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HIGHLIGHTS

of Agricultural Research

ALABAMA AGRICULTURAL EXPERIMENT STATION
GALE A. BUCHANAN, DIRECTOR

AUBURN UNIVERSITY
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DIRECTOR'S COMMENTS

THERE ARE MANY WAYS that basic research can be defined. However, one useful and workable definition is, "that research for which immediate application is not obviously apparent." Basic research is keyed to the development of scientific information required to explain various phenomena. This contrasts with applied research in which immediate application and utilization are expected.

GALE A. BUCHANAN

Contrary to what some might think, as evidenced by Senator Proxmire's Golden Fleece Award, basic research is relevant and crucial to the success of a research institution. In a research organization such as the Alabama Agricultural Experiment Station, it is exceedingly difficult to separate the importance of basic and applied research and, frankly, there is little need to do so. Many of our research projects include both basic and applied components. This, of course, is complementary in that questions uncovered in practical or applied research can be addressed in a more fundamental fashion in basic research endeavors.

Numerous examples from our research programs could be cited to show how basic and applied research complement each other. However, two typical examples will illustrate the point.

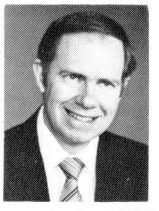
Basic research is often initiated in response to practical problems that appear on the farm. For example, it is axiomatic that all farms and all fields do not need the same amounts of fertilizer to make top yields. Why not? To find the answer, soil scientists turned to their laboratories. They discovered that plant roots absorb nutrients only from the solution phase of a soil. They further discovered that only a small fraction of most nutrients was present in the soil solution at any one time; the majority was in a chemically unavailable form as part of the soil's solid phase. Soil chemists then proceeded to determine the chemical reactions that occurred between the solution and solid phases of a soil and uncovered the reactions responsible for changing unavailable nutrients into available forms and vice versa. Thus, unraveling these basic soil chemical reactions paved the way for fertilizing each field on a prescription basis.

Another example deals with research which was designed to clarify the basic biology of a little known and hard to detect intestinal parasite. A basic zoology research group developed a simple, yet accurate method to detect the parasite so as to facilitate their work. Utilizing this methodology they determined that this parasite was a major cause of calf scours. Furthermore, they demonstrated that the parasite is readily transmitted to man, where it causes serious medical problems. Thus, from a quest to generate fundamental knowledge, a significant health problem with both animals and humans has been identified which can be treated.

The generation of fundamental knowledge about many topics is the lifeblood of the Alabama Agricultural Experiment Station. It is important that we continue to make major contributions in our basic research effort as well as continue the more immediately useful research in practical areas. Probably never before in the history of research have there been more exciting opportunities for basic research that can contribute to more efficient agricultural and forestry production as well as making life more pleasant for all of us. Indeed, almost every area of research has opportunities for major contributions through basic research. We will only achieve the maximum effectiveness of our Experiment Station when such opportunities are exploited to the fullest extent possible.

may we introduce . . .

Dr. Stephen Paul Schmidt, associate professor in the Department of Animal and Dairy Sciences. Specializing in ruminant nutrition, Schmidt came to Auburn in 1976 as an assistant professor.



Born in Oakland, California, and raised on a cattle ranch in Idaho, Schmidt received his undergraduate degree from the University of Idaho in 1966 and his M.S. and Ph.D. degrees from the University of Wisconsin in 1968 and 1972, respectively. His postdoctoral work was done at Iowa State University from 1972 to 1975.

Dr. Schmidt's main areas of research are in fescue toxicity, using sorghum grain for finishing cattle in Alabama, and comparing feedlot versus forage systems for managing crossbred calves postweaning. The author of numerous publications, Schmidt has served on the editorial board for the Journal of Animal Science.

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ON THE COVER. Grain sorghum production research caught the attention of farmers attending the 1983 research tours at the E.V. Smith Research Center, Shorter.

SORGHUM as a Grain Source for Beef Cattle Feedlot Diets

S.P. SCHMIDT, E.E. THOMAS, and G.W. TURNBULL, Department of Animal and Dairy Sciences

SORGHUM GRAIN (milo) has been an important grain crop in the western part of the Great Plains for many years and is becoming an increasingly popular grain crop in Alabama because of its heat and drought resistance. Recent research at the Alabama Agricultural Experiment Station shows that feedlot performance and economics of gain by cattle fed sorghum diets compare favorably with corn; thus, grain sorghum is a viable alternative to corn as a grain source for feeding cattle in the Southeast.

When processed, sorghum has a feeding value that is 90-95% as good as corn. If sorghum is dry rolled or coarsely cracked, its energy value will improve 6 to 7%. If an airtight silo is available, reconstituting the grain (adding water at harvest time) to 25 to 30% moisture is an excellent processing method that is widely used in Great Plains feedlots. Early harvesting as high-moisture grain is also an excellent alternative.

The crude protein content of sorghum grain is about the same as corn but there is limited information about how that protein is digested and utilized by feedlot cattle. Also, little is known about feeding situations in which urea is an effective and economical source of supplemental "protein" for cattle diets and which situations call for a natural protein supplement such as soybean meal or cottonseed meal.

The objectives of the research conducted at the Experiment Station were (1) to evaluate soybean meal (SBM) and urea as protein sources for feedlot steers fed diets containing non-bird-resistant sorghum grain (yellow endosperm variety), and (2) to compare this sorghum grain and corn as energy sources for feedlot steers.

The sorghum-containing diets, table 1, all contained the same amount of energy, differing only in the source and amount of protein. The basal diet had no protein supplement. The basal diet was then supplemented with either (1) a low amount of urea (LU), which resulted in a diet that was below the protein requirement of lightweight feeder steers, (2) a high amount of urea (HU), or (3) SBM. The HU and SBM-supplemented diets contained 12% crude protein and were calculated to meet the protein requirement of feeder steers. The steers used in the study were Angus and Angus x Hereford crossbreds averaging 518 lb. initially.

For steers fed the diets containing the sorghum grain, urea supplementation did not result in maximum gains during the first 70 days or up to a weight of approximately 700 lb., table 2. Feed efficiency was better for steers fed SBM-supplemented diets. The fact that daily gains for the steers fed the LU and HU diets were nearly the same for the first 70 days indicated that the extra protein (or nitrogen) provided in the HU diet was not utilized by the rumen microorganisms and hence was wasted. The SBM diet, which contained the same percent crude protein as the HU diet, provided more total protein for the rumen microorganisms and animal, resulting in faster gains.

Also during the first 70 days, steers fed corn gained more rapidly than those fed sorghum. Since both diets contained the same amount of protein, this indicates that more energy was available from the corn than from the sorghum grain. During the last 70 days, however, all steers gained approximately the same, regardless of protein source or grain source.

The feed cost per 100 lb. gained was less for the sorghum diets than for the corn, table 2. This is due mainly to the cost differential that existed between corn and sorghum grain—10 to 15% less for sorghum than corn. With the potential for high yields of grain sorghum in the Southeast compared with the low average yields of corn, this economic advantage would be expected to be consistent over the years.

This experiment, combined with other feeding trials at the Experiment Station, suggests a two-phase feeding program for weaned calves: (1) natural protein supplements for fast-growing calves weighing less than 700 lb., and (2) after the calves reach 700 lb., urea is usually as effective as natural proteins in providing rapid gains. Beyond 700 lb., economics can dictate the decision whether to use natural protein or urea in high-energy feedlot diets.

TABLE 1. FEED AND CHEMICAL COMPOSITION OF DIETS FED TO STEERS DURING THE 140-DAY GROWTH TRIAL

Item	Sorghum grain				Corn,
	Basal	LU	HU	SBM	SBM
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Feed composition[1,2]					
Cracked corn	-	-	-	-	71.5
Cracked sorghum	77.8	77.9	78.1	71.7	-
Chopped Coastal bermudagrass hay	9.4	9.0	8.5	9.4	9.2
Molasses	10.0	10.0	10.0	10.0	10.0
Soybean meal	-	-	-	6.8	6.8
Urea	-	.5	.9	-	.3
Dicalcium phosphate	.7	.6	.6	.5	.6
Limestone	.8	.8	.8	.8	.8
Potassium and magnesium sulfate	.8	.7	.6	.3	.3
Trace mineral salt	.5	.5	.5	.5	.5
Chemical composition					
Percent protein	9.5	11.2	12.0	12.0	12.0

[1]As-fed basis.
[2]All diets contained 1,000 IU vitamin A and 10 mg Rumensin per pound.

TABLE 2. FEEDLOT PERFORMANCE OF STEERS FED DIETS VARYING IN SOURCE AND AMOUNT OF CRUDE PROTEIN

Item	Sorghum grain				Corn,
	Basal	LU	HU	SBM	SBM
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Initial weight	516	530	511	514	517
70-day weight	676	711	694	710	727
140-day weight	846	885	859	875	905
Performance for first 70 days					
Feed consumed per day	17.6	18.5	17.8	18.3	18.4
Daily gain	2.3	2.5	2.6	2.8	3.0
Feed per lb. gain	7.7	7.4	6.8	6.5	6.1
Performance for second 70 days					
Feed consumed per day	22.9	23.7	22.5	23.0	23.0
Daily gain	2.4	2.5	2.4	2.4	2.5
Feed per lb. gain	9.5	9.5	9.4	9.6	9.2
Feed cost per 100 lb. gained[1]	$42.27	$41.11	$40.29	$42.60	$49.07

[1]Costs of sorghum and corn were $100 and $135 per ton, respectively, based on 1983 prices. Chopped hay was valued at $70 per ton; SBM and urea each cost $230 per ton.

New Biological Seed Treatment Fungicide Increases Peanut Yields

Peanuts treated with fungicide alone, left, and treated with fungicide plus *Bacillus subtilis* bacterium, above. Treatments were grown in neighboring rows.

P.A. BACKMAN, J.T. TURNER, M.A. CRAWFORD, and R.P. CLAY
Department of Botany, Plant Pathology, and Microbiology

SEED TREATMENT fungicides have been a standard component of the peanut disease control recommendations for many years. They are applied to prevent seed-borne fungi from rotting the seed, and to protect the emerging seedling from fungi living in the soil. However, they are virtually of no benefit beyond 2 weeks after planting.

Recently, Alabama Agricultural Experiment Station scientists evaluated a new seed treatment which contained a bacterium called *Bacillus subtilis*. Results of the study showed that farmers who used the bacteria-treated seed had average yield increases of more than 8%. Furthermore, yield increases were more than 15% for 17% of the farmers.

When the Experiment Station study began in 1980, peanut seed treated with this product produced seedlings that emerged sooner and lapped the row sooner than did peanut plants developing from seed treated with the traditional chemical fungicides. In addition, the bacteria could be mixed with chemical seed treatments without being killed, and the commercial product had excellent shelf life, unlike the nitrogen-fixing bacteria.

In 1982, Experiment Station researchers began to better understand what was happening to the more vigorous peanut plants. Early emergence was probably a growth response to a hormone produced by the bacteria. However, the faster growth of plants, see photo, and the yield increases were probably because of healthier roots, table 1. The bacteria were found growing on the roots throughout the life of the peanut plants, while the peanut plant itself had a healthier root system with less *Rhizoctonia* and *Fusarium* damage. The *Bacillus subtilis* organism applied to the seed is known to produce several antibiotics. The antibiosis that probably results following successful root colonization, plus the competition with pathogens for growth sites, apparently serves to protect the peanut root system from several root-rotting fungi. Therefore, these healthier roots are responsible for the improved yields.

Studies were conducted during 1982 and 1983 to determine which peanut farmers would benefit from this bacterization procedure, and how often this would translate into a significant economic benefit. These comparisons were made throughout the Southeast with randomly selected farmers growing treated seed (bacteria plus standard seed treatment fungicide) in side-by-side comparison with seed treated only with the standard fungicide.

Results of this experiment indicated that approximately 60% of the farmers who used the bacteria-treated seed had yield increases of more than 5%, while 17% of the farmers had yield increases of more than 15%, table 2. When all of the approximately 24 locations were averaged, the yield increase for *Bacillus*-treated peanuts was 8.3%. Only one case of a reduced yield was reported. Farmers who grew either peanuts or soybeans in either of the previous 2 crop years averaged 12.3% increase in yield, while farmers who had no history of these crops in the previous 2 years reported only a 3.4% yield improvement.

