HIGHLIGHTS

of Agricultural Research

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Alabama Agricultural Experiment Station
Auburn University
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DIRECTOR'S COMMENTS

MY SINGLE GREATEST concern as an agricultural experiment station director is our ability to effectively address important, relevant, and researchable problems in agriculture and forestry. My second concern, and one that impacts on the first, is the apparent perception on the part of some state and national leaders that maintaining the strength, efficiency, and productivity of American agriculture through agricultural research is not sufficiently important to justify a high priority among the funding demands for research dollars. This apparent lack of appreciation for agricultural research, particularly at the national level, can only make it increasingly difficult to obtain the funds necessary to adequately meet the highest priority research needs of agriculture and forestry.

Scientists involved in any area of research can suggest dozens of ways in which their research efforts could be enhanced by better funding for equipment, supplies, and support personnel. In fact, many creditable and worthwhile research ideas are not being considered in our Nation's agricultural experiment stations because of lack of resources. To illustrate this point, usually fewer than 25% of research proposals submitted to USDA are funded. By far the majority of these proposals are of excellent quality and would contribute to improvements in agriculture. Scientists working in the system recognize the need for many new and expanded research studies, and they have the expertise to perform these studies. Unfortunately, this recognition and competence are not matched by the funding of agricultural research.


GALE A. BUCHANAN

Unlike many areas, such as in engineering, in which precise, definitive goals can be defined and accomplished in a specified period of time, most objectives in agricultural research are moving targets. Agricultural problems are constantly changing, so our goals must be constantly redefined. Furthermore, agricultural researchers are constantly raising their sights.

The time-worn argument that lack of funds can be solved by redirecting resources to work on more relevant research problems hardly deserves a response. Redirecting the entire agricultural budget of the United States Department of Agriculture would not allow work on all the new problems that face us today. To state the problem clearly, agricultural research is woefully underfunded.

As recently as 1980, the state agricultural experiment stations were receiving only 23% of the federal funds that go to support food and agricultural research. Even more distressing, however, is that only 2% of the federal dollars going to research and development go to agricultural research.

The attitude of the current administration in Washington offers no encouragement. The executive budget submitted to Congress in February calls for a reduction of 14% in funding for the state agricultural experiment stations through Cooperative State Research Service (CSRS) items in the USDA budget and an overall 6% reduction in all agricultural research. At the same time, there is a projected 22% increase in the research and development budget for defense and 6.4 and 6.9% increases for National Aeronautics and Space Administration and National Science Foundation, respectively.

There are signs of encouragement. Many legislators, both at the state and national level, are sufficiently enlightened to appreciate and understand the importance of a strong agriculture and the role of research in keeping agriculture strong. I sense a renewed concern on the part of many farm organizations and individual farmers that agricultural research programs play a crucial role in agriculture. I am impressed that, for the most part, there is an honest appreciation of what such research organizations should and can do. Hopefully such support will result in adequate funding in the future.

may we introduce

Dr. Troy Patterson, professor of animal and dairy sciences. A native of Mississippi, Dr. Patterson came to Auburn in 1957, after serving for several years on the teaching and research staff at Mississippi State University. He pioneered much of the early crossbreeding research in beef cattle in Alabama and helped build the Auburn bull testing program into one of the finest in the Nation.

Though his early crossbreeding research was openly opposed by some groups in the State, the practical application of this work by Alabama cattlemen has meant untold millions of dollars in revenue for the State's cattle industry. His current research includes projects on selection of cattle for optimum ratio of maturing and growth.

Dr. Patterson earned a bachelors degree in animal science from Mississippi State University. He also earned a masters degree and Ph.D. in animal breeding and genetics from Texas A&M University. His article on the productivity of Simmental-Hereford versus Angus-Hereford cows on page 6 reports on findings from a long-term study at the Black Belt Substation.

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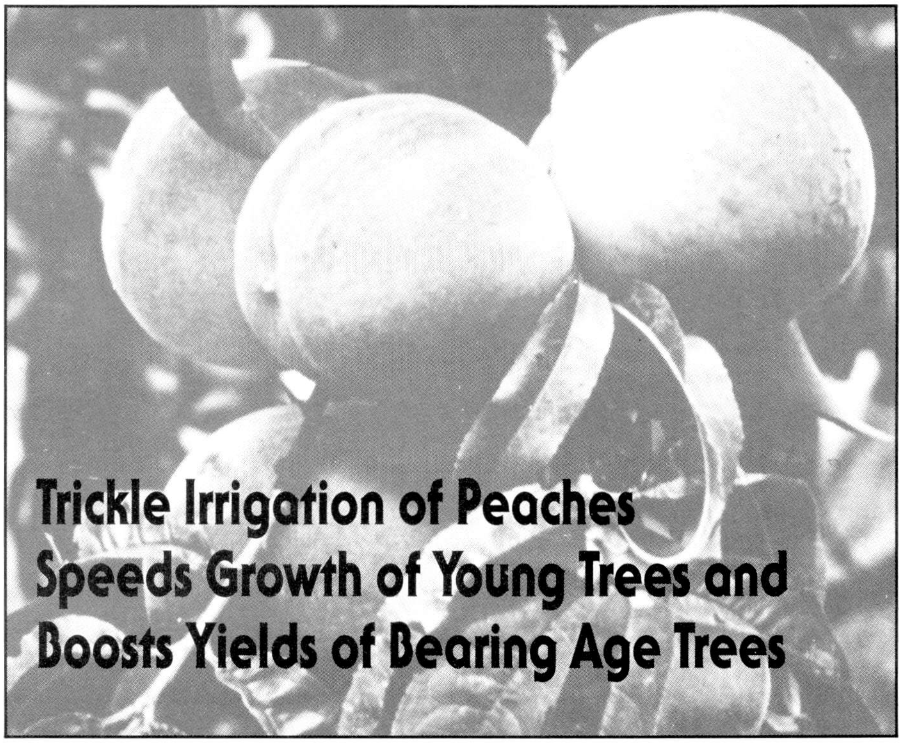
ON THE COVER. Calves from Simmental-Hereford cows were taller and heavier, see story page 6.



Trickle Irrigation of Peaches Speeds Growth of Young Trees and Boosts Yields of Bearing Age Trees

J.W. KNOWLES and W.A. DOZIER, JR., Horticulture Research
J.A. PITTS and K.C. SHORT, Chilton Area Horticulture Substation

TRICKLE IRRIGATION is a commonly used method for irrigating fruit trees. The theory behind this method is that, by providing a constant supply of water to the root zone, fruit trees will never undergo drought stress and will make maximum tree and fruit growth. Since drip irrigation has low energy requirements and uses less water than other irrigation methods, growers should be able to reap maximum returns.

Such advantages seem possible, according to findings of Alabama Agricultural Experiment Station research. Nonbearing trees showed increased growth rates with trickle irrigation, and bearing trees had higher production. Irrigation also may make possible savings in nitrogen costs.

The studies, which began in 1983 at the Chilton Area Horticulture Substation, addressed such questions as when to start irrigating, how much water to supply, and what nitrogen rates are needed when irrigation is used. One test was on a newly planted Monroe variety orchard and the other on an orchard of All Red Elberta that was in production.

In each study, the normal irrigation rate (1X) was the amount of water needed to replace water lost through evaporation and transpiration during the previous day. This rate was determined each day with an equation which takes into consideration tree size, tree density, soil type, transpiration rate, and evaporation loss. Evaporation loss was measured with a Class A Evaporation Pan.

Water rates of 0, 1/2X, 1X, and 2X were applied to the young Monroe orchard. In the established All Red Elberta orchard, water rates of 0, 1X, and 2X were applied, and nitrogen rates of 1/2X, 1X (recommended rate for tree age), and 2X were applied at each water rate.

