	31	-	-
	June/July	-	-	100	31	100	10	97	39
10. Tolban-PPI; Toxaphene-POT (3/4; 3; 3)	May	-	-	-	-	62	25	-	-
	June/July	-	-	-	-	96	9	90	32
11. Lasso-PRE; Toxaphene-POT (3; 3; 3)	May	-	-	-	-	64	23	-	-
	June/July	-	-	-	-	100	7	94	32
12. Hand hoed check	May	98	35	91	56	98	33	-	-
	June/July	-	-	100	28	96	6	98	35
13. Non-treated check	May	38	33	41	64	8	16	-	-
	June/July	-	-	0	26	9	5	0	25

[1]Essex soybeans planted first week of May and Lee 74 planted last week in June at Belle Mina. Ransom soybeans planted first week in July at Fairhope. Soybean seeding rate was same for both row spacings, 130,000 plants/acre.
[2]Low yield due to injury from Sencor post-directed.

PAYROLLS & POLLUTION

West Alabamians View the Issues

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RURAL AREAS have traditionally been characterized as cleaner, healthier environments than more densely populated locales. Industries were primarily located in urban centers, and industrial wastes have been a major source of both air and water pollution. As the decentralization of the nation's (and Alabama's) population proceeds, it is followed by a corresponding trend toward rural industrialization and changes in the rural environment.

Although the most recent wave of industrial expansion is occurring in a midst of heightened sensitivity to pollution and expanded regulatory controls, many rural places are confronting tradeoffs between employment opportunities and some level of environmental deterioration. This analysis examines survey results from a 1% random sample of residents age 18 and over in eight west Alabama counties (Choctaw, Clarke, Greene, Hale, Marengo, Pickens, Sumter, and Washington). Termed the Tennessee-Tombigbee corridor, the area's location along a major new transportation route is expected to bring significant growth and industrialization to some communities.

Personal interviews were conducted with 926 residents in the eight-county area, an 85.6% completion rate. The sample generally reflects population profiles, but is slightly older, slightly underrepresents black males, and slightly overrepresents black females.

The table shows responses to four survey items relating environmental concern to economic growth. Most residents favored or strongly favored the idea that natural resources should be used whenever possible to increase economic growth (Item 1).

Item 2 revealed a great deal of indecision about relaxed environmental standards. Although 44% favored less stringent requirements, a third were undecided, and 23% opposed a change. Among subgroups, the majority of black females were undecided, as were more than a third of the black males. Most white males favored relaxed environmental standards, but white females were almost equally divided over this issue.

Most respondents thought that the destruction of some places of natural beauty was a price one has to pay for the sake of economic progress (Item 3). More blacks were undecided about this item, but more white respondents opposed the idea that such losses were inherent in the economic development process.

The fourth questionnaire item found most respondents in favor of increased regulation of industrial natural resource use. More blacks were undecided here.

SURVEY RESPONSES OF WEST ALABAMA RESIDENTS

Characteristic	Response (percent)					Chi-square statistic
	Strongly favor	Favor	Undecided	Oppose	Strongly oppose	
Item 1: Our natural resources should be used whenever possible to increase economic growth.						
All respondents	24.5	51.7	17.7	3.3	2.8	
By sex and race						
Black males	19.4	54.8	21.0	2.4	2.4	
Black females	21.2	50.0	25.9	1.8	1.1	
White males	28.9	52.2	9.9	4.7	4.3	
White females	26.5	51.6	14.7	3.9	3.2	
						34.8*
Item 2: Do you favor relaxing environmental standards in order to achieve economic growth?						
All respondents	16.3	27.4	33.3	9.6	13.4	
By sex and race						
Black males	14.5	30.6	38.7	8.1	8.1	
Black females	14.1	24.2	53.8	5.1	2.9	
White males	22.8	32.3	17.2	7.8	19.8	
White females	13.9	25.0	23.9	16.4	20.7	
						138.2*
Item 3: The destruction of some places of natural beauty is a price we have to pay for the sake of economic progress.						
All respondents	16.4	44.0	16.0	11.7	11.8	
By sex and race						
Black males	10.5	48.4	19.4	12.1	9.7	
Black females	12.6	47.3	23.6	9.7	4.7	
White males	22.5	39.0	8.2	10.8	19.5	
White females	17.9	42.9	11.4	14.3	13.6	
						69.8*
Item 4: The government should exercise greater control over the way industries use our natural resources.						
All respondents	28.5	31.2	20.4	6.7	13.2	
By sex and race						
Black males	32.5	30.1	24.4	4.9	8.1	
Black females	24.6	33.3	34.1	4.0	4.0	
White males	30.7	33.3	7.4	8.2	20.3	
White females	28.8	27.8	16.0	8.9	18.5	
						94.1*

* $p < .001$

Objective Alternatives for Improving Delivery Route Efficiency

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RISING PRICES for petroleum products and increases in wages and benefits for labor have placed added pressure on the costs of transportation. When diesel fuel was 20 cents a gallon and drivers worked for $1.50 an hour, transportation costs were not a problem. Since the cost of transportation was a relatively small part of the total operating budget of many firms, little emphasis was directed toward improvements in transportation efficiency. Current cost conditions, however, are such that every alternative for increased effeciency must be examined.