The bacterial preparation, which will be marketed under the name Quantum-4000®, was remarkably capable of colonizing peanut roots. All treated seed resulted in successfully colonized roots. Lack of yield response was caused by lower levels of fungal disease on the root systems of untreated plants, not by lack of colonization. Peanuts that showed an obvious vigor response, see photo, almost always recorded considerably improved yields. However, many peanut tests that did not show vigor differences still resulted in improved yields for the *Bacillus*-treated peanuts.

Peanut fields most likely to benefit from the practice are those that have 2-year or less rotations of peanuts or soybeans or both. If peanuts are planted before May 10 on these poor rotations, yield improvements will be even more pronounced. Peanuts will be the first crop targeted for the marketing of Quantum-4000 inoculant, which will be available in limited quantities in 1984. In addition, it marks the first commercialization of the root bacterization principle for the control of soil-borne plant disease.

TABLE 1. EFFECTS OF BACTERIA APPLIED TO SEED ON ROOT DISEASE AND YIELD OF PEANUTS, 1982

Strain	Root rot[1]	Yield/ acre	Pct. Increase
		Lb.	
No bacteria	2.45	2,171	--
Bacillus subtilis			
No antibiotic	2.68	2,264	+ 4.2
Antibiotic producer	2.14	2,541	+17.0

[1]Scale of 1 to 5: 1 = no disease, 2 = 25% rotted, 3 = 50% rotted, 4 = 75% rotted, and 5 = 100% rotted.

TABLE 2. YIELD EFFECT OF PEANUT SEED TREATED WITH *BACILLUS SUBTILIS* SPORES AND FUNGICIDE AS COMPARED TO FUNGICIDE ALONE, 1983

Previous date	Legumes in either of previous 2 years	No legumes in previous 2 years
Early (before May 10)	(6)[1] +15.2%	(2) +3.0%
Late (after May 10)	(5) + 8.7%	(3) +3.7%
Weighted average[2]	(11) +12.3%	(5) +3.4%

[1]( ) parenthesis indicates number of locations fitting the description.

[2]At eight other locations there was a 6.3% increase in yield following bacterization by *Bacillus subtilis*.

LAND USE PATTERNS INFLUENCE WILD TURKEY ANNUAL RANGES

D.W. SPEAKE, Cooperative Wildlife Research Unit

FORTY YEARS AGO wild turkey populations in Alabama were scarce and located only in remote areas. Today, however, this magnificent game bird has become a huntable inhabitant of every county in the State, thanks to successful wild turkey restoration and management.

For several years, biologists of the Alabama Cooperative Wildlife Research Unit and the Alabama Agricultural Experiment Station have conducted research on the ecology and management of the wild turkey. The studies included work on life history, food habits, movements, habitat preferences, and factors limiting populations. Results showed that land use patterns had a strong influence on population levels, hunting success, and the survival rate of the turkeys. The most successful hunting territories contained a wide variety of habitat types, with a large percentage being in hardwood forests. However, one densely populated study area had 61% pine forests. In any habitat type, it was shown that 12-25% of the area should be in openings to provide hens with a place to nest and raise poults.

The research was conducted in Coastal Plain, Piedmont, and mountain habitat types, utilizing solar-powered radio transmitters to monitor the movements of individual turkeys for up to 3 years. This research was based on 241 instrumented turkeys, which included 171 hens and 70 gobblers.

Nests of 107 instrumented turkeys were found and examined. Most of the nest sites were selected so that the nesting hen and the eggs could not easily be seen by predators. More than half of the nests were in mixed-herbaceous, low-brushy cover types, such as old fields, utility line rights-of-way, open cutover forests, and old house sites. Nests in forests were usually in patches of greenbriar, huckleberry, blackberry, or hardwood sprouts. Only 8% of the nests were located more than 100 yd. from a road or other opening.

Large forested tracts devoid of openings provided poor nesting habitats. In one north Alabama study area, 37% of the turkey nests were found in a power line right-of-way habitat that transversed a hardwood forest and comprised only 0.6% of the area. To maintain the quality of this type nesting area, it was mowed every third year. However, mowing was avoided during the April-June nesting season.

The favored habitat for hens with broods was permanent pasture or mowed grasses, but various grains and legumes, old fields, and chufa fields were also used. Insects and grass seed heads are the most important foods for turkey poults and are more abundant in grassy openings than in the forest. Soon after hatching, hens and broods moved from nesting areas to brood ranges. If a good brood range was not available near the nesting range, hens frequently moved miles before settling. Once settled, the daily movements were small, linear, and strongly influenced by feeding areas.

Proper brood habitat is important for brood survival. On one state wildlife management area, 10 hens raised only 12% of their poults to 14 days of age when they used small wildlife openings and adjacent hardwood forest as brood range. Twenty hens that left the management area and used mowed rights-of-way, grazed pastures, and the adjacent grazed forest as brood range raised 34% of their poults to 14 days of age. Only 2% of the management area was in openings. Consequently, the majority of the turkeys moved to open pastures on private land, then back to the management area in early fall.

On most study areas, gobblers and hens without poults also moved out of large forested areas to openings where they remained until acorns began to fall. By November, habitats shifted from openings to hardwood and mixed forests. During the fall and winter period, mast production in upland hardwoods and mixed forest was valuable to turkeys.

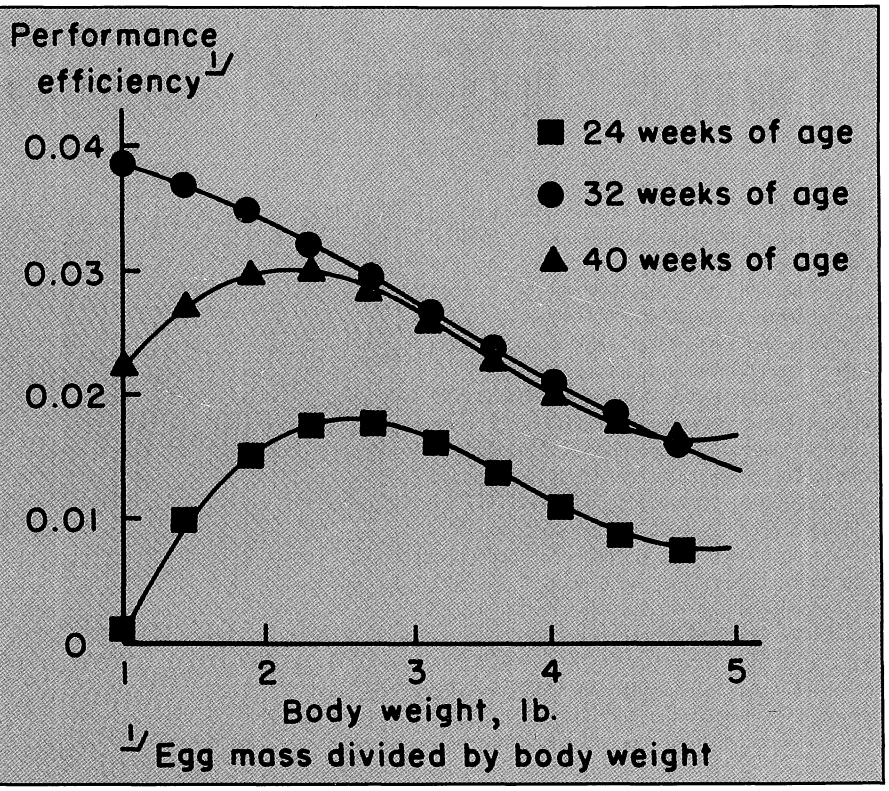
Turkeys tolerate a wide range of habitat conditions and patterns of land use. A high density population of more than one turkey for every 20 acres was carried on one large study area which had 61% of its area in pine forest, 6% in hardwood forest, and 24% in pasture. However, most successful turkey hunting areas have a higher percentage of the hardwood habitat type. A 15-year study showed a strong relationship between diversified habitat and hunter success.

Maintaining 12-25% of land acres in openings is desirable to reduce the distance of spring dispersal of hens seeking open country to nest and raise poults. Cattle-timber operations with well distributed permanent pastures and timber managed on a long rotation provide an ideal land use pattern for wild turkey management.

Though large forested tracts can be satisfactory habitats, they are often deficient in suitable openings. Artificial openings should be created at frequent intervals to produce grasses, forbs, and insects. Nesting habitat can be provided by timber cutting and maintenance of mixed herbaceous vegetation and scattered brush.

Relationship of Body Size to Egg Production in Dwarf White Leghorn Chickens

J.A. RENDEN
Department of Poultry Science



THE AMERICAN CONSUMER shows a preference for table eggs weighing approximately 1.9 to 2.3 oz., which are commonly classified as large. Egg size is closely related to body weight of the hen, and consequently, commercial hens must weigh 3 to 4 lb. to produce large eggs. However, as body weight increases, the efficiency of egg production generally decreases. This is because larger birds have greater body maintenance requirements, and their egg size relative to body size is lower than that of smaller birds.

Since large hens producing large eggs are generally less efficient, any significant boost in egg production efficiency would require some change in marketing methods. A shift to marketing by weight instead of by dozen could result in a change to small hens that produce small eggs more efficiently. Such a shift could occur in the future if efficiency becomes more important than egg size to the egg industry.

An Alabama Agricultural Experiment Station research project was conducted to determine the optimal body size for maximum egg production efficiency of dwarf Single Comb White Leghorn hens. The hens were selected for large (high line) or small (low line) body weights. Results showed that egg production efficiency was lowest in high weight dwarf hens, and that efficiency was not significantly different between the low weight and the control groups of hens.

The gene responsible for dwarfing in layer type chickens reduces body weight approximately 30% and egg weight 10%. Average body weights of dwarf high and low weight hens at 40 weeks of age are 4.3 and 2.2 lb., respectively. Results of this study demonstrated that both high and low line birds are most efficient during peak egg production.

Feed efficiency and performance efficiency were determined for the high, low, and control dwarf hens from 24 to 40 weeks of age, see table. Feed efficiency was defined as egg mass per estimated daily feed intake, and performance efficiency as egg mass per body weight. Egg mass was computed as average egg weight multiplied by percent egg production.

Data in the table demonstrate that egg production efficiency was decreased in high weight dwarf hens, while the low weight dwarf hens were not significantly different from the controls. This suggests that there is a minimum body weight requirement for most efficient egg production.

The relationship of body weight to performance efficiency was established for the three dwarf lines at 24, 32, and 40 weeks of age, see figure. Estimated optimal body weights for the hens used in this study were approximately 2.6 and 2.2. lb. at 24 and 40 weeks of age, respectively. This does not imply that birds should lose weight as they age, but that lighter birds are more efficient at the older age. Ideal body weight, however, not only depends on breeding type, but also on various environmental factors such as nutrition and management. Hens that are above or below an optimal body weight will be less efficient. Extremely small hens were most efficient only during peak egg production, which was at approximately 32 weeks of age.

The performance efficiency of small bodied birds seemed to be limited by their ability to maintain adequate egg production before and after peak production. It has also been suggested that some aspects of body composition, such as percent fat or protein, may be associated with normal egg production maintenance. Therefore, studies have been initiated to characterize body composition of hens during an egg production cycle to relate these factors to performance efficiency.

In summary, the optimal body weights of dwarf Single Comb White Leghorn hens were 2.6 lb. at 24 weeks of age and 2.2 lb. at 40 weeks. Maximum egg production efficiency occurred during peak egg production for both heavy and light birds. However, extremely small hens were more efficient than controls only during peak egg production, which was at approximately 32 weeks of age.

FEED AND PERFORMANCE EFFICIENCY OF DWARF SINGLE COMB WHITE LEGHORN HENS SELECTED FOR BODY WEIGHT

Measure	High	Control	Low
Feed efficiency[1]	0.28	0.38	0.34
Performance efficiency[2]	.018	.026	.027

[1]Egg mass (egg weight x percent production) divided by daily feed intake.
[2]Egg mass divided by body weight.