Tree growth measurements were made in December 1983 and complete data were taken on both orchards in 1984. Data taken in 1984 included tree height, spread, and trunk circumference (measured September 5, 1984), yield, fruit size, and percent red color. Leaf samples were taken in June 1984 to determine foliar nutrient levels.

During 1984, a slight increase in most growth measurements was observed with the addition of water when compared to nonirrigated trees, table 1. Increasing the nitrogen rate resulted in a slight increase in vegetative growth of All Red Elberta.

There were no real differences in yield of the young Monroe peaches, and lowest yields were observed for the 2X water rate. This was the first crop year (third leaf) for these trees, and while yields in excess of 100 lb. per tree were obtained on some trees, yields were highly variable.

In 1984, highest yields of All Red Elberta were obtained with the 1X water rate, table 2. There was an average yield difference of 25 lb. per tree between this treatment and the no water treatment. Most of this increase resulted from an increase in fruit size that was brought about by irrigation. With an average increase of 25 lb. per tree and 128 trees to the acre, the yield increase from irrigation was 66 bu. per acre.

The yield boost was obtained despite sufficient rainfall during late July when the fruit was in its final swell. Since there is usually a dry period during this time of year, even greater yield responses from irrigation would be expected in years of normal weather. Overall, the high nitrogen rate did increase yield, but at the 1X water rate there was little difference in yield with the different nitrogen rates, table 2.

Percent red color was not affected by water for either orchard, but showed a slight decrease with the higher nitrogen rates. Foliar nutrient levels were generally unaffected by water rate, except boron levels increased with the highest water rate. Foliar nitrogen increased, as expected, with increased nitrogen application and potassium levels decreased with the higher nitrogen rate. Foliar nitrogen levels were sufficient even at the 1/2X nitrogen rate.

From these early data, it appears that (1) use of irrigation is beneficial in increasing fruit yields, (2) over irrigation may actually decrease yields, and (3) nitrogen rates may be decreased without detrimental effects if orchards are irrigated. Young orchards will benefit from irrigation during nonbearing years with increased tree growth.

TABLE 1. TREE GROWTH MEASUREMENTS OF MONROE AND ALL RED ELBERTA PEACH FOR DIFFERENT WATER RATES

Water rate[1]	Monroe			All Red Elberta		
	Circumference	Height	Spread	Circumference	Height	Spread
	In.	*Ft.*	*Ft.*	*In.*	*Ft.*	*Ft.*
0	12.0	11.3	13.2	17.0	13.0	17.1
1/2X	12.9	11.6	14.1	—	—	—
1X	12.7	11.5	13.6	16.5	13.2	18.1
2X	12.8	11.5	13.4	17.5	13.8	19.3

[1]Times normal rate.

TABLE 2. EFFECT OF TRICKLE IRRIGATION AND NITROGEN RATES ON FRUIT YIELD OF ALL RED ELBERTA, 1984

Water rate[1]	Fruit yield/acre			
	1/2X N rate	1X N rate	2X N rate	Average N rates
	Lb.	*Lb.*	*Lb.*	*Lb.*
0	131	138	153	141
1X	165	163	170	166
2X	155	152	158	155
Average	150	151	160	

[1]Times normal rate.

Alabama Farmers in Precarious Financial Position

W.E. HARDY, J.S. SMITH, and L.R. COX, Agricultural Economics and Rural Sociology Research

SELECTED CHARACTERISTICS OF SURVEY RESPONDENTS CLASSIFIED BY AGRICULTURAL PRODUCTION AREA, 1984

Production area and number responding	Selected characteristics					
	Av. gross sales 1984	Av. cash oper. expense	Av. total debt	Av. value of assets	Debt to asset ratio	Av. acres operated
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Pct.*	*Acres*
Limestone Valley (52)	52,852	45,468	58,630	240,812	24.3	369
Sand Mountain (26)	27,311	11,338	44,120	225,590	19.6	176
Upper Coastal Plain (40)	33,239	24,237	53,047	180,950	29.3	314
Black Belt (24)	73,402	67,466	213,844	504,837	42.4	744
Piedmont (15)	13,622	9,777	26,667	157,500	16.9	192
Lower Coastal Plain (20)	47,889	40,042	54,384	209,433	26.0	280
Wiregrass (61)	57,942	50,994	62,602	231,035	27.1	346
Gulf Coast (13)	43,271	40,280	144,578	538,153	26.9	231
State (251)	47,047	39,161	74,246	260,486	28.5	346

THE FINANCIAL CONDITION of the agricultural sector is a major economic issue confronting Alabama and the nation. Depressed commodity prices, high input costs, high interest rates, declining land values after a period of increase, several seasons of bad weather, too much debt, and poor management are but a few of the factors that have placed many farmers in a precarious financial position.

At the request of the Alabama Commissioner of Agriculture and Industries, a survey of Alabama farmers was conducted by researchers in the Department of Agricultural Economics and Rural Sociology in cooperation with the Alabama Crop and Livestock Reporting Service to determine the financial condition of Alabama farmers. A total of 1,500 questionnaires was sent to a stratified sample of farmers representing all types of agricultural enterprises in the State; 553 questionnaires were returned. For this analysis, retired farmers and those not reporting agricultural sales at least 1 of the last 3 years were eliminated, leaving 251 usable responses. Even though the number of cases analyzed was small, a comparison of the characteristics of the respondents with data given in the *1982 Census of Agriculture* indicated that the respondents closely resembled the total agricultural population of the State.

Data given in the table illustrate the average farm size and financial characteristics of those who responded to the survey. The data are classified by the eight major agricultural production areas in the State. Average 1984 gross sales per farm for the total sample were slightly over $47,047. The lowest average sales were in the Piedmont area ($13,622) and the highest in the Black Belt ($73,402). These two areas also had the minimum and maximum values for cash operating expenses, $9,977 and $67,466, respectively. Operating expenses for the State averaged $39,161. Total debt for all respondents averaged $74,246.

Total assets as an average for all respondents amounted to $260,486. Again, the Piedmont area had the lowest value, $157,500. Respondents from the Gulf Coast region reported the highest value of assets, averaging $538,153.

An important measure of the level of financial pressure and resultant stress is the debt to asset ratio. This ratio reflects the portion of a farm's value necessary to cover existing debt. The 28.5% State average is significantly higher than the 21.7% average for all U.S. farmers reported in the December 1984 Federal Reserve System *Agricultural Finance Databook*. By standards for other industries, the 28.5% ratio is not too high, but it is high compared to the 15 to 17% range that prevailed in the 1970's. Piedmont Area farmers had the lowest debt to asset ratio, 16.9%, while Black Belt respondents reported the highest value, 42.4%.

Additional data classifications were completed to see if farmers who had purchased land in the last 10 years exhibited characteristics different from those who did not expand their operations through the purchase of additional real estate. The analysis revealed that those who purchased land had a higher debt to asset ratio, 33.5% compared with 23.2% for those who did not purchase. For all financial measures, those who purchased land within the past 10 years had higher values. These were: 1984 gross sales — $73,384 to $30,457; 1984 cash operating expenses — $60,907 to $25,469; total debt — $116,389 to $47,702; and value of assets — $347,373 to $205,758.

Respondents were asked to indicate if they were current in paying their debt obligations. A total of 23.1% indicated that they were delinquent on either principal or interest for at least one loan.

Another question asked in the survey of farmers was if they expected to leave farming during the next 5 years. A total of 38.3% of those who responded to the survey indicated they expected to exit the farming profession. Major reasons given for leaving the industry were retirement (46%), financial problems (44%), health (22%), and other reasons which related to financial matters (26%).

Respondents were asked to identify and rank the most prominent causes of the financial difficulties that they and other farmers are facing. Low product prices was given most often as a cause of farmers' financial difficulties. High interest rates and the high cost of inputs were also listed by over half of those who responded.