A large portion of the total transportation marketing bill is generated by vehicles that follow regular distribution or assembly routes. Food products such as milk, soft drinks, bread, and beer are all delivered to the local store by a vehicle traveling on a route. The prominence of such operations in the total marketing system creates the potential for significant cost savings by increasing operating efficiency.

The typical transportation network operated by a business is a very complex system. It is made up of many customers with each having specific product requirements. Each customer usually demands that a given quantity of the product be delivered to his store on certain days. In some cases, the customer even specifies a time range during which he is willing to accept delivery. The route manager must design his routes to meet these customer demands while at the same time operating within the capacity constraints imposed by the number, size, and type of trucks available.

As the number of customers in a distribution network increases, it becomes practically impossible for even the most experienced route manager to effectively evaluate all possible route alternatives. In many cases, even the best managers are so involved with day-to-day operations that they are satisfied simply to update or make minor changes in existing delivery systems. By doing this, they forego the possible significant gains in operating efficiency that might be realized through an examination and analysis of the complete system.

Computerized Routing Analysis

Objective, computerized techniques are available to aid management in evaluating and redesigning their transportation network. The data given in the table are from the case study designed to illustrate gains that can be realized through the use of computer-assisted route analysis. The study firm serves an excess of 600 wholesale milk customers in a market area consisting of one major city, several small towns, and the surrounding rural areas.[1]

The existing delivery system required 90 trips per week to meet all customer demands. The computer analysis revealed that the number of trips could be reduced to 74. This significant decline is reflected in all other measures of performance and cost. Total miles per week are reduced 34%, an important consideration with the high fuel costs of today. In addition, a 29% savings was projected in the time required to serve all customers.

Cost values for both the existing and improved systems were calculated on the following basis. It was assumed that 16-ft. refrigerated trucks, costing $20,500, would be used for delivery. These vehicles would have a 5-year useful life, giving annual depreciation of $3,690. Other annual fixed costs were: insurance, $550; taxes, $110; interest, $1,446; and office and administrative expenses, $1,454. It was further assumed that on a per mile basis, fuel would cost 27 cents, tire expense would be 1.5 cents, and maintenance would be 6 cents. This gave a variable operating cost of 34.5 cents per mile. Total wages were assumed to be $20,800 per year with $11,700 of this being base pay and fringe benefits and the remainder, commissions. If all these costs were combined and it was assumed that an average vehicle traveled 25,500 miles per year the cost per mile would be $1.47.

With the addition of ownership and operating costs, the physical savings of miles and hours given in the table may be translated into significant cost reductions. The largest relative saving, 34%, was realized for the variable costs associated with operating the vehicles (fuel, tires, maintenance, etc.). Significant reductions were also seen in the labor and fixed expense categories.

The "bottom-line" figures show the total savings that could be realized were $86,826. This 13% reduction in cost is similar to results found consistently by other researchers and economic analysts. The possibility for such savings should prompt any conscientious route manager to consider computer-assisted route reorganization as a means for reducing costs.

COMPARISON OF EXISTING DELIVERY ROUTES WITH IMPROVED SYSTEM DEVELOPED BY OBJECTIVE COMPUTER ANALYSIS

Item	Existing system	Improved system	Reduction
			Pct.
Number of trips/week	90	74	17.8
Total miles/week	6,837	4,495	34.3
Average miles/trip	76.0	60.7	20.1
Total time/week (hr.)	735.7	519.9	29.3
Average time/trip (hr.)	8.2	7.0	14.6
Annual variable cost (dol.)	122,656	80,640	34.3
Annual labor cost (dol.)	397,540	360,100	9.4
Annual fixed cost (dol.)	138,130	130,760	5.3
Total annual cost (dol.)	658,326	571,500	13.2

[1]Murphy, Vayden L., Jr. and William E. Hardy, Jr. **Efficient Vehicle Routing—A Milk Distribution Example.** Auburn University Agricultural Experiment Station Bulletin 511, February 1979.

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