Effects of Irrigation, Nitrogen, and Growth Regulators on Cotton

J.T. COPE, TED WHITWELL, and J.H. DANE, Department of Agronomy and Soils

COTTON YIELDS in Alabama are frequently limited by drought. The extent of loss varies with the year, location, nitrogen (N) rate, and damage from insects and diseases. Thirteen years of Alabama Agricultural Experiment Station research at the Tennessee Valley Substation showed wide variations in cotton's response to irrigation. However, when data from the experiments were averaged, results showed that irrigation improved yields 7 of the 13 years, with the increase averaging 560 lb. per acre of seed cotton for the total period.

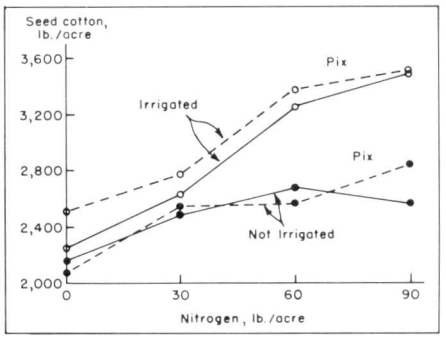
During the first two studies, from 1956-59 and 1961-66, irrigation had a positive effect on yields 5 of the 10 years. The average yield increase was 503 lb. per acre of seed cotton for the period. These experiments also showed that 60 and 120 lb. per acre of N produced essentially the same yields with and without irrigation for the 10 years.

Increased cotton acreage, a series of poor yields during the 1970's, and changes in varieties used in the Tennessee Valley area led to another experiment from 1981-83 to determine cotton's response to irrigation. Results showed that irrigation increased yields an average of 700 lb. per acre of seed cotton for the 3-year period. The study also showed that 90 lb. per acre N was the best rate with irrigation, while 30 lb. was adequate for nonirrigated cotton.

On a Dewey silt loam soil, this experiment included four rates of N with and without irrigation. A growth regulator, Pix®, was used on split plots at 1 pt. per acre applied at early bloom to determine the effect of reduced plant height on yield. Irrigated blocks were used as main plots with N and Pix treatments as subplots. Subplots were four rows 40 ft. long with four replications of all treatments. Irrigation need was determined with tensiometers. Water was applied with overhead sprinklers when tension at a 6-in. depth reached 0.3 bar. This assured that water was applied before plants began to wilt.

Yields of 2 to 3 bales per acre, see table, were produced without irrigation in 1981 and 1982. In 1981, seven irrigations totaling about 11 in. of water from June 15 to August 9 increased yields at the 60- and 90-lb.-per-acre N rates by about 800 lb. per acre. The 60- and 90-lb.-per-acre N rates produced about the same yield both with and without irrigation. Pix reduced plant height on irrigated plots from 48 in. to 40 in., and increased yields 200 lb. per acre. However, Pix had little effect on nonirrigated plots, which contained plants with an average height of 40 in.

Yields in 1982 reached the 3-bale-per-acre level and were not increased by irrigation. One in. of water was applied five times from June 9 to August 19. The 90-lb.-per-acre N rates averaged 3,840 lb. per acre of seed cotton, which was 360 lb. per acre more than the 60-lb.-per-acre rate. Pix increased yields at the 90-lb.-per-acre N rate but not at the lower rates.



Severe drought in 1983 limited yields without irrigation to about 1 bale per acre. Approximately 10 in. of water were applied in six applications from July 19 through August 23. Irrigation increased yields from 1,330 to 2,710 lb. per acre at the 60- and 90-lb.-per-acre N rates, which produced the same yields. Pix did not increase yields on irrigated or nonirrigated plots. However, plants were much shorter in 1983 on all plots than in the other 2 years because of the drought.

Average yields for the 3 years presented in the graph show an increase of 700 lb. per acre of seed cotton from irrigation at the 60- and 90-lb.-per-acre N rates. On irrigated plots, the 90-lb.-per-acre N rate increased yields 170 lb. per acre over the 60-lb.-per-acre N rate. However, on nonirrigated plots, the 30-pound-per-acre rate was adequate. Pix did not increase yields at the recommended N rates on irrigated or nonirrigated treatments in the 3-year average.

When data from the 1981-83 experiment were combined with those from the two earlier experiments, they showed that cotton yield was increased by irrigation in 7 of 13 years. The average increase for the 13 years was 560 lb. per acre of seed cotton. Results also showed that the best rate of N for irrigated cotton was 60-90 lb. per acre.

INFLUENCE OF NITROGEN AND PIX ON IRRIGATED AND NONIRRIGATED COTTON AT THE TENNESSEE VALLEY SUBSTATION, 1981-83

N, lb./acre	Seed cotton/acre			
	1981	1982	1983	3-yr. av.
	Lb.	*Lb.*	*Lb.*	*Lb.*
Nonirrigated				
Without Pix				
0	2,790	2,700	900	2,160
30	2,901	3,290	1,270	2,490
60	3,035	3,640	1,360	2,680
90	2,810	3,550	1,300	2,550
With Pix				
0	2,760	2,610	880	2,080
30	2,940	3,300	1,400	2,550
60	3,010	3,320	1,340	2,560
90	3,100	4,080	1,320	2,830
Irrigated				
Without Pix				
0	3,100	2,320	1,330	2,250
30	3,230	2,850	1,810	2,630
60	3,610	3,410	2,740	3,250
90	3,810	3,760	2,850	3,470
With Pix				
0	3,500	2,670	1,380	2,510
30	3,480	2,940	1,890	2,770
60	3,950	3,530	2,620	3,370
90	3,870	3,960	2,630	3,490

Evaluation of Hershey's Red Azalea Growth Using Three Pot and Mulch Combinations

G.J. KEEVER, Department of Horticulture
G.S. COBB, Ornamental Horticulture Substation

PRODUCING CONTAINER-GROWN woody ornamentals during the summer is often limited by high growing medium temperatures. With most plant species, maximum root growth occurs between 77° and 86°F. When soil temperatures are above 86°F, reduced root growth occurs, and at temperatures above 113°F, root tips are killed. Roots of container-grown plants are often concentrated near the pot walls where soil temperatures exceeding 113°F have been measured in both green and black pots exposed to direct solar radiation. Results of recent Alabama Agricultural Experiment Station research show that using black pots and white shell mulch, a commonly used combination for container-grown plants, actually contributes to reduced root growth due to high soil temperatures. However, white pots on black mulch proved to be a viable alternative.

The Experiment Station study was initiated to characterize medium temperature fluctuations and growth of Hershey's Red azalea in three pot and mulch combinations. In March 1982, the azaleas were potted in 1-gal. black or white polyethylene pots in amended pine bark. The three treatments selected to determine pot and mulch effects on growing medium temperatures and plant growth were: black pots on a white shell mulch, a frequently used combination in coastal areas of the South; white pots on a black polyethylene mulch; and black pots recessed into a white plywood frame so that the pot sides were shielded from direct solar radiation. The third treatment simulated nursery conditions where plants are spaced pot-to-pot, or where canopies shade the pot.

Air and medium temperatures were monitored continuously during the summer. In September, determinations were made for percent root coverage of the bark medium surface, relative root development, growth index, and top dry weight.

Results of the study showed that growing medium in the black pots on white mulch consistently reached the highest maximum temperatures, while medium in white pots on a black mulch averaged 6°F cooler. In the shielded pots, soil temperatures were lower than the other two pot and mulch combinations, and slightly lower than ambient air temperatures.

Percent root coverage of the bark surface was greatest for plants grown in the shielded pots, followed by plants in white pots on black mulch and those in black pots on white mulch, respectively, see table. Root coverage was greater on the north side of white pots on black mulch and black pots on white mulch compared to the south side. Relative root development and growth index were greater in the shielded pots and in white pots on black mulch than in black pots on white mulch. Growth, measured by top dry weight, was greater in the white pots on black mulch than in black pots on white mulch.

White pots on black mulch appear to provide a viable alternative for growers to the commonly used black pots on white mulch because the white pot combination provides cooler temperatures, which result in greater root and top growth. The black pot and white mulch combination actually contributes to reduced root growth because of high soil temperatures. Lowest temperatures and best root development of the plants in shielded pots show that close plant spacing to minimize direct solar radiation is beneficial during the summer.

ROOT COVERAGE OF THE NORTH AND SOUTH BARK SURFACES, RELATIVE ROOT DEVELOPMENT, GROWTH INDEX, AND TOP DRY WEIGHT OF HERSHEY'S RED AZALEA IN THREE POT/MULCH COMBINATIONS

Pot/mulch combination	Root coverage		Relative root development[1]	Growth index[2]	Top dry weight
	North	South			
	Pct.	*Pct.*			*Oz.*
Black pot/white mulch	7.2	0.7	2.6	26.6	0.90
White pot/black mulch	31.1	20.4	3.3	26.0	1.20
Black pot/shielded	47.4	42.6	3.6	25.8	1.12

[1]Rating: 1 = least developed and 5 = most developed root systems.
[2]Growth index = (height + width)/2.

Diversity of Root Characteristics Among Southernpea Varieties

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O.L. CHAMBLISS, Department of Horticulture

DIFFERENCES IN THE NATURE and extent of root systems of assorted varieties of southernpeas were recognized in the early stages of southernpea breeding at the Alabama Agricultural Experiment Station. Some 30 to 40 years ago, Dr. C.L. Isbell emphasized the importance of the root system in developing high yielding varieties.

Current interest in nitrogen fixation and conservation tillage has stimulated renewed interest in understanding the root system of legumes, their genetic diversity, and their potential for improvement through breeding. There is a need to develop southernpea varieties with strong, deep penetrating roots, with high nitrogen-fixing capability, for use as summer legumes in conservation cropping systems.

Efforts are currently being made at the Experiment Station to relate the various root system characteristics of southernpeas to biological nitrogen fixation and root growth in compacted soils. Once these relationships are established it should be possible to (1) develop southernpea varieties with superior nitrogen-fixing capability that are adapted to Alabama soils, and (2) at a later date relate this information to possible yields.

An Experiment Station study was initiated to characterize root morphology of a number of diverse southernpea varieties and to determine if a correlation existed between root morphology and nitrogen fixation. Traditional techniques for studying root systems in the field are laborious, time consuming, and not as accurate as desired because of root loss in the process of excavation. Thus, a greenhouse technique was developed in 1982 to make possible the growth and evaluation of root systems for 40 individual plants every 3 weeks.

Fourteen southernpea varieties representing a diversity of horticultural types were grown in the greenhouse in polyethylene cylinders filled with non-compacted Cahaba fine sandy loam. Eleven days after planting, soil was washed from the roots and data taken on taproot development and number and distribution of lateral roots for each variety. The photographs illustrate the diversity of root systems. Also, a field experiment was conducted to compare root systems of the same varieties using traditional methods of excavation and plotting.

California Blackeye, a popular table variety, was distinctive in that lateral roots near the crown were long and somewhat fibrous. In the field, the taproot was strong and effective in penetrating a plowpan. Knuckle Purple Hull, a variety which has been shown experimentally to be extremely capable in biological nitrogen fixation, has a strong root system. Dr. Isbell noted that when this variety was released (by Auburn in 1959), its root system was large enough to support large plants and heavy yields. Knuckle Purple Hull had a symmetrical root system with laterals well distributed along the sturdy taproot.

A cluster of laterals near the soil surface and few laterals at greater depths on the taproot were characteristic of Freezegreen, released by the Experiment Station in 1979. This same effect showed up in a Freezegreen x Iron cross (no photograph). Lateral roots of Mississippi Silver extended down a strong taproot but were sparse in comparison to Pinkeye Purple Hull which had more lateral roots that were longer and better distributed than those of Mississippi Silver.

The possibility of breeding for a specific type of root system is illustrated by Worthmore, a variety developed from a cross between Mississippi Silver and Pinkeye Purple Hull. Worthmore had root characteristics intermediate to the parent lines. Root symmetry, number, and strength of Worthmore laterals resembled Pinkeye Purple Hull more than Mississippi Silver.