The overall results of the survey indicated that the financial situation faced by Alabama farmers in general is indeed serious. Declining asset values, coupled with low product prices and high input and interest costs, have eroded the solvency and liquidity of agricultural producers. This loss of wealth and financial stability has caused lenders to look more closely at agricultural loans and show increased concern for profitability and repayment ability.

Virginia Buttonweed: Turfweed on the Increase

RAY DICKENS and D.L. TURNER, Agronomy and Soils Research

Seed of Virginia buttonweed.

Flowers of Virginia buttonweed.

Newly germinated Virginia buttonweed seedling.

Mature Virginia buttonweed plant.

TURF managers in Alabama and the Southeast are facing an increasing threat from Virginia buttonweed, a species native to the area but not a problem until about 10 years ago. Since that time, however, this weed has increased rapidly in fine turfs such as lawns, sod fields, and golf courses.

Virginia buttonweed is an erect or spreading perennial weed with fleshy roots, a woody crown, and usually hairy stems. Early plant explorers and botanists recorded its appearance throughout an area from New Jersey to Florida and westward to Missouri, Arkansas, and eastern Texas. Until recent years it occurred along wet ditches, stream margins, marshes, and pond banks. In the past decade, turf managers have observed dramatic increases of the weed in fine turf areas. These infestations are not confined to low lying wet areas, although the problem may be more severe in these locations. The reasons for the sudden prominence of this weed are not known.

A study was initiated in 1983 by the Alabama Agricultural Experiment Station to investigate the biology of Virginia buttonweed and to evaluate herbicides for its control. Seeds of Virginia buttonweed were collected in the fall of 1983 along with individual plants from throughout the State. The plants were maintained in a greenhouse and observed for morphological differences. The seeds were used in a laboratory experiment designed to determine the effects of both light and temperature on the germination.

Virginia buttonweed seeds germinated well immediately after harvest, indicating no dormancy factor. Germination increased with increasing temperature up to 85 to 95°F. No germination occurred at 70°F or below. Most seeds germinated rapidly (about 5 days) under optimum temperature conditions. These results indicate Virginia buttonweed may escape normal preemergence herbicide treatment by delaying germination until warm weather after the herbicides have dissipated. Its rapid germination would allow it to occupy midsummer voids in the turf caused by death of cool season weeds or other factors.

Virginia buttonweed seeds germinated equally well in either continuous light, continuous darkness, or alternating light and dark. Alternating the temperatures of light and dark periods also had no effect on germination. Thus it appears that the seeds have the ability to emerge from variable depths of soil, a definite competitive advantage in most cases.

Numerous herbicides have been screened for effectiveness on established Virginia buttonweed in bermudagrass turf. At this point, no single herbicide treatment has given complete control of this species at rates safe to bermudagrass. The hormone type herbicides, such as 2,4-D, dicamba (Banvel®), and triclopyr (Garlon®), appear the most promising for postemergence use. Preliminary results indicate that effective control of the species will require the use of repeated applications of postemergence herbicides combined with an effective preemergence treatment made in early summer when germination is occurring. The triazine herbicides (simazine and atrazine) have given the best results in trials to date.

Simmental-Hereford Cows Show Better Productivity than Angus-Hereford Cows

T.B. PATTERSON and S.P. SCHMIDT, Animal and Dairy Sciences Research
L.A. SMITH, H.W. GRIMES, and J.L. HOLLIMAN, Black Belt Substation

SIMMENTAL-HEREFORD (SH) cows, with excellent management and nutrition, outperformed Angus-Hereford (AH) cows in a previous study at the Black Belt Substation. A 2-year continuation of this study, in which Charolais (C) and Polled Hereford (PH) bulls were bred to these same cows, substantiates the results of the previous study. Calves out of SH cows were heavier at birth and at weaning, were taller at the hips, and had a higher stocker grade than calves out of AH cows. Since there was no reduction in percent calf crop in the SH cows, the extra weaning weight resulted in a substantial increase in pounds of calf weaned per cow exposed when compared to the AH cows.

High-quality grade Hereford cows were artificially inseminated (AI) with semen from selected Angus and Simmental bulls. University-bred, performance-tested Angus were used as clean up bulls following AI. All of the better heifers over a 2-year period were included in this study. A third set of heifers was produced in a similar manner at the Black Belt Substation. Since the matings were random, differences in characteristics contributed by the grade Hereford cows to these AH and SH crossbred females were minimized.

All heifers that weighed 65% of their expected mature weight by the time they were 15 months old were bred to calve as 2-year-olds. This accounted for 87% of the total number of heifers. The remaining smaller heifers were bred to calve first as 3-year-olds.

In the second phase, excellent performance-tested C and PH bulls were placed with the cow herd the first week in February for a 90-day, natural service breeding season. Data were collected for 2 years and included calves out of 3-, 4-, 5-, and 6-year-old cows.

The cow herd grazed dallisgrass-tall fescue-white clover pastures March 1-November 15. When pasture was inadequate during the winter, johnsongrass hay and a corn-cottonseed meal supplement were fed to meet National Research Council requirements. Salt was offered free choice. During the winter, whole shelled corn was provided as a creep feed for the calves, but was discontinued as spring pasture became available.

All calves were weighed, measured at the hip, and assigned stocker grades at weaning. Cows weaning calves were also weighed and measured at the hip. In the following results, only differences that are statistically significant are discussed.

Neither the breed of sire, breed of dam, nor age of dam caused any differences in percent cows that calved, percent calves that were born dead or later died, or in percent cows that weaned a calf, table 1. The 93.3% overall calf crop weaned indicates the potential for Alabama herds, if well managed and provided with proper nutrition.

There were no differences in birth weight or weaning weight due to breed of sire, table 2. However, C-sired calves were taller at the hip and had higher stocker grades than PH-sired calves. SH cows produced calves that were approximately 3 lb. heavier at birth, 38 lb. heavier at weaning, 1 in. taller at the hip, and had higher stocker grades than calves produced from AH cows.

The breed of calf contributed no differences in performance that could not be explained by differences in breed of sire or breed of dam. It was expected that the three-breed cross calves by C bulls would have better performance than the backcross calves by PH bulls since heterosis is only half as much in the latter group. This did not occur.

There is no advantage to larger size in the brood cow unless accompanied by increased productivity. It is generally accepted that for each 200-lb. increase in mature cow weight at least 50 extra lb. of calf are needed at weaning to offset the additional maintenance requirements for the larger cow. SH cows were 72 lb. heavier and 3 in. taller than the AH cows. However, since the SH cows weaned 42 lb. more calf per cow exposed than the AH cow, table 2, this extra calf weight is more than enough to offset the extra cow weight. Further, these cows have reached their mature size in both weight and hip height and therefore the weight difference between these cow breeds will not change, table 3.

It is of interest to note the added advantage of extra height in calves out of the SH cows. Based on heritability of 0.6 for hip height, one would expect calves out of the taller SH cows to be approximately 0.9 in. taller than calves out of AH cows. The actual difference was 1.3 in., which is equivalent to over one-half of a frame score. A diffference of 2 in. in height equals one frame score.

TABLE 1. REPRODUCTIVE PERFORMANCE OF CHAROLAIS, ANGUS, HEREFORD, AND SIMMENTAL CLASS BREEDS

Comparison	Cows calving	Born dead or died	Weaning
	Pct.	*Pct.*	*Pct.*
By breed of sire			
Charolais (143)[1]	95.9	3.6	92.5
Polled Hereford (143)	98.6	4.3	94.4
By breed of dam			
Angus x Hereford (138)	97.9	5.2	92.9
Simmental x Hereford (148)	96.6	2.8	93.9
By age of dam			
3-yr.-olds (17)	100.0	5.9	94.1
4-yr.-olds (85)	96.5	3.7	92.4
5-yr.-olds (126)	98.4	5.6	92.9
6-yr.-olds (58)	94.8	0	94.8
Total or average (286)	97.2	4.0	93.3

[1]Numbers in parenthesis indicate number of cows exposed to bulls.