Other older varieties had distinct characteristics. Lateral roots around the crown of Red Ripper were fibrous, with many branches. The taproot was strong and penetrating under field conditions. The root system of Iron was symmetrical with a strong taproot. Both laterals and taproot of Iron were strong soil penetrators in the field.

Data from these varieties and others indicate that each variety has a characteristic root pattern, indicating genetic diversity in root systems. Through breeding, the possibility is good for developing better performing root systems.

Root morphology of southernpea varieties grown in the greenhouse in polyethylene cylinders filled with non-compacted Cahaba fine sandy loam.

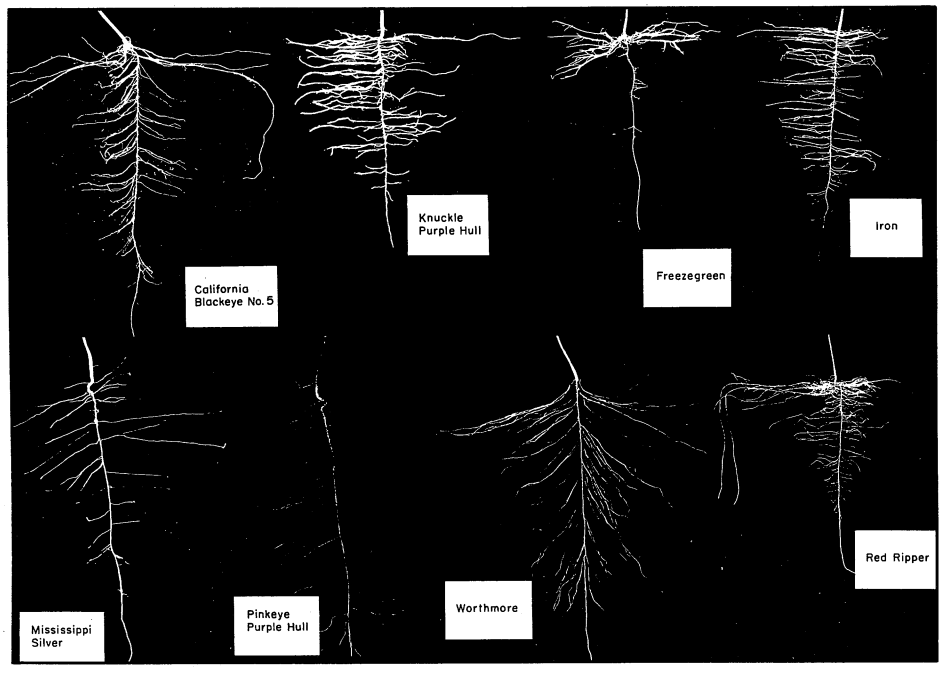


FIG. 1. SIDAS incorporates the use of a digitizing tablet to allow for analysis of field boundaries and obstructions.

SIDAS offers efficient irrigation of fields with irregular boundaries

EUGENE W. ROCHESTER, Department of Agricultural Engineering

MANY OF THE FIELDS in Alabama used to produce row crops have irregular boundaries, that is, they are not squares, rectangles, or any other simple shape. Many of the fields also have obstructions such as houses, power lines, and roads. These irregular shapes and obstructions affect the potential to irrigate these fields with sprinkler irrigation systems.

A common problem, for example, is a power line crossing a field and restricting the potential use of a center pivot irrigation system. Typical design techniques for these fields include examining the possibility of moving obstructions and boundaries. Those obstructions and boundaries which cannot be changed must be considered in the irrigation design, causing changes in the size, positioning, and type of equipment which can be utilized. These considerations affect the efficiency of water utilization, energy usage, and finally, the cost of the system. However, even with obstructions and irregular boundaries, there will typically be several ways to irrigate a field.

A research goal at the Alabama Agricultural Experiment Station is to provide methods for efficient water and energy utilization for irrigation systems which can be utilized on irregular fields. Techniques include field testing of irrigation systems, theoretical analyses, and computer simulations. In the past, these techniques have allowed researchers to develop methods to provide more uniform irrigation with traveler irrigation systems. However, there has not been a technique developed that would allow evaluation of various systems as they are affected by irregular field boundaries. Therefore, a program has been initiated to provide that capability. The effort has resulted in a group of computer programs—the Sprinkler Irrigation Digital Analysis System (SIDAS). The unique feature of SIDAS is the use of a digitizing tablet which allows maps of field boundaries and obstructions to be coded into a form which can be used for analysis, figure 1.

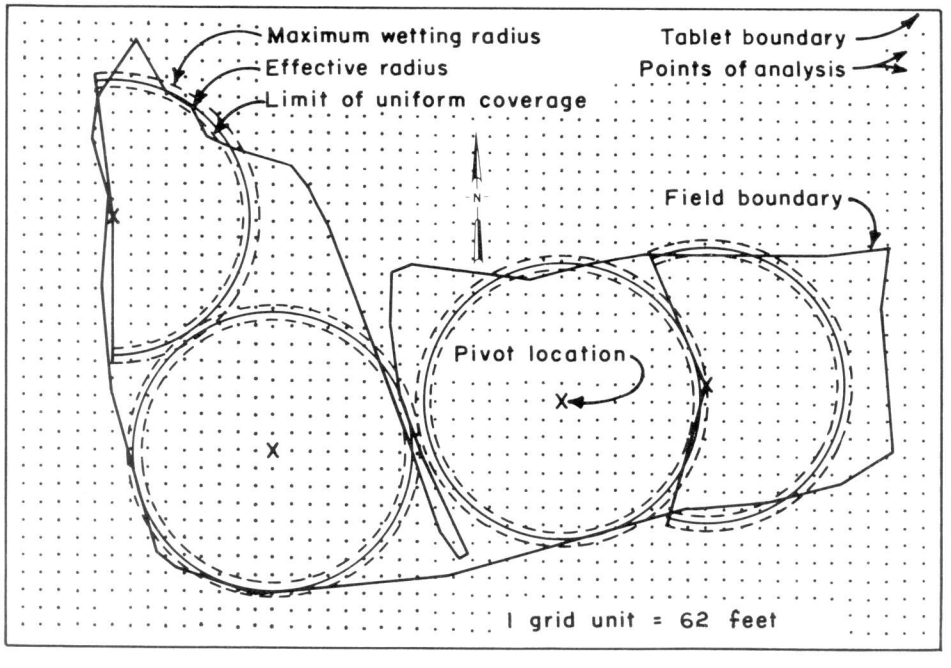
To use SIDAS, a map is attached to the tablet. The operator gives the computer a few commands, enters the map scale, and then enters the field boundaries by using a 12-button positioning marker. At short intervals along the boundary, one of the buttons is depressed to designate that point as being on the boundary. The boundary is assumed to be straight between the two points. The more points used, the more accurate the boundary, but more points mean more computations and more computational time. Field obstructions can be entered using other buttons from the positioning marker.

Several computer programs have been written to accomplish specific objectives, but the basic concept is that the water applied onto the field by an irrigation system can be computed at regular points across the field. These points are shown as dots on figure 2. Additional computations determine the amount of water applied outside the field boundary, and areas of land which are either under- or over-irrigated. Therefore, a total accounting of the water can be made.

At present, programming has been developed for center pivot systems only. Figure 2 shows a typical field with four center pivot irrigation systems. Here, SIDAS can be used to compare this design with other possible designs and thus provide a guide for appropriate system selection.

Two somewhat different uses are planned for SIDAS. The initial use is that of a research tool. In this usage, field and sprinkler system characteristics will be matched so that basic concepts and guidelines can be developed providing more efficient utilization of our water and energy resources. The second stage will allow individual fields to be analyzed so more efficient irrigation systems can be specified. However, additional development is anticipated before any extensive usage can be made of SIDAS for design of individual systems.

FIG. 2. Grid system with typical field and center-pivot positioning.



TEXAS PANICUM CONTROL IN PEANUTS WITH PARAQUAT

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GRASSES such as Texas panicum and crabgrass are generally controlled in peanuts with dinitroaniline herbicides. These soil-applied materials, when properly used, can provide good to excellent control. However, because of poor application or incorporation, adverse weather, extremely high weed pressure, or combinations of these variables, escapes often occur. Few alternatives, in terms of economical herbicide treatments, exist for the control of grasses after they have become established.

Researchers at the Alabama Agricultural Experiment Station, though, have been evaluating Paraquat CL® for control of Texas panicum in peanuts. Preliminary results suggest that Paraquat CL can be used to control Texas panicum with minimal injury to peanuts. (At this time, this herbicide is not registered for this use in peanuts.)

Paraquat CL, a nonselective contact-type herbicide, is effective on many annual grasses and some seedling broadleaf weeds. It can be selective, however, if applied early to a crop which has a greater ability to overcome injury than the target weeds. Such is the case with peanuts where the seedling taproot penetrates deep into the soil even before emergence. Compared to other crops, peanuts can tolerate considerable herbicide injury prior to the flowering period without a reduction in yield.

Experiments were conducted at the Wiregrass Substation in Headland to define the rate and application timing of Paraquat CL necessary for maximum weed control with a minimum of crop injury. The test areas were treated with 1 pt. per acre of Prowl and 2.5 pt. of Vernam® to provide marginal grass control, imitating a weed escape situation. Texas panicum was the predominant weed species present. Paraquat CL was applied at three different rates: 1/4, 1/2, and 1 pt. product per acre. The application times were single applications at true ground cracking of peanuts, 1, 3, and 5 weeks after ground cracking, and multiple applications at 1 and 3, and 1, 3, and 5 weeks after ground cracking.

All Paraquat applications included X-77, a nonionic surfactant at 1/4% of total spray volume. An untreated control was also included, which was maintained weed free by hand hoeing.

Recovery from injury depends on the time interval between herbicide application and crop maturity. Consequently, separate experiments were conducted at two planting dates: normal (first week of May) and late (first week of June). The late planting date experiment was conducted in 1982 and 1983; the normal planting date experiment was conducted only in 1983.

A portion of each plot was maintained weed free so that any canopy width, yield, or grade reduction would reflect only herbicide effects. Weed control ratings were obtained from the nonweeded portion after the final scheduled Paraquat CL application (6 weeks after ground cracking).

The 1/2-pt.-per-acre rate provided the best balance between effective Texas panicum control (89% averaged over all times of application, planting dates, and years) and minimal crop injury, table 1.

The slight reductions in canopy width, yield, and grade compared with the 1/4-pt.-per-acre rate and the untreated check are probably an acceptable trade-off for grass control.

Timing of application had a great influence on the effectiveness of Paraquat CL. Delaying a single application until the third week (normal planting date) or the fifth week (late planting date) after ground cracking resulted in the greatest Texas panicum control, table 2. Paraquat CL has no residual soil activity, thus an early application may miss later emerging grasses. Delayed applications, while providing better grass control, were more injurious to the peanuts. At the normal planting date, applying Paraquat CL at the third week after ground-cracking had no effect on grade and resulted in minimal, if any, reduction in canopy width and yield. Multiple applications provided excellent weed control; however, injury was excessive.

Similar results occurred with late planting. Excellent Texas panicum control was achieved with a single application postponed to the third or fifth week after ground cracking. With each delay in application timing, however, canopy width, yield, and grade progressively decreased.

Regardless of planting date, the application of no more than 1/2 pt. per acre of Paraquat CL at approximately 3 weeks after ground cracking, when peanuts were 3 to 6 in. across and Texas panicum was 1 to 2 in. tall, resulted in optimum control and minimal injury. Beyond this time, grasses generally became harder to control and the peanut's ability to recover was reduced. This was even more apparent at the later planting date. Multiple applications provided excellent grass control, but excessive crop injury.

TABLE 1. EFFECTS OF PARAQUAT RATE WHEN AVERAGED OVER ALL APPLICATION AND PLANTING TIMES, WIREGRASS SUBSTATION, 1982-83

Paraquat rate, pt./acre	Texas panicum control	Yield	Sound mature kernels
	Pct.	*Lb./acre*	*Pct.*
1/4	84	2,100	65
1/2	89	1,960	63
1	92	1,750	61
Untreated (hand weeded)	100	2,260	65

TABLE 2. EFFECTS OF PARAQUAT CL APPLICATION TIME AS AVERAGED OVER ALL RATES, WIREGRASS SUBSTATION, 1982-83

Time of application	Normal planting				Late planting			
	Texas panicum control	Peanut canopy width[1]	Peanut yield	Sound mature kernels	Texas panicum control[2]	Peanut canopy width[2]	Peanut yield	Sound mature kernels
	Pct.	*In.*	*Lb./acre*	*Pct.*	*Pct.*	*In.*	*Lb./acre*	*Pct.*
Single applications								
Ground cracking (GC)	66	19	2,450	65	87	18	2,090	66
GC + 1 wk.	62	20	2,370	64	91	17	2,070	65
GC + 3 wk.	89	18	2,380	66	94	17	1,970	65
GC + 5 wk.	79	16	2,230	67	97	16	1,630	62
Multiple applications								
GC + 1 and 3 wk.	93	15	2,190	65	97	13	1,500	61
GC + 1, 3, and 5 wk.	99	14	2,160	62	100	10	1,350	54
Untreated (hand weeded)	100	20	2,410	66	100	20	2,110	65

[1]Data taken 1st week of July.
[2]Data taken 1st week of August.

Vitamin C in Dairy Calf Diets Improves Immunity Traits

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DAIRY CALF DEATH losses on some dairy farms average 20% of all calves born. Most of these losses occur during the early weeks of life before the calf's immune system is fully functional. Adding vitamin C to calf diets has been shown to reduce these calf losses by stimulating the immune system, according to Alabama Agricultural Experiment Station research results.

Antibody absorption from the small intestine within 24 hours following birth is responsible for the calf's immunity to infectious disease for the first months of the calf's life. Thus, it is vital that dairy calves receive high quality colostrum shortly after birth. To obtain the needed colostrum, standard practice on many commercial dairy farms is to allow the calf to remain with its dam for 12 to 24 hours to nurse. However, surveys of the serum immunoglobulin levels of dairy calves indicate that approximately 40% of calves allowed to remain with the dam fail to nurse. As a result, they have inadequate serum antibody levels, or titers. Death loss within this population can be as high as 60% in the first 2 months of life.

In previous research, dietary vitamin C (ascorbic acid) was shown to stimulate the immune system of several species, including sheep, poultry, and man. Therefore, an experiment was conducted at the Experiment Station dairy located at the E.V. Smith Research Center to determine whether dietary vitamin C would stimulate blood antibody production in calves that were denied colostrum at birth.

Twenty-one male calves were randomly assigned at birth to one of three groups each containing seven calves. The first group received colostrum for two feedings after birth and then whole milk until 6 weeks of age, along with calf starter. Another group received no colostrum, being fed whole milk from birth along with calf starter. The last group did not receive colostrum, but was fed whole milk containing 1.75 grams of vitamin C each day, as well as calf starter. Calves were weighed at birth and 8 weeks of age. All calves were weaned at 6 weeks. To determine blood antibody levels, blood samples were taken at birth, 3 days, and 1, 3, 5, and 8 weeks. In addition, calves were observed daily for any signs of sickness.

In another experiment, 20 female calves were assigned to one of two diets: one containing vitamin C and one without vitamin C, after receiving colostrum for the first two feedings. The purpose of this experiment was to see if calves that received colostrum would get any additional benefit from dietary vitamin C.

In male calves that did not receive colostrum, dietary vitamin C increased blood antibody titers in a linear manner from 3 days to 8 weeks of age. By 6 weeks of age, blood antibody titers in the calves receiving vitamin C were equal to those of control calves that received colostrum at birth.

Antibody titers in calves that received neither colostrum nor vitamin C were low throughout the experiment. Scouring was also evident twice as many days in these calves than in calves that received colostrum or vitamin C.

Three calves that received neither colostrum nor vitamin C died during the experiment and were replaced. However, there were no death losses in the other two groups. Neither the average daily weight gain nor incidence of respiratory disease differed among diets.

Female calves that received colostrum showed no benefit from dietary vitamin C in terms of blood antibody titers, average daily gain, scours, or respiratory disease. Therefore, when vitamin C is added to the diet of calves that received colostrum, there does not appear to be any additive effect on antibody titers, growth, or incidence of disease.

Results of these experiments show that addition of vitamin C to calf diets, most conveniently in commercial milk replacers, may benefit dairymen in reducing calf losses. While bottle-feeding newborn calves colostrum is an effective management practice for preventing calf losses, it is not always possible to feed newborn calves colostrum within a few hours of birth. In this population of dairy calves, dietary vitamin C may help reduce the risk of disease.

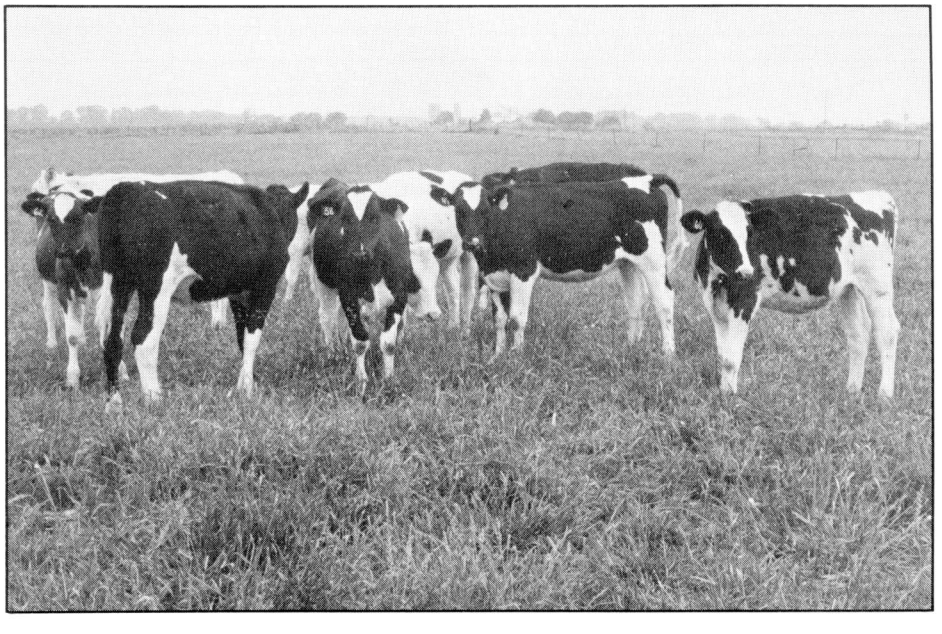

TABLE 1. BLOOD IMMUNOGLOBULIN G (IGG) ANTIBODY CONCENTRATION IN MILLIGRAMS/100 MILLILITERS

Diet	IGG by age, weeks			
	1	3	5	8
Males				
Colostrum	1,602	805	603	859
No colostrum	182	104	198	184
Vit. C	405	398	568	917
Females				
No vit. C	1,300	1,620	1,710	1,523
Vit. C	1,357	1,343	1,743	1,667

TABLE 2. GROWTH AND DISEASE INCIDENCE FROM 0-8 WEEKS OF AGE

Diet	ADG[1] lb./day	Scours, days/calf	Respiratory distress, days/calf
Males			
Colostrum	0.94	2.1	0.6
No colostrum	1.1	4.6	0
Vit. C	1.2	2.6	0
Females			
No vit. C	1.1	2.9	1.3
Vit. C	1.1	2.0	1.0

[1]Average daily gain.

WOOD BORERS AND FIREWOOD

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Department of Zoology-Entomology

USE OF WOOD as a primary fuel for heating homes has increased substantially in recent times because of scarcity and high cost of other common fuels. Heating successfully with a fireplace or wood-burning stove calls for stockpiling considerable amounts of firewood. With the increase in number of homes using and stockpiling firewood, there has been increased concern over finding unfamiliar "wood-boring beetle" adults inside and around the home.

Findings of an Alabama Agricultural Experiment Station study indicate that firewood may be responsible for the beetles' presence. Although some wood borers are potentially damaging to the home, information about their habits from the Auburn study may reassure concerned homeowners.

Several insects fit into the "wood-boring" category, but the most common species identified in this situation were long-horned wood borers, Cerambycidae. Some cerambycids attack living trees but most species are attracted to and infest dead, dying, and felled trees. Adults are active during the warm months (March-October), with females laying eggs on bark, in bark crevices, or in similar situations. The small newly hatched larvae bore in, leaving little or no external evidence of their presence. Larvae tunnel and develop in the bark or wood or both. Duration of the larval stage varies greatly by species (50-60 days to 1, 2, 3-5, or more years); consequently, stockpiled firewood may contain developing borer broods for more than one season.

Mature larvae, figure 1, pupate in the wood, bark, or between wood and bark and new adults emerge leaving conspicuous round exit holes, figure 2. Outdoors, most long-horned wood borers spend the winter in the larval or pupal stage and adult emergence begins in spring.

FIG. 1. (left), Cerambycid larva; FIG. 2. (right), adult wood borer exit holes.

Temperature is a determining factor in adult emergence, and if wood containing late-stage larvae or pupae is stored in a warm house, adult emergence may occur at any time pupal development is completed. Thus, presence of borer adults inside the home, even in winter, and around the house in spring and summer may often be traced to firewood cut and stockpiled during summer.

Concern over discovery of wood borer adults in the home is justified because there are species that may attack and damage home structures. However, most species found associated with firewood-type timber prefer that habitat and do not usually constitute a home pest problem.

In the Alabama Agricultural Experiment Station research, more than 40 species of cerambycids were identified in association with various freshly felled hardwood trees. Adults of the most common of these are shown in figure 3 A-H: (A) *Neoclytus acuminatus* (red-headed ash borer); (B) *N. scutellaris;* (C) *N. mucronatus;* (D) *Xylotrechus colonus* (rustic borer); (E) *Euderces pini;* (F) *Elaphidion mucronatum;* (G) *Graphisurus fasciatus;* (H) *Stenosphenus notatus.* All of these species were found associated with oak and hickory, two favorite firewood tree groups, and may be encountered where firewood is concentrated.

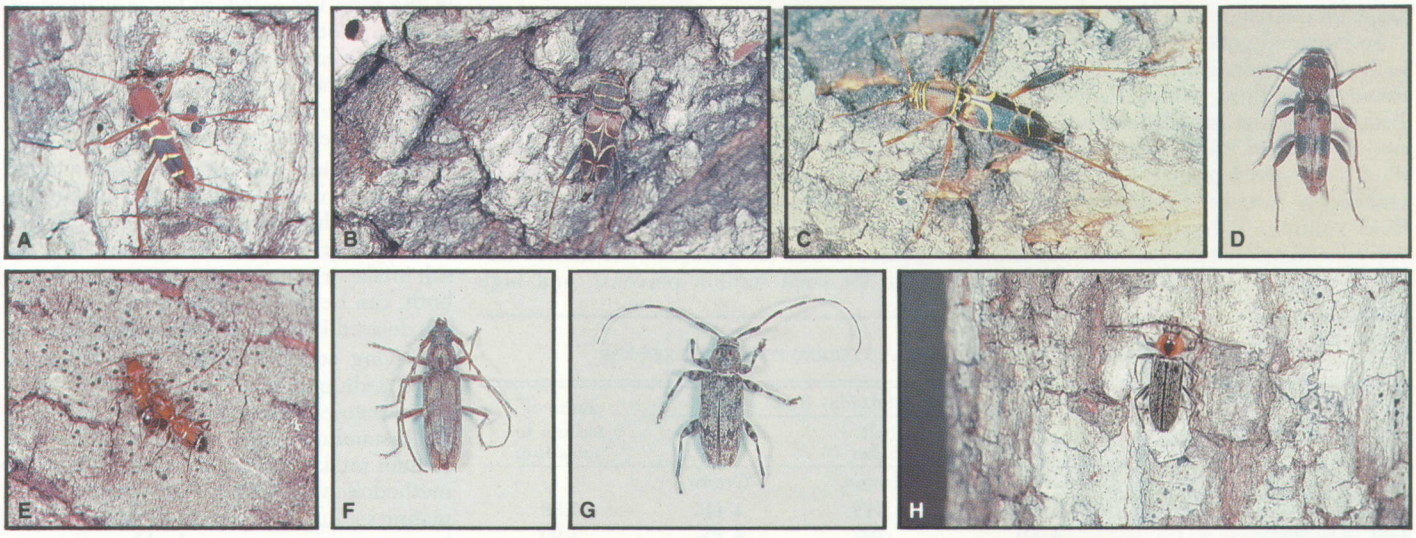

FIG. 3. Some common long-horned wood borer adults associated with felled hardwood trees: (A) *Neoclytus acuminatus*, (B) *N. scutellaris*, (C) *N. mucronatus*, (D) *Xylotrechus colonus*, (E) *Euderces pini*, (F) *Elaphidion mucronatum*, (G) *Graphisurus fasciatus*, (H) *Stenosphenus notatus.*

UNDERSTANDING SODIUM AND POTASSIUM USE HELPS PROMOTE NUTRITIONAL HEALTH

A.J. CLARK and C. FIELDS, Department of Home Economics Research

SODIUM AND POTASSIUM occur in many foods and both are important in good nutrition. However, there is considerable concern about excess use of salt and inadequate consumption of potassium by Americans. This pattern of consumption means that the sodium to potassium ratio is different than the desired 1:1.