TABLE 2. PERFORMANCE OF CALVES FROM BIRTH TO WEANING BY BREED OF SIRE AND DAM

Comparison	No. of calves	Birth weight	250-day adj. weaning wt.	Calf weaned/ cow exposed	Hip height at weaning	Stocker grade at weaning[1]
	No.[2]	*Lb.*	*Lb.*	*Lb.*	*In.*	
By breed of sire						
Charolais	132	81	647	599	45.3	14.7
Polled Hereford	135	82	642	606	44.3	14.4
By breed of dam						
Angus x Hereford	128	80	625	581	44.2	14.3
Simmental x Hereford	139	83	664	623	45.5	14.7
Total or average	267	81	645	603	44.8	14.5

[1]13 = Choice, 14 = high Choice.
[2]Calves that were weaned.

TABLE 3. WEIGHT AND HEIGHT OF COWS WEANING CALVES

Comparison	Cow weight at weaning	Cow height at weaning
	Lb.	*In.*
By breed of cow		
Angus x Hereford (128)[1]	1,096	48.0
Simmental x Hereford (138)	1,168	51.1
By age of cow		
3-yr.-olds (16)	1,107	49.5
4-yr.-olds (79)	1,115	49.8
5-yr.-olds (117)	1,149	49.6
6-yr.-olds (54)	1,158	49.3

[1]Numbers in parenthesis indicate number of cows weaning a calf.

WHAT HAPPENS TO SOYBEAN ROOT NODULE BACTERIA AFTER THE CROP IS HARVESTED?

A.E. HILTBOLD, Agronomy and Soils Research

SOYBEAN root nodule bacteria (*Rhizobium japonicum*) provide about 70% of the nitrogen required by this high protein crop. If not already present in soil, they must be applied when the crop is planted. The rhizobia multiply in the soil around soybean roots and still further in the root nodules that form after they enter the roots. The ability of *R. japonicum* to live outside the root, or as soil inhabitants after the crop is removed, affects the need for inoculation when soybeans are planted again in a crop rotation.

Recent research by the Alabama Agricultural Experiment Station at Auburn has provided insight into the soil population of *R. japonicum* as it changes with season of the year, crop rotation, and soil fertility conditions. The Cullars Rotation experiment which began in 1911 at Auburn, Alabama, was selected for sampling because soybeans were included in the 3-year rotation in 1962, fertilizer and lime treatments ranged from adequate to very deficient, and the long term of the experiment suggested equilibrium of *R. japonicum* with soil and crop conditions. The rotation consisted of cotton in the first year with fall-planted vetch and crimson clover turned ahead of corn in the second year. Rye was seeded in the fall after corn and harvested for grain the following spring ahead of soybeans in the third year. Sufficient plots were included so that all crops were represented each year.

Fertility treatments included (1) lime and NPK fertilizer for maximum yield, (2) same as (1) but no P, (3) same as (1) but no K, and (4) same as (1) but no lime. Nitrogen was applied as ammonium nitrate to provide 80, 60, and 60 lb. of N per acre to cotton, corn, and rye, respectively. Phosphorus (P) and potassium (K) were applied at 90 and 224 lb. per acre, respectively, per 3-year rotation. Half was broadcast after corn before rye, and half after soybeans before cotton. Lime was applied to maintain pH at 6.0 to 6.4.

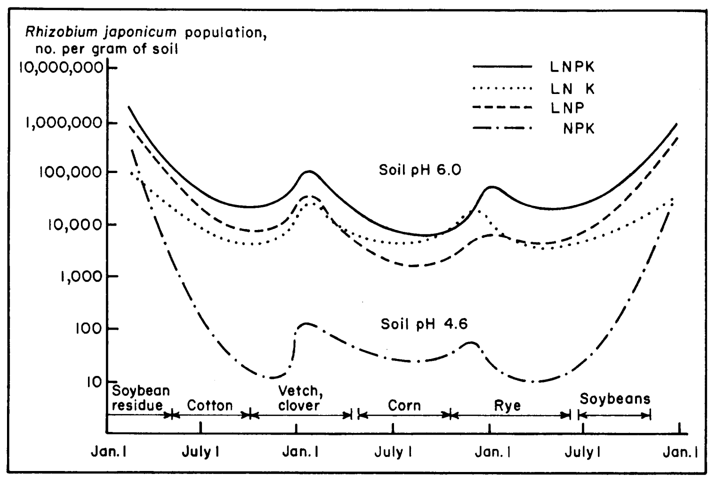
Beginning in January 1980, and at monthly intervals over 2 years, soil samples were collected from the plow layer of each plot for determination of *R. japonicum* numbers. Soil was serially diluted and applied to surface-sterile soybean seed in growth pouches. When the plants were 3 weeks old their roots were examined for nodulation. From the frequency of nodulation and the dilution factor, the most probable number of bacteria was calculated. Plotting these numbers of *R. japonicum* on the time scale of the crop rotation shows their relationship to season and cropping, see graph. Note the scale for bacteria numbers is compressed to accommodate the wide range of population.

Maximum numbers of *R. japonicum* occurred during the winter after the soybean crop, with a million or more rhizobia per gram of soil in the plow layer. This high population reflects the recent host crop and the decomposition of root nodules and release of bacteria into the soil. However, rapid die-off of rhizobia accompanied soil preparation for cotton and cultivation of this crop. Under cotton, minimum numbers were reached in October, after which some increase occurred into fall and winter.

It was speculated that vetch and crimson clover, being legumes, would stimulate *R. japonicum* numbers to increase, but this did not occur. Plots without winter legumes showed the same increase of *R. japonicum* in the fall as did those with winter legumes. *R. japonicum* does not nodulate vetch or clover; these legumes have specific rhizobia. In the second year under corn, another cycle of summer decline and increase into the fall was noted. When soybeans were planted in the third year the number of *R. japonicum* increased rapidly, approaching the initial high level.

Long-term deficiencies of P, K, and lime markedly reduced yields of all crops, see table. These soil conditions also affected the survival of *R. japonicum*. In phosphorus (P) deficient soil, survival of *R. japonicum* was only 40% of that in P-sufficient soil, while in potassium (K) deficient soil survival was only 16% of that in K-sufficient soil. Lime deficiency, or soil pH 4.6, was the most severe stress on *R. japonicum* survival. In this strongly acid soil the *R. japonicum* population approached extinction within a few months after the soybean crop, see graph. Fewer than 100 rhizobia per gram of soil persisted in this acid soil until soybeans were replanted, compared to 10,000 or more per gram of soil in the limed and fertilized control. The soil fertility conditions that favor high crop yields also favor survival of soybean rhizobia.

Effect of season and cropping on numbers of soybean root nodule bacteria for two soil pH levels.



CROP YIELDS AND *R. JAPONICUM* SURVIVAL IN P-DEFICIENT, K-DEFICIENT, AND STRONGLY ACID SOIL, RELATIVE TO ADEQUATELY LIMED AND FERTILIZED SOIL

Treatment[1]	Crop yields relative to control, pct.					*R. japonicum* survival, pct.
	Cotton	Winter legumes	Corn	Rye	Soybeans	
LNPK	100	100	100	100	100	100
LNK	63	15	30	21	30	40
LNP	24	42	43	53	45	16
NPK	40	25	34	64	17	1

[1]LNPK is adequate lime, nitrogen, phosphorus, and potassium.

New Granular Herbicides Provide Weed Control in Container-Grown Ornamentals

C.H. GILLIAM, Horticulture Research, G.S. COBB, Ornamental Horticulture Substation, D.C. FARE, Horticulture Research

PRODUCERS OF container-grown ornamentals in the Southeast usually rely on Ronstar® herbicide for weed control. This herbicide has generally provided good weed control; however, as with other single-herbicide systems, problems may develop from weeds that escape control.