The average American consumes about 1/3 to 1/2 oz. (10 to 15 grams) of salt per day, which contains about 1/6 oz. (5 grams) of sodium. This is considerably more than the 1.1 to 1.3 grams of sodium an adult needs to maintain good health. In contrast, the usual American diet contains about 1.6 to 3.0 grams of potassium per day.

Sodium and potassium have several roles in the body. Sodium is the principal cation of extracellular fluid, which includes blood. Potassium is the princpal cation of the intracellular fluid (fluid inside the cell). Sodium is involved primarily with the maintenance of osmotic equilibrium and body fluid volume. Potassium is primarily involved with cellular enzyme function and, to a lesser extent, osmotic pressure and body fluid volume. The salt content of the fluids in the body affects movement of water into or out of the tissues.

The body content of sodium and potassium and their concentration in body fluids are under homeostatic control. Moderate sodium and potassium intakes are promptly excreted in the urine and excretion of these elements quickly drops to low levels when intake is reduced.

Since sodium is involved with control of body fluid volume, it can affect blood pressure. The relationship between sodium intake and hypertension (high blood pressure) is strong enough to suggest a causal role for salt in the development of many cases of hypertension.

One of the leading causes of kidney disease in the South is high blood pressure. The Southern diet, which often contains high amounts of fat and too much salt, may be an important reason why hypertension is prevalent in the region. Alabama currently has the highest incidence of kidney disease in the United States (90 persons with kidney disease for each million persons), and high blood pressure is a leading cause of kidney disease. Blood pressure can be decreased by lowering sodium intake and increasing potassium consumption.

Since adolescent females are a high risk group as related to nutritional health, information about this group is being sought in Alabama Agricultural Experiment Station research. A recent study developed methodology to accurately determine sodium and potassium intake and excretion in this population group.

Eight female subjects, about 13 years of age, were asked to prepare or purchase a duplicate serving of each food or beverage ingested from meals or snacks. Serving sizes of each food were estimated to the nearest gram by weighing the food before ingestion. Subjects were allowed to salt food at the table, but a salt shaker containing a known amount of salt was provided so amount of salt added to the food could be determined.

Weighed food portions and beverages were collected into a plastic container for each food consumed each day of the week for a total of 7 days. Corresponding 24-hour urine samples were obtained. Sodium and potassium analyses of food and urine were done by atomic absorption spectrophotometry.

Subjects ingested daily almost twice as much sodium as potassium (2.883 vs. 1.446 grams). Most of this was excreted in the urine (2.410 and 1.121 grams, respectively).

One of the reasons for collecting the urine was to confirm the amount of each element consumed in the diet. This check indicated any error that would occur if subjects failed to comply with directions for food sample and urine collections.

How heavy use of salt at the table affects sodium consumption showed up in data gathered concerning salt shaker use. Subjects were arbitrarily divided into three groups: high use, low use, and no use. Those in the high use category had a marked increase in total sodium consumption and a high sodium:potassium ratio, see table. Thus, the practice of adding salt to prepared foods may be a substantial contributor to the problem of excess salt consumption.

Since sodium and potassium are involved in altering blood pressure, it is prudent to maintain a close ratio of sodium to potassium in the American diet. Either lowering the salt intake or increasing potassium intake, or both, can be done to more nearly approach the desired 1:1 ratio of sodium to potassium.

Having accurate information about dietary sodium intake of a particular population segment is necessary to obtain a clear understanding of the relationship between sodium intake and hypertension. Thus, the methodology developed for accurately estimating sodium and potassium intakes of adolescent girls may prove valuable in this area of work.

MEAN DAILY SODIUM INTAKE OF SUBJECTS, ACCORDING TO SALT SHAKER USE

Salt shaker use	Sodium intake/day from			Ratio of sodium to potassium
	Food	Salt shaker	Total	
	Grams	*Grams*	*Grams*	
High (2 subjects)	3.040	1.415	4.445	2.86
Low (3 subjects)	2.357	.105	2.462	1.65
None (3 subjects)	2.162	--	2.162	1.67

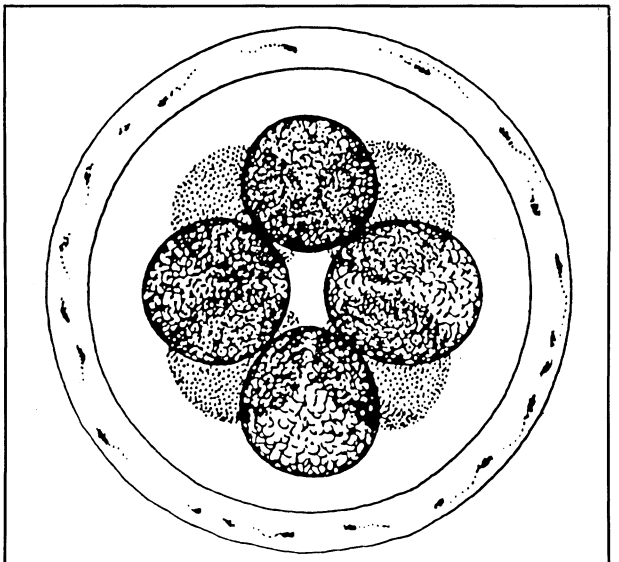

Illustration of fertilized bovine embryo.

Effect of Transportation Stress on Ovulation Rate in Superovulated Hereford Heifers

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EMBRYO TRANSFER in cattle is a process of recovering fertilized ova from a donor female 6 to 8 days after breeding and transferring the ova into unbred recipient females. The recipients must be in estrus at the same time as the donor animal. The recipient cow then carries the developing embryo through gestation without influencing the genetic makeup of the offspring. The process of embryo transfer also involves superovulation of the donor (stimulating multiple follicular growth with an injectable hormone), insemination, embryo recovery (flushing), and storage of the embryos (either short-term incubation or freezing) in addition to the actual transfer of the fertilized ovum.

During the last decade, embryo transfer has become commonplace in the cattle industry. Since genetic improvement in cattle is usually limited by low reproductive rates (70 to 75%) and long intervals between generations (5 to 7 years), many successful producers of purebred cattle have either used embryo transfer or are considering its use as an attractive alternative enabling them to improve the quality of their herds more rapidly. The Alabama Agricultural Experiment Station is searching out and evaluating those variables that determine the success of such a program.

In recent years, hundreds of commercial companies have been organized throughout North America and Europe for the purpose of transferring embryos. The larger, more established companies normally provide producers with two options: (1) on-the-farm transfers, or (2) the producer may transport the donor animal to the embryo transfer center where the appropriate procedures are carried out.

Before deciding to transport a valuable donor animal to an embryo transfer center, producers should carefully consider several factors. Most embryo transfer centers have the added capability of freezing embryos, producing two or more potentially viable embryos from one original (splitting), and in some instances determining the sex of the embryos. Usually it is more expensive for the producer to transport a donor animal to an embryo transfer center. Furthermore, animals which are transported may be injured or stressed as a result of shipping. Since stress associated with transportation has been shown to adversely affect reproduction, a study was conducted by the Experiment Station to determine the interaction of transportation stress with ovulation rate in superovulated donor heifers.

Four trials were conducted during 1982. Thirty cycling Hereford heifers between the ages of 15 and 21 months and of similar weight (600 to 750 lb.) and body condition were used. Cattle were maintained together in a 5-acre pasture for at least 3 weeks prior to assignment to groups. Heifers received 10 lb. per head per day of a ground hay, corn, and soybean meal diet that was approximately 12.5% crude protein and were allowed free access to Coastal bermudagrass hay and water. After the acclimation period the animals were divided into control and stressed groups.

Stress was induced by transporting the animals to a new location every 12 hours during a 4-day period. The amount of time the animals were transported ranged from 20 to 60 minutes. During this 4-day period, control and stressed animals were superovulated with a hormone which causes multiple follicular growth. The superovulatory regimen consisted of twice daily injections of 5 mg FSH (follicle stimulating hormone) for 4 days beginning on day 10 to 12 following the onset of estrus. On the fourth day of injections, the heifers were given 25 mg $PGF2_{\alpha}$ in the morning and 15 mg $PGF2_{\alpha}$ in the afternoon to regress the existing corpus luteum, a component of the ovary that produces progesterone.

Following the 4 days of FSH treatment, stressed heifers were regrouped with their control counterparts. In both groups, ovaries were visually examined 8 days following standing heat to determine the number of corpora lutea which reflects the number of ova produced by the animal.

EFFECT OF TRANSPORTATION STRESS ON FORMATION OF CORPORA LUTEA IN RESPONSE TO SUPEROVULATION TREATMENT

Treatment	Animals	CL left ovary	CL right ovary	Total CL
	No.	*No.*	*No.*	
Control.....	13	10.6	8.6	19.1
Stress	17	8.0	7.5	15.5

Results of the experiment are summarized in the accompanying table. The 13 control heifers had an average of 19.1 corpora lutea (range was 7 to 33), whereas the 17 stress heifers had an average of 15.5 corpora lutea (range was 6 to 32). Although there were on the average four fewer corpora lutea in the stressed group, these differences were not significant. Furthermore, there were not significant differences between the number of corpora lutea on the left and right ovaries. These results indicate that transportation stress of the intensity and duration used in this study did not affect FSH-induced ovulation rate in Hereford heifers.

"Take-all" Disease of Wheat Moves into Alabama

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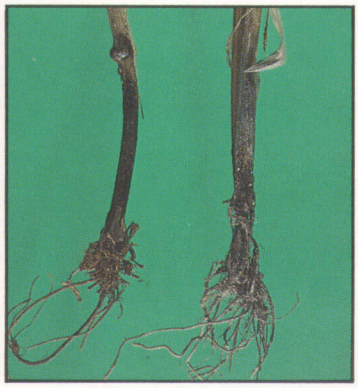

FIG. 2. (left), Degenerate roots and darkened stem bases indicative of take-all; healthy plant (left). FIG. 3. (center), Close-up of wheat plants with take-all disease. FIG. 4. (right), Dark, superficial mycelium of take-all fungus on stem base of wheat plant; healthy (left).

TAKE-ALL DISEASE OF WHEAT, long recognized as a serious problem in temperate climates, was identified for the first time in Alabama during the spring of 1983. The disease was discovered initially in wheat fields in Limestone and Madison counties. Later it was found in Cullman, Jackson, Lauderdale, Marshall, and Morgan counties. This documented occurrence, plus observations by county agents and farmers, indicates that take-all was probably present in previous years.

Response to the take-all disease problem by the Alabama Agricultural Experiment Station has been twofold: (1) to determine the extent of the disease and it's seriousness to Alabama agriculture, and (2) to seek methods of preventing or controlling the disease to reduce crop losses.