Prostrate spurge is one weed not controlled by Ronstar. This native summer annual weed has become a major pest in container-grown ornamentals in Alabama.

A solution to this problem may be possible by using some of the new preemergence-applied granular herbicides. Rout®, Rout GL®, and OH-II® gave excellent control of spurge, as well as other weeds (both grasses and broadleaves), in Alabama Agricultural Experiment Station tests.

Rout 3G combines two previously labeled herbicides (Goal® and Surflan®) and was introduced by Sierra Chemical Co., with only limited testing in the Southeastern United States. Rout GL 4G (Goal + Lasso®) is not currently labeled for ornamental use.

The two Rout formulations were evaluated for use with four woody ornamentals: Christmas Cheer azalea, Andorra juniper, English boxwood, and Mentor barberry. Uniform liners were potted in March 1984 into a 5:1 pine bark-sand mixture (volume basis) amended with the following per cubic yard: 12 lb. Osmocote 18-6-12, 6 lb. dolomitic limestone, 2 lb. gypsum, 1 lb. Micromax, 1 lb. superphosphate (0-46-0), and 1 lb. Aquagro®. The 10 treatments given in table 1 were applied May 7 and again July 31.

On May 11, an equal mixture of goosegrass and crabgrass was sown uniformly over the azalea and boxwood. Eight weeks after each herbicide application (July 11 and September 24), pots were weeded and prostrate spurge seed were sown. This timing was chosen to test spurge control during the latter third of the 10-12 weeks of control normally expected with preemergence herbicides used in containers.

Excellent control of both goosegrass and crabgrass was noted June 5 and July 6 (60 days of control) with all herbicides in the test. There was no damage to the woody ornamentals from any herbicides applied.

Two weeks after spurge seed were sown, both Rout herbicides and OH-II provided excellent control of prostrate spurge, table 1. Ronstar and Devrinol® provided poor control of prostrate spurge, but Ronstar performed better than Devrinol. On July 31, all existing weed seedlings were removed prior to retreatment so the September 24 data reflect spurge control 8 weeks after the second herbicide application. At this time, all treatments provided excellent spurge control, except for Devrinol, which was no better than the weedy check treatments.

Resowing of the spurge seed 8 weeks after the second herbicide application (September 25) resulted in results similar to those occurring after the first herbicide application. Record low temperatures on October 1 reduced seedling numbers, but similar trends in control were noted; Rout, Rout GL, and OH-II provided superior spurge control, with poorer results from Ronstar, Devrinol, and the weedy check.

In a second study, Rout and Rout GL applied at 100 lb. of product per acre were compared with three other labeled granular herbicides: Ronstar 2G (200 lb. product per acre), Scott's OH II 3G (100 lb.), and Devrinol 5G (100 lb.).

Herbicide was applied to container-grown (pine bark medium) Compacta holly, gardenia, Moyer's Red nandina, Tradition azalea, and Pink Lady raphiolepis on July 3 and again on September 5, 1984. A mixture of goosegrass, large crabgrass, small-flowered morningglory, coffee senna, and sicklepod was sown 1 week after each herbicide application. A greater number of seed were sown in September than in July. The number of weeds per pot was determined 3-4 weeks after herbicide application and phytotoxicity was evaluated monthly through October.

No phytotoxicity was observed on any species regardless of herbicide. Weed control data taken July 23 showed that both Rout materials provided grass and broadleaf control similar to Ronstar and OH-II and generally better than Devrinol, table 2. Following the second herbicide application, and with a greater number of weed seeds present, Rout, Rout GL, and OH-II provided better broadleaf weed control than Ronstar or Devrinol. Grass control with Devrinol was poor, but Ronstar and other materials provided good grass control.

These data show that Rout, Rout GL, and OH-II provided superior control of prostrate spurge even when spurge seed were distributed 8 weeks after herbicide application. In a subsequent study, these three herbicides generally provided superior broadleaf weed control. Although none of the plant species tested was injured by any of the herbicides tested, these materials should be used only on plants listed on the label.

TABLE 1. SPURGE CONTROL WITH PREEMERGENCE HERBICIDES

Herbicide, lb. product/acre	Spurge/pot		
	July 30[1]	Sept. 24	Oct. 8
	No.	*No.*	*No.*
Rout 3G, 100	1.1	0	0.2
Rout 3G, 200	.1	0	.1
Rout GL-4G, 100	.1	0	.2
Rout GL-4G, 200	0	0	0
Ronstar 2G, 200	17.8	0	2.0
OH-II 3G, 100	2.6	0	.4
OH-II 3G, 200	.1	0	.8
Devrinol 5G, 100	51.5	3.3	5.8
Devrinol 5G, 200	41.5	3.5	9.7
Weedy check	84.0	3.4	11.4

[1]On July 30 existing spurge seedlings were removed from all pots.

TABLE 2. EFFECTS OF PREEMERGENCE GRANULAR HERBICIDES ON GRASS AND BROADLEAF WEED POPULATIONS IN CONTAINER-GROWN ORNAMENTALS[1]

Herbicide, lb. product/acre	Weeds/pot			
	July 23		October 8	
	Grass	Broad-leaf	Grass	Broad-leaf
	No.	*No.*	*No.*	*No.*
Rout 3G, 100	0	0.7	1.7	1.8
Rout GL-4G, 100	.1	.8	.5	2.4
Ronstar 2G, 200	0	1.0	3.8	4.2
OH-II 3G, 100	.2	1.0	5.9	2.2
Devrinol 5G, 100	3.1	2.0	54.1	5.2
Untreated check	14.3	2.6	79.8	4.2

[1]Treatments applied July 3 and September 5, 1984; weed seed sown 1 week later.

Detoxification of Aflatoxin-Contaminated Corn Makes Grain Safe for Feeding

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AFLATOXIN CONTAMINATION of corn before harvest was a serious problem in the Southeastern United States in 1973, 1977, and 1980. In 1980 alone, it caused economic losses of over $100 million to commercial livestock and grain producers.

Aflatoxin in corn can also be hazardous to human life. This was dramatically evidenced by the death of 106 persons of over 400 afflicted in one community in India in 1974, after consuming aflatoxin-contaminated corn bread.

In epidemic years, corn is contaminated in the field before harvest by invasion of the silks and developing kernels by the fungus. Insects also carry fungus spores into the ears during feeding. Preharvest contamination appears to be associated with high temperatures, drought stress, and other factors.

Corn and other grains that are inadequately dried before storage will be quickly invaded by *Aspergillus flavus* and other fungi, resulting in high levels of aflatoxin contamination in a few days. Levels of 200 parts per billion (p.p.b.) aflatoxin B_1 in feed may cause toxicity problems in swine and poultry, but cattle feeding trials have shown tolerance to 400 p.p.b. in corn. However, due to the carcinogenic nature of aflatoxin, FDA has set maximum tolerance levels of aflatoxin B_1 of 100 p.p.b. for corn intended for interstate shipment and use in animal feeds.

Many chemicals and methods have been tested for inactivation of aflatoxin in peanuts, cottonseed, and more recently corn in the United States. The most promising method has been ammoniation, which is the exposure of an aflatoxin-contaminated product to ammonia in gaseous or solution form. This gave good results in Alabama Agricultural Experiment Station research.

Experiments were conducted to determine if methods for the detoxification of aflatoxin-contaminated corn by fumigation with anhydrous ammonia could be adapted to facilities and production practices of Alabama farmers and livestock feeders.

Aflatoxin-contaminated corn of the 1982 crop used in the test was determined to have levels of contamination of 2,000-2,200 p.p.b. aflatoxin B_1, 220 p.p.b. aflatoxin B_2, and 60 p.p.b. cyclopiazonic acid. Two ammoniation methods were evaluated, one for small-batch treatment and the other for large-batch treatments. Cost was 15-20¢ per bushel.

For the small-batch treatment, a grain drying wagon was lined with plastic (6 mil) and all edges were sealed with wide plastic tape to make an air-tight bag containing 200 bu. of shelled corn. Anhydrous ammonia was introduced through a perforated pipe located in the center of the bag and extending the length of the wagon. Corn was exposed to 1.5%, by weight, of anhydrous ammonia (0.82% N_2) and sealed for a period of 14 days at ambient temperatures. Treatment procedures were repeated twice. The small-batch treatment regime reduced the high level of aflatoxin B_1 to an average of 29 p.p.b. (8 to 60 p.p.b.).

The large-batch treatment (applied in August 1984) utilized an 8,000-bu. steel grain storage bin with the top lined with 6-mil plastic and sealed around the edges. Twenty-three hundred bushels of corn were treated at the same rate and level as for the small batch; the anhydrous ammonia was air-forced into the bin through an air vent at the bottom of the bin, with infiltration and upward flow moving the ammonia throughout the bin. Levels of measured aflatoxin B_1 taken over a period of 14 days to 180 days after ammonia application showed B_1 levels reduced to 40 to 100 p.p.b. These reduced levels, attained by ammoniation of dry corn (12% moisture), are considered safe for feeding, especially to cattle.

Several cattle feeding trials were conducted using aflatoxin-contaminated corn and ammonia-detoxified corn as the principal grain source in diets for beef cattle in various physiological states. Twenty Holstein steer calves weighing less than 400 lb. were fed the highly contaminated corn. Five steers died after 3 weeks consumption of contaminated corn. Necropsy analysis determined that the calves suffered from acute liver damage attributed to aflatoxin contamination of corn.

Additional older and larger beef animals (500-700 lb.) were fed the contaminated corn, mixed half and half with uncontaminated corn. Cattle fed this diet showed acute signs of aflatoxin toxicity after approximately 3 to 4 weeks on the feed. The cattle were removed from this feeding regime when signs of aflatoxin toxicity appeared, and no mortality occurred. Feeding trials were then conducted to learn if these older cattle could utilize ammonia-detoxified corn to good advantage. Two groups of 25 steers each (850-lb. initial weight) in a finishing phase of production were fed a ration of 93% ammonia-detoxified corn plus protein/mineral supplemental pellets. These cattle gained 3.17 and 2.89 lb. per day over 90-day feeding periods. Ammoniated corn has also been fed to mature beef cows in all phases of production, in limited amounts, and to replacement heifers with no observed detrimental effects.

Based on these findings, it is safe to assume that aflatoxin-contaminated corn can be safely and effectively detoxified for use in animal feed rations. Five precautionary statements summarize the information available: (1) the fumigation process must last for a minimum of 14 days, (2) approximately 7 days of open-air aeration of the ammoniated corn is necessary prior to feeding, (3) ammonia and/or mold dust can be harmful to humans if inhaled, (4) ammonia is highly corrosive and destructive to metal, and (5) interstate shipment of ammoniated corn is illegal.

Cottonseed Hulls Improve Feed Efficiency and Gains of Cattle on Broiler Litter Diets

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AS THE USE of broiler litter in cattle feeds increases, more producers are asking, "What needs to be added to broiler litter diets to improve performance?" In research conducted at the Sand Mountain Substation, in Crossville, Alabama, the addition of cottonseed hulls as a roughage supplement to broiler litter diets resulted in increased weight gains, feed efficiency, and amount of feed consumed.

The purpose of this research was to determine the effect of adding cottonseed hulls; cottonseed hulls plus urea; cottonseed hulls plus soybean meal; and a mixture of cottonseed hulls, soybean meal, and calcium and phosphorus sources to a basal diet consisting of 57% ground corn and 43% broiler litter, table 1. All diets were calculated to contain an equal amount of usable energy and adequate amounts of crude protein. The broiler litter was stored under cover in a deep stack during the trial.

TABLE 1. COMPOSITION OF TEST DIETS (AS-FED BASIS)

Ingredient	Ration				
	Basal	Hulls	Hulls, urea	Hulls, soybean meal	Hulls, soybean meal, and minerals
Corn, ground, lb.	1,146	1,160	1,160	1,063	1,066
Broiler litter, lb.	854	650	650	650	651
Cottonseed hulls, lb.		190	177	190	134
Soybean meal, lb.			97	97	
Urea, lb.			12		
Limestone, lb.					18.8
Dynaphos, lb.					15.9
Dynamate, lb.					8.6
Salt, lb.					8.6
Cost/ton [1]	$77	$88	$88	$94	$93

[1]Cost of individual ingredients were: corn, $3.55/bu.; soybean meal, $250/ton; cottonseed hulls, $118/ton; urea, $128/ton; and broiler litter, $10/ton.

TABLE 2. SUMMARY OF FEEDLOT PERFORMANCE

Performance item	Ration				
	Basal	Hulls	Hulls, urea	Hulls, soybean meal	Hulls, soybean meal, and minerals
Initial 83 days					
Starting weight, lb.	425	427	424	424	425
Weight at 83 days, lb.	623	664	638	654	620
Daily gain, lb.	2.3	2.8	2.6	2.7	2.3
Feed consumed/day, lb.	17.7	19.9	19.0	18.6	17.0
Feed/lb. gain, lb.	7.7	7.1	7.3	6.9	7.4
Feed cost/cwt. gain	$30	$31	$32	$32	$34
Entire 236 days					
Final weight, lb.	929	977	960	978	944
Daily gain, lb.	2.1	2.3	2.3	2.3	2.2
Feed consumed/day, lb.	21.0	22.3	22.1	21.4	20.9
Feed/lb. gain, lb.	10.0	9.7	9.6	9.3	9.5
Feed cost/cwt. gain	$38	$42	$42	$44	$44

For the 236-day trial, 80 heifers of Angus or Angus x Hereford breeding, with an average starting weight of 425 lb., were randomly assigned to the five dietary treatments (2 pens of 8 animals each per treatment). All heifers were fed twice daily and weighed at 2-week intervals.

During the initial 83 days of the study, when the cattle weighed between 425 and 650 lb., average daily gains by cattle fed diets containing added roughage exceeded the basal group by an average of 13%, table 2. Addition of calcium and phosphorous sources to the diet containing cottonseed hulls and soybean meal appeared to slightly depress gains. On the average, the addition of roughage improved feed efficiency by 6.8% over the basal diet, whereas the cottonseed hulls-soybean meal diet improved feed efficiency 10.3%. Feed intake increased an average of 5.2% when cottonseed hulls were added to the basal diet and may largely account for the increased feed efficiency seen in the roughage-supplemented diets.

When feedlot performance over the entire 236-day trial was considered, the diets containing cottonseed hulls improved average daily gains, amount of feed consumed, and feed efficiency, as in the early part of the trial, table 2. There was no benefit from the addition of urea, soybean meal, or minerals to the basal diet.

The feed cost per cwt. gained was excellent during this trial, and ranged from $30 to $34 during the initial 83 days. Feed costs during the entire trial ranged from $38 per cwt. gained for the basal diet to $44 for the soybean meal- and mineral-containing diets. In spite of the fact that average daily gains, feed intake, and feed efficiency were greatly improved by the addition of cottonseed hulls to the basal diet, the cheapest gains were obtained by the basal group.

In conclusion, the addition of cottonseed hulls to the basal diet resulted in faster gains, more feed consumed, and improved feed efficiency. Additional protein supplementation appeared to be of little benefit during any phase of the trial.

Adding cottonseed hulls to rations improved cattle performance in tests at the Sand Mountain Substation.

Amiben Controls Florida Beggarweed in Peanuts when Applied at Ground Cracking

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R.B. REED, Research Data Analysis

FLORIDA BEGGARWEED is one of the most troublesome weeds in peanuts in the Southeastern United States. This weed, a non-nodulating legume, can grow to 6 ft. in height, thereby towering above the peanut canopy. Yields are not generally affected by light to moderate infestations (approximately 3-7 plants per sq. yd.), however, greater densities can be highly competitive. In addition, Florida beggarweed foliage hinders fungicide applications and interferes with peanut harvest.

In response to grower inquiries, experiments were conducted at the Wiregrass Substation at Headland, Alabama, to evaluate the feasibility of controlling escaped Florida beggarweed with postemergence applications of Amiben® mixed with a crop oil concentrate. At present, Amiben is labeled for ground-cracking applications, but not for postemergence applications. The Experiment Station study showed that Amiben applications at ground cracking were more effective in controlling escaped Florida beggarweed than were later applications.

Florida beggarweed is considered by growers to be a late season weed because infestations are not readily visible until midway through the growing season. At this time, they begin to penetrate the crop canopy. This phenomenon gives the appearance that Florida beggarweed typically germinates relatively late in the season. However, previous research by the Alabama Agricultural Experiment Station had shown that virtually all the Florida beggarweed plants which eventually penetrate the canopy generally had germinated within 4 weeks, and at the very latest 6 weeks, after crop planting. This weed simply grows slower than peanuts during the early portion of the season. Research has shown that the first 4 weeks of peanut growth are the most critical in terms of weed-crop competition. Thus, controlling Florida beggarweed after this period will have minimal effect in allowing the crop to yield its full potential.

Control generally is achieved by cultivation and/or herbicide applications at ground cracking or soon after, preferably when the Florida beggarweed is in the seedling stage. Standard herbicides used are dinoseb (Premerge 3®) and dinoseb mixed with naptalam in a 1:2 ratio (Dyanap®). These and other comparable products are commonly applied alone or in combination with Lasso®, Dual®, and/or Amiben. Amiben is registered as a ground-cracking treatment in peanuts at rates of up to 3 lb. per acre (6 qt. per acre). This herbicide generally provides excellent control of Florida beggarweed. Unfortunately, control with these treatments can vary, resulting in a high number of weeds that escape control. This variability can be attributed to inappropriate weather, improper timing of applications, and/or excessive weed pressure. Few, if any, alternatives are available for the postemergence control of Florida beggarweed.

This study was conducted for 2 years at the Wiregrass Substation. The test area, which was heavily infested with Florida beggarweed, received a preplant incorporated treatment of Balan® (4 qt. per acre) and Vernam® (2 1/2 pt. per acre). This treatment was effective in controlling pertinent grasses but had minimal effect on Florida beggarweed. Florunner peanuts were planted in accordance with normal practices. Amiben was applied at 4 qt. per acre (2 lb. per acre) at ground cracking and postemergence at 30, 45, 60, 75, and 90 days after planting. All postemergence treatments included a crop oil concentrate (Agridex®) at 1 qt. per acre. A standard treatment of Lasso (3 qt. per acre) plus Dyanap (6 qt. per acre) at ground cracking was included, as well as untreated weedy and weed-free checks.

A portion of each plot was maintained weed free so that any differences in yield or grade would reflect only herbicide effects. Florida beggarweed plants produced in each plot were clipped at ground level and weighed prior to peanut harvest so the efficacy of each treatment could be determined.

All herbicide treatments reduced the Florida beggarweed infestation relative to the untreated check, see table. Lasso + Dyanap reduced the infestation by approximately 73%, but even with this amount of control an infestation equivalent to 1,460 lb. per acre fresh weed weight remained. Maximum control was achieved with Amiben applied at ground cracking, which reduced the infestation by approximately 98%. Later applications resulted in progressively less control.

Peanuts were generally tolerant to Amiben regardless of application timing. However, a slight reduction in yield occurred with applications at 60 days after planting, which corresponds to the main flowering and pegging period. The lower yields indicated that peanuts were somewhat sensitive to Amiben during this period. Applications at 30 to 45 days after planting resulted in a slight increase in yields. No detrimental effect on grade could be attributed to any of the treatments.

While mid-season application of Amiben plus a crop oil concentrate (a non-labeled use) can control escaped Florida beggarweed, at best it is a catch-up type of treatment. A timely treatment at ground cracking is much more effective. In addition, preliminary studies by Union Carbide, the manufacturer of Amiben, have indicated that postemergence applications can result in crop residue levels in excess of current tolerances.

FLORIDA BEGGARWEED CONTROL AND PEANUT YIELD AND GRADE AS INFLUENCED BY VARIOUS TREATMENTS

Treatment	Rate[2]	Florida beggarweed/acre		Peanut yield[3]/acre		Peanut grade, SMK[4]	
		1983	1984	1983	1984	1983	1984
	Qt.	*Lb.*	*Lb.*	*Lb.*	*Lb.*		
Amiben-ground cracking	4	90	80	3,360	3,280	68.1	75.5
Amiben 30 DAP[1]	4	460	100	3,400	3,490	68.4	78.5
Amiben 45 DAP	4	1,980	1,360	3,430	3,440	73.8	75.8
Amiben 60 DAP	4	2,150	1,213	2,910	2,700	71.3	76.0
Amiben 75 DAP	4	1,570	4,020	3,190	3,280	69.4	77.5
Amiben 90 DAP	4	3,340	4,010	3,390	3,180	69.7	77.5
Lasso + Dyanap-ground cracking	3 + 6	1,490	1,430	3,200	3,320	69.8	75.8
Weed-free check	—	0	0	3,180	3,350	69.4	77.4
Weedy check	—	5,460	5,040	—	—	—	—

[1]DAP = days after planting.
[2]Based upon a 2 lb./gallon formulation of Amiben.
[3]Supplemented with hand weeding so that yields would only be affected by herbicide treatments.
[4]SMK = sound mature kernels.

Attacks on Livestock by Horse and Deer Flies Result in Losses to Alabama Producers

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CATTLE, horses, and hogs are commonly attacked by horse flies and deer flies, especially during the late spring and early summer when adult fly populations tend to be the greatest. When abundant, these flies can cause severe problems for livestock. The flies can cause reduced weight gain and milk production as well as decreased general thriftiness. It has been estimated that individual cattle may lose 2-10 oz. of blood per day during intensive feeding by these flies, collectively referred to as tabanids. Tabanids also are known to transmit livestock diseases such as bovine anaplasmosis and equine infectious anemia in the Southeast.

Annual losses and control costs attributed to tabanids on cattle in the United States are estimated to be $25 million. The losses to swine, sheep, goat, and poultry producers are unknown. Estimated losses for cattle in Alabama, Georgia, and Louisiana in recent years have exceeded $1.5 million. In Alabama alone, estimates of tabanid-associated losses and control costs to cattle producers range from $750,000 to $820,000 per year.

Preliminary observations of tabanid attacks in Baldwin County, Alabama, in 1977, a year in which fly attacks were particularly severe, led to a subsequent study conducted at the Alabama Agricultural Experiment Station to determine the species of horse flies and deer flies biting cattle in the Auburn area during the summer. By identifying the attacking species and learning about their habits, researchers will be better able to investigate methods for controlling these pests.

Using Holstein bulls as bait animals at the Animal Health Research Unit, flies were taken either directly from hosts or from drop traps during the daytime from June 1 to August 15, 1982. Nineteen tabanid species were collected with *Tabanus fulvulus* and *T. pallidescens* being by far the most common. Most species were present only in June. Major species taken from cattle during July or August were *T. fulvulus*, *T. fairchildi*, *T. pallidescens*, *T. sulcifrons*, *T. zythicolor*, *Chrysops flavidus*, and *C. univittatus*.

During the preliminary study in 1977, Experiment Station researchers found that beginning in mid-May, the fly problem intensified along the Tensaw River in Baldwin County until tabanid counts reached as high as 40-50 per animal at one time. Cattle and horses would not venture into open pastures but instead sought the shade and protection of bordering woodlands or waded deeply into any available water in their attempt to escape the intense biting discomfort. Cattlemen in the area estimated weight losses of 50-100 lb. per animal over a 2-week period in some of their herds. Hogs were also attacked heavily during this time.

Observations in Baldwin County showed that the most troublesome species on both cattle and hogs was *Tabanus maculipennis*, a large horse fly not previously regarded as common or economically important. The immature stages develop in root mats of aquatic and semiaquatic plants, accounting for the high population levels near the Tensaw River swamps. Four other major species attacking cattle were *T. melanocerus*, *T. pumilus*, *T. atratus*, *and Chrysops reicherti*. In addition, *T. wiedemanni* was commonly observed feeding on hogs. Twelve other tabanid species were collected in the immediate area but were not directly implicated in the problem affecting livestock.

Only the female flies bite and thus cause harm to livestock by their persistent attempts to obtain blood meals required for egg development. Eggs are typically deposited on vegetation overhanging aquatic or semiaquatic substrates, such as the margins of ponds, along stream or creek banks, and low-lying seepage areas that tend to be wet most of the year. The larvae, upon hatching from the eggs, drop to the water below to develop in the wet soil where they prey on other immature insects and invertebrates.

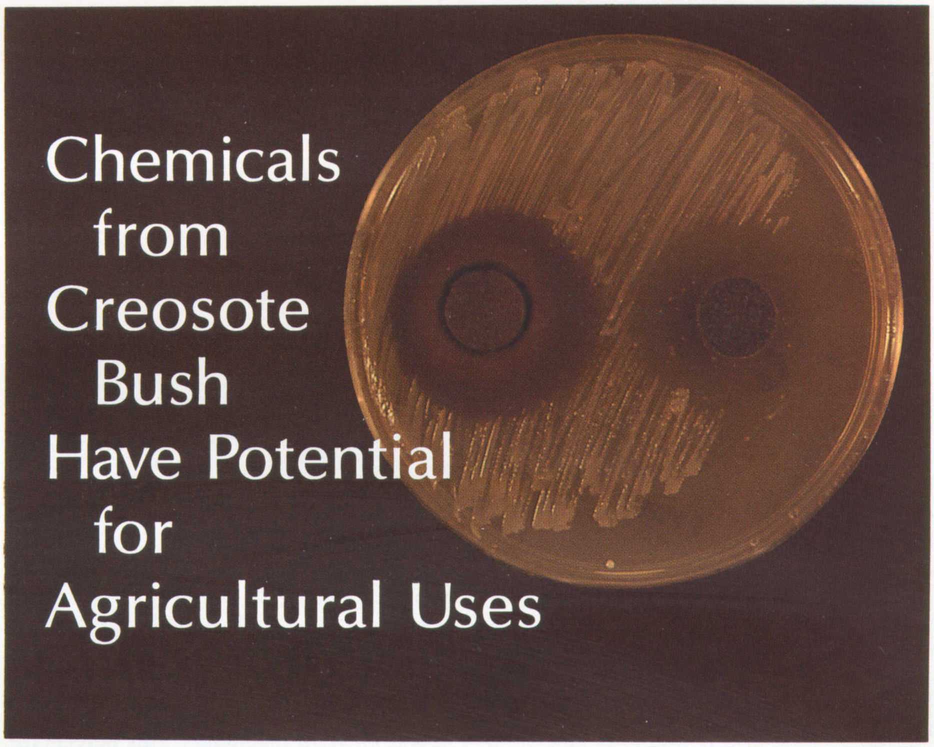
Most tabanids tend to feed only on certain parts of the host animal. Generally the larger species feed on the upper flank and along the back where the hair is thickest. Smaller species, including most of the deer flies of the genus *Chrysops*, tend to attack lower parts of the animal or around the face and ears where the hair is thinner. This preference for feeding sites was evident in the Tensaw River area where *T. maculipennis* concentrated its attack along the back; smaller species such as *T. pumilus* were found to feed primarily on the belly and udder, and *C. reicherti* on the legs.

Because of the difficulties in controlling tabanids in both the immature and adult stages, horse flies and deer flies continue to present a major problem for livestock producers and horse owners. To date, no effective, practical means has been developed for dealing with this problem in livestock despite the research efforts that have been made. However, the identification of attacking species and the knowledge gained about their habits from this study bring scientists a step closer in their attempts to develop effective, practical means for controlling these pests.

ABOVE. *Tabanus maculipennis* on hogs with house flies attracted to resultant feeding wounds. BELOW. *Tabanus atratus*, largest horse fly in Alabama and severe pest of cattle.

EDITOR'S NOTE: Natalie J. McMillan received a B.S. degree in zoology-entomology. This report is based on a special project she conducted as an undergraduate under the direction of G.R. Mullen.

Chemicals from Creosote Bush Have Potential for Agricultural Uses



E.C. MORA and JOHN ZAMORA, Poultry Science Research

USE OF plants and plant extracts for health benefits to man dates back thousands of years. Egyptian records of 1550 B.C. describe the medicinal use of plants. Dioscorides in 78 A.D. described 600 medicinal plants and 1,000 drugs. Such plants as aloe, belladonna, opium, and ergot are used in essentially the same manner today as they were in 78 A.D. In the new world, the Aztec and Mayan civilizations knew how to use and distinguish 1,200 plants and compounds. Several drugs still in use, such as emetine, quinine, and chenopodium oil, originated as plant extracts used by these new world natives.

There appear to be a number of plants that have yet to be recognized for their beneficial uses and exploited to the fullest. One such plant with significant potential is the creosote bush (*Larrea tridentata*). This plant is a perennial evergreen shrub that grows in the arid southwestern region of the North American continent.

Extracts or teas of the creosote bush were used by Indians for the treatment of stomach and menstrual cramps, rheumatism, sore feet, bruises, wounds, kidney ailments, tuberculosis, and facial cancers. During World War II, a component of the creosote bush was used as a potent antioxidant, which preserved butter even in the tropics. This antioxidant also had antimicrobial properties.

With the introduction of antibiotics and new synthetic medicinals or drugs, the use of extracts of the creosote bush fell into disuse. However, recent Alabama Agricultural Experiment Station investigations of the biological properties of the plant's chemical components (phytochemicals) indicate it may have potential for modern-day use. These studies reveal that not only does the creosote bush have medicinal properties, but its phytochemicals have potential for beneficial nonmedicinal use. Many of these uses are related to agriculture.

Five chemical fractions from creosote bush leaves were obtained and the biological properties of the extracts were determined. Four fractions had potent antimicrobial activities against 16 genera of bacteria, including two species of virulent tuberculosis bacteria. The fractions were also effective in inhibiting growth of nine genera of pathogenic fungi and yeasts. These properties justified the Indians' use of creosote tea as medication for wounds, bruises, and infections.

The potential for using creosote plant extracts to help prevent intestinal disorders of poultry, such as coccidiosis, showed up in the Experiment Station research. Four organic solvent fractions and hot water extracts from the plant were found to inactivate certain poultry coccidia, the protozoan parasite that causes coccidiosis. Feeding a crude preparation of ground, dried, creosote bush leaves to chickens was found to effectively control some parasitic coccidial infections.

Inhibition of bacterial growth by two fractions of creosote bush.

In a feeding trial, adding 1% ground leaves to feed for broiler chicks at 5 weeks of age resulted in faster weight gain than broilers getting the same feed without the creosote bush medication. The extra gain reported in the table translates into 1 lb. more growth for each eight broilers between the 5-week size and market size.

Animals do not eat the creosote bush because of the aromatic resinous, sticky, waxy coat on the leaves. This waxy substance prevents dehydration of the plant during the dry seasons.

Destruction by creosote bush extract of anterior, invasive end of coccidial sporozoite.

Because the creosote bush normally grows individually, not in tight bunches or aggregates, it is said to be a private bush. Few grasses