Take-all is caused by a soil-borne fungus *(Gaeumannomyces graminis)* that attacks the roots, crown, and lower stems of wheat plants. Infected plants are stunted and chlorotic and often have few tillers. Stems and heads of diseased plants turn tan-colored to white at the time of grain filling in green, healthy plants. Diseased plants occur in scattered patches ranging in size from a few feet to acres in diameter, figure 1. Severely diseased plants are easily pulled from the soil because rotted roots break off, leaving plants with short, brittle, and dark-colored roots, figures 2 and 3. The black-brown dry rot also extends into the crown and lower stem, and a superficial, dark-colored mass of fungus growth (mycelium) develops on the lower stem beneath the sheath, figure 4. Black, flask-shaped reproductive bodies (perithecia) of the fungus may be found embedded in the leaf sheath.

The fungus persists as mycelium or perithecia primarily in crop debris in the soil. It is most active in the soil at temperatures of 54-68°F and at high soil moisture levels. Infection generally takes place when mycelia growing through the soil come in contact with wheat roots. Spores are considered a minor source of inoculum. Movement of infested soil or crop debris by farm machinery, wind, or water is the primary means by which the fungus is dispersed from field to field.

Rotation is the best control for take-all. This entails planting wheat for no more than three successive seasons and keeping fields with a severe take-all problem out of wheat for at least 2 years. Cotton, corn, and sorghum are suitable for rotation. Other small grains or pasture grasses cannot be used as substitutes for wheat but leguminous cover crops are acceptable substitutes. Maintenance of fertility at soil test recommendation levels will promote root growth and differentiation, thereby reducing effects of take-all. Excessive application of lime and nitrate nitrogen reportedly favor the disease.

Incidence and severity of take-all were low in most fields examined in 1983. However, there were a few fields in which losses to the disease were estimated at 50% or higher. Damage was heaviest in fields that had been planted to wheat for 5 or 6 successive years. Little damage was noted in fields where wheat had not been grown for more than 2 successive years.

The cool, wet spring of 1983 probably contributed to the severity of take-all; however, successive cropping of wheat appeared to be the chief factor in the outbreak of the disease in Alabama in 1983. Studies planned for the future include a survey in the spring of 1984 to better determine the distribution and importance of take-all in wheat in the State, and research on methods of prevention or control. To aid in the surveys, growers are requested to report suspected cases of take-all to their county extension office or any of the authors.

FIG. 1. Wheat field showing large areas killed by the take-all fungus.

JAPANESE BEETLE
A threat to Alabama agriculture

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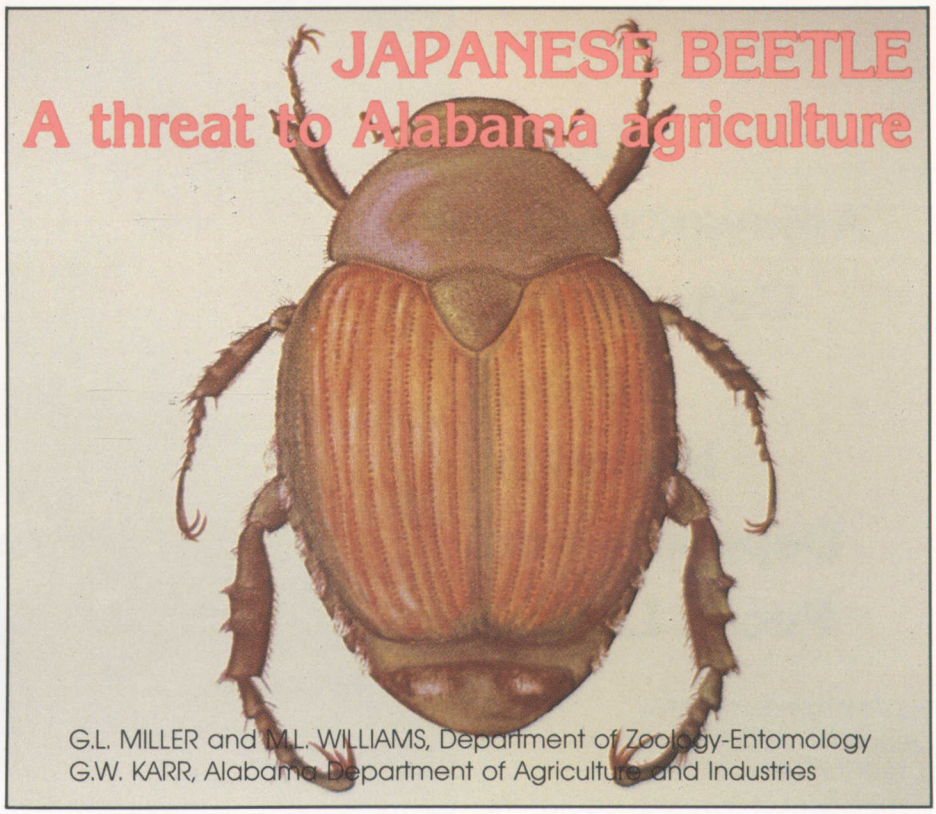

FIG. 1. Adult Japanese beetle.

THE JAPANESE BEETLE is a classic example of the destructiveness of an introduced insect pest. This beetle was only known to occur on the main islands of Japan before its accidental introduction into this country. In 1916, a dozen beetles were discovered near Riverton, New Jersey. During the next 50 years, the species (*Popillia japonica* Newman) multiplied and spread over an area of 100,000 sq. mi., covering most of the Eastern United States.

The beetle posed little agricultural threat in its native habitat, but it has been a different story in the United States. Here, the scarcity of natural enemies, the abundance of large turf areas, and suitable host plants provided ample opportunity for unchecked growth.

Because of the Japanese beetle's potential for damaging many types of plants in Alabama, the Alabama Agricultural Experiment Station is giving attention to the pest. Involvement has been in a cooperative venture with the Alabama Department of Agriculture and Industries in determining areas of infestation and potential damage.

Both adults and larvae of the Japanese beetle are destructive. Adults are known to feed on nearly 300 species of plants, often with devastating effects. Favorite hosts include apples, cherries, corn, grapes, peaches, plums, quince, rose, sassafras, viburnum, wisteria, and zinnia.

Adult beetles, figure 1, are approximately 1/2 in. long with brilliant metallic brown and green coloring. They often congregate in bright sunlight and feed on the foliage, flowers, and fruits of their hosts, figure 2. Adults will skeletonize a leaf by eating the succulent tissue between veins. In late spring (early to mid-June in Alabama), the adult beetle emerges from its underground pupal cell and begins feeding and mating. A female will periodically leave the plant she is feeding on and burrow into the soil to deposit eggs. Each female produces 40-60 eggs in her lifetime.

The larvae hatch and feed on turf roots until cold weather arrives. The larvae are C-shaped white grubs, figure 3, and when numerous can cause serious damage to large turf areas. Once the grub is fully developed, it forms a pupal cell and prepares to pupate. The grub changes into a pupa and then to an adult which emerges from the ground to feed, mate, and continue the cycle. There is one generation per year.

The first detection of Japanese beetles in Alabama occurred at the L&N Railway Yard in Huntsville on July 6, 1959. Since that date, the beetle has been detected in 26 counties over the State. Because of the potential destructiveness of this introduced insect, a quarantine regulation has been established. The intention of this regulation is to provide protection of cultivated crops and turf by reducing the chance of Japanese beetle infestation through restriction of movement of infested materials into non-infested areas.

All living stages of development of the beetle are regulated. In general, some other regulated articles include soil, sod, plants with roots with soil attached, and used, soil-moving machinery. A certificate or permit is required for movement of articles from portions of Cleburne, Jackson, Jefferson, Lee, Marion, and Winston counties. Specific information on the Japanese beetle quarantine and regulated articles may be obtained by contacting a representative of the Plant Industry Section, Alabama Department of Agriculture and Industries.

The Alabama Department of Agriculture and Industries is currently involved in a Japanese beetle monitoring program. Trapping results for 1983 show that Cleburne, Jackson, Lee, Madison, Marion, and Randolph counties have infestations of Japanese beetles. Additional infestations potentially occur in Calhoun, Clay, DeKalb, and Marshall counties. Because of the danger of a number of nurseries becoming infested and the lack of effective, soil-applied, residual pesticides, the Alabama Department of Agriculture and Industries will begin issuing compliance agreements to nurseries to meet quarantine requirements.

A number of available registered insecticides offer effective control of Japanese beetle adults and grubs, if used according to label directions. The bacterium *Bacillus popilliae* is an effective biological control agent that causes milky spore disease in grubs and is available commercially in powdered form.

FIG. 2. (left). Adult beetles often congregate to feed on host plants. FIG. 3. (right). Larvae, C-shaped white grubs, hatch and feed on turf roots.

Using Adjuvants with Concentrate Sprays Improves Deposition on Pecan Leaves

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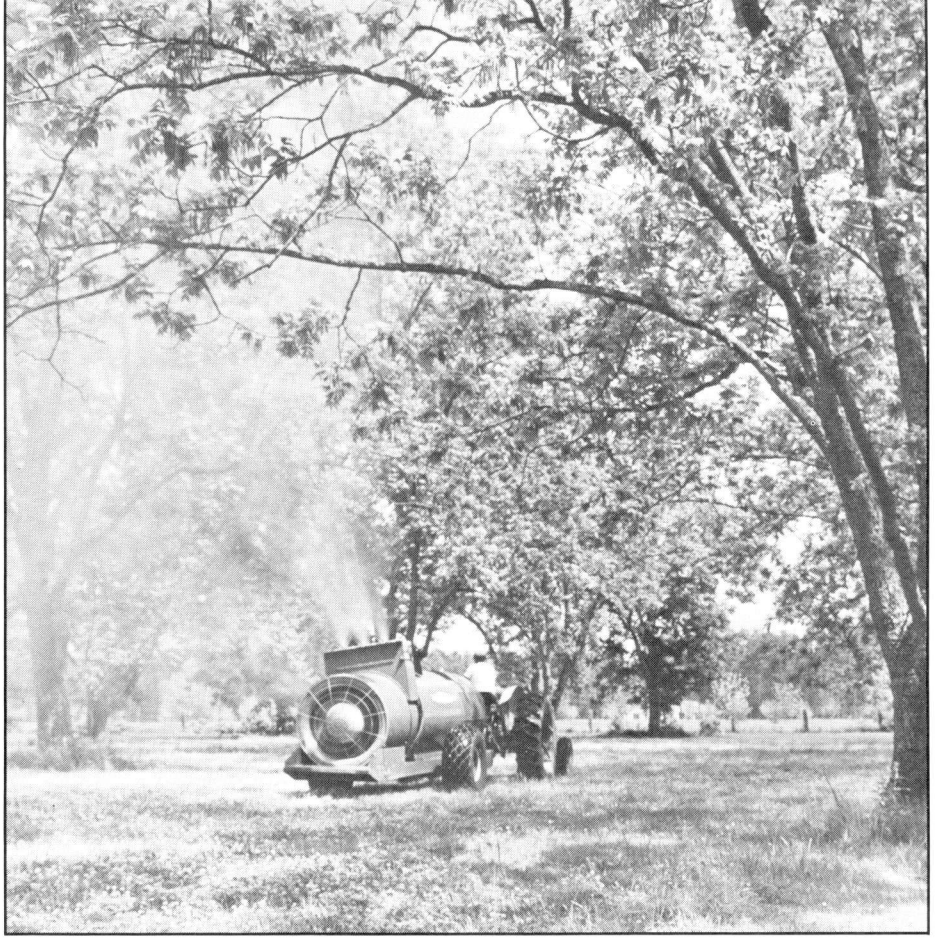


CONCENTRATE SPRAYS have two distinct advantages over dilute sprays for tree crops: (1) there is no runoff from foliage, and (2) the use of small amounts of water (5-7 gal. instead of 15-21 gal. per tree) speeds the spraying job because less time is devoted to filling spray tanks.

On the minus side, the small droplets used with concentrate spraying are more likely to evaporate between sprayer and tree tops, thereby reducing pesticide effectiveness. Studies with apples indicate that more than 40% of the original spray droplets may evaporate when spraying distances of 40 ft. Efforts to avoid this problem have included use of surfactants or adjuvants.

In the case of pecan trees, droplets must travel 50 ft. or more to impinge on leaves and shucks, and generally under high evaporative air conditions. Thus, the evaporation potential is great for pecan spraying. This problem was addressed in Alabama Agricultural Experiment Station research on adjuvant effectiveness, conducted at the Turnipseed-Ikenberry orchard near Union Springs.

FMC ceramic disc nozzle tips (No. 3 and No. 4), which are designed to increase spray break-up into fine particles, were used to evaluate spray droplet impingement and insecticide deposition on foliage with different rates and kinds of adjuvants. Pink Panther® and Superior Oil-70® were the adjuvants used, and carbaryl (Sevin®) insecticide was used as the marker.

Target slides to record size and number of droplets capable of impingement were suspended perpendicular to the ground at heights of 25 and 50 ft. A sprayer (FMC 957 airblast) was driven directly under the slides at a ground speed of 2.5 miles per hour. Number of droplets impinging per square centimeter of slide and average diameter of the impression made by the droplet were determined. Individual chemical analysis of 40 leaflets per treatment collected at the 50-ft. height determined the actual amount of Sevin residue deposited on leaves.

Temperature during the experiment was approximately 90°F or higher and relative humidity was 50% to 62%. Wind movement was minimal.

Examination of target slides held at 25 ft. showed that impingement of water spray droplets at that height was sufficient without addition of an adjuvant. At 50 ft., however, the number of water droplets impinging on the target slides was increased substantially by adding Pink Panther adjuvant at either 0.25 or 0.50 gal. per 500 gal. spray, using No. 3 and No. 4 nozzle tips. Droplet diameters were increased by the adjuvant, but not as dramatically as the number of droplets hitting the slide.

Addition of Pink Panther at 0.25 or 0.50 gal. per 500 gal. of spray mix showed only small differences over use of Pink Panther + water alone. This comparison involved the use of Duter® fungicide (5 lb. in 500 gal. of spray), to learn if the addition of a pesticide in the spray would affect results. Higher adjuvant rates than those described gave poorer results.

Actual amounts of pesticide deposited on foliage were significantly increased by use of the adjuvants. Data in the table indicate that using 1 qt. of Pink Panther to 500 gal. of spray mix will give a substantial increase in amount of pesticide deposited (using No. 3 FMC nozzle tips). Doubling the rate of adjuvant decreased the amount of pesticide deposited. Superior Oil-70 did not consistently improve results over the water-spray control.

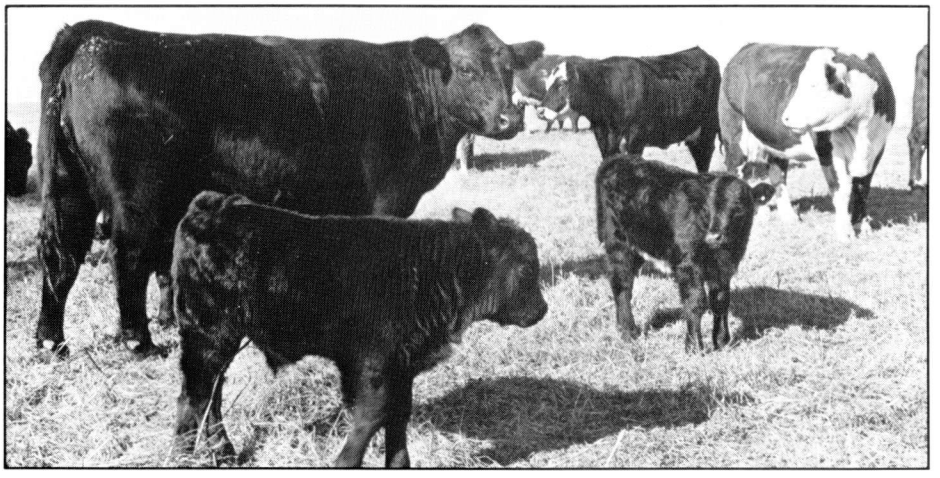
CARBARYL DEPOSITION ON PECAN LEAVES 50 FT. ABOVE GROUND LEVEL AS INFLUENCED BY RATES OF ADJUVANTS, USING NO. 3 FMC CERAMIC DISC NOZZLE TIPS

Adjuvant, rate per 500 gal.	Carbaryl[1] per sq. cm. leaf surface	Increase over control
	Micrograms	*Pct.*
Pink Panther[2]		
0.25 gal.	19.1	49
0.50 gal.	15.6	22
Superior Oil[3]		
0.31 gal.	11.7	-9
0.62 gal.	13.5	5
Water only	12.8	--

[1]Carbaryl (Sevin) used at rate of 10 lb. per 500 gal.

[2]Pink Panther is a nonionic surfactant produced by Great West Lubricants Co., Inc., Dallas, Texas.

[3]Superior Oil-70 is a product of Woolfolk Chemical Works, Inc., Fort Valley, Georgia.



Brucellosis Eradication Program Profitable for Alabama

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STATE AND FEDERAL authorities spent $118 million in 1979 trying to control bovine brucellosis. During that same year, Alabama had about 200 infected herds and lost over $2 million from bovine brucellosis. These losses were in the form of abortions, birth of weak calves, increased calving intervals, and reduced milk production. It is estimated that infected herds can lose up to 40% of the calf crop and about 20% of their milk production. Brucellosis can also be transmitted from livestock to man and is known as undulant fever, which is a debilitating disease.

Because of the seriousness of the disease, Alabama has been involved in a nationwide accelerated eradication program since 1976. This program is based on test and slaughter of reactors and vaccination of heifer calves.

A benefit-cost analysis of the brucellosis eradication program in Alabama has been conducted by the Alabama Agricultural Experiment Station. This analysis indicates a positive value to both farmers and consumers from the program.

The study was divided into two components. First, a computer model developed for the National Brucellosis Technical Commission (NBTC) was utilized to calculate physical losses of beef and milk over a period of 18 years in Alabama. The results of these simulations were then used to estimate the economic consequences of the eradication program during the 18-year period and to calculate the benefit-cost ratio and net present value for the program. The impact of supply changes on prices and the change in monetary benefits to producers and consumers of beef and milk products were also measured.

For the accelerated program, costs were defined as those expenditures incurred by the State and Federal governments plus an estimate of costs incurred by the beef and dairy producers to combat bovine brucellosis. These expenditures were calculated for the period 1983-2000, and producers' costs were estimated from responses to a mail questionnaire relating to management practices and costs for herds that had been infected or were presently infected.

The benefits of each program were measured in terms of the savings in physical losses of beef and milk due to the implementation of each alternative program. The physical losses reported from the model were represented as pounds of weaner calf losses because of abortions, birth of lightweight calves, delayed calving intervals, and reduced milk production.

As illustrated by data in the table, the accelerated program was far more desirable than the no-program option. The saving in animal products from an accelerated program was $185.756 million that otherwise would have been the value of physical losses.

BENEFIT-COST RATIO AND NET PRESENT VALUE AT THE END OF YEAR 2000

Item	Accelerated program	No program
Benefits, mil. $	185.756	-331.8
Program costs, mil. $	44.585	0
Benefits to cost ratio	4.166	-
Net value of program, mil. $	141.711	-331.8

The discounted value of cumulative costs was approximately $44 million.

The accelerated program yielded a benefit of $4.166 per dollar cost. In terms of net present value, the accelerated program yielded $141.171 million by the year 2000. Without the program, there would have been a loss of $331.8 million.

In terms of the impact on society, the study indicated that the supply of beef over the 18-year period would be 69 million lb. less with the no-program option, and milk supplies would be decreased by 83 million lb. These reduced supplies would boost consumer prices.

The results indicate that the accelerated brucellosis eradication program yields significant benefits over the no-program option. If the goal of eradication is to be realized in a reasonable time, it is important that the control and surveillance method be maintained at its present or even higher levels. If support by State and Federal authorities is discontinued, the cost over the 18-year period could be devastating to consumers. Although such a situation is unlikely to occur, the losses of $331 million projected under the no-program option give an indication of how economically unfavorable it could be to the people of Alabama without the program.

The large negative impact on consumers' prices indicates that it would be in the best interest of consumers to compensate producers to participate in the State-Federal Brucellosis Eradication Program. Producers are being compensated now because this program is being paid for partially by Alabama taxpayers. If Federal funds were reduced, the magnitude of the projected benefits makes it still in the best interest of the Alabama taxpayers to increase the State's contribution.

The nature of brucellosis disguises the direct cost to producers because effects on herd reproduction are harder to detect. Therefore, some producers may oppose following the program procedures. To alleviate this problem, an educational program is needed to explain brucellosis and its consequences. The magnitude of the benefit-cost ratio is evidence of consumers' benefits from the program. The net benefit of $141.711 million far outweighs the discontinued program cost for the same period.

Management is a key to control and eradication of the disease. The brucellosis program has the capability of increasing a producer's average returns to the livestock operation. Adherence to the eradication program can lead to lower production and health maintenance costs, thereby helping maintain the farmer's competitive edge.

Planting Corn into Strip-killed Clover

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Corn no-tilled into live crimson clover.

USING WINTER LEGUMES as a nitrogen (N) source for no-tillage planted summer crops is increasing in popularity. Even in a fair growing season, the value of the N in the legume tissue is greater than the production cost of the legume. Using reseeding winter legumes, such as clover, which eliminate seed and seeding cost in subsequent years, is by far the most economical approach to cropping systems which include winter legumes grown as a N source for summer crops.

Grain sorghum works well in these systems primarily because clover will generally set seed prior to the expiration of the optimum planting period for sorghum. Unfortunately, optimum corn planting dates in most areas of the State occur prior to maximum N accumulation in the legume and prior to seed set.

During the past 2 years, some innovative cropping systems have been developed which permit corn to be planted during the optimum period without losing the reseeding potential of the legume. Strip killing narrow bands of clover for the corn row at planting is one of these systems. With this system, clover in the row middles will continue to grow, accumulate N, and produce seed. However, research at the Alabama Agricultural Experiment Station suggests that the strip-kill system may actually reduce corn yield.

In 1983, a study with Autauga crimson clover was initiated at the Sand Mountain Substation, Crossville, to evaluate the feasibility of planting corn into immature clover. The clover was drilled into a prepared seedbed on October 18, 1982, at a seeding rate of 20 lb. per acre. The corn, RA 1502, was planted in 36-in. row widths on May 10, 1983, when the clover was in the early bloom stage.

Treatments at planting included kill strips with Paraquat 0,9,18, and 36 in. wide in the corn row. The 36-in. kill strip was a complete kill across the entire plot. Each strip-kill plot was divided into two subplots; one received no sidedress N and the other received 60 lb. per acre of sidedress N 3 weeks after planting. All plots were replicated four times and each one, regardless of the sidedress N rate, received 10 lb. per acre of N as a starter fertilizer at planting.

Oven-dry weight of the above-ground clover tissue at corn planting was 6,000 lb. per acre. Nitrogen in the tissue averaged 140 lb. per acre, which is adequate to produce an acceptable corn yield. Higher corn yields with than without fertilizer N clearly indicate that a sufficient quantity of N was not released from the clover material even when the clover was completely killed at corn planting, see table. Inadequate release of N from the clover may have been partially caused by extended droughts in July and August. Average rainfall for May, June, July, and August were 7.1, 4.4, 2.9, and 0.4 in., respectively.

Higher corn yields were attained when the clover was completely killed (36-in. kill strip) than when either 9- or 18-in. strips were killed. Lower yields with the strip-killed treatments than the complete-kill treatment may have been caused by slower or less N release from the clover tissue, but was most likely caused by soil moisture depletion by the clover.

YIELD OF NO-TILL CORN AS AFFECTED BY SIDEDRESS NITROGEN AND WIDTH OF KILLED CLOVER STRIPS IN THE CORN ROW AT PLANTING

Sidedress nitrogen, lb./acre	Yield/acre, by killed strip widths[1]			
	0 in.	9 in.	18 in.	36 in.
	Bu.	*Bu.*	*Bu.*	*Bu.*
0.....	18	34	32	50
60.....	65	75	76	91

[1]Row width was 36 in. and the 36-in. width was a complete kill.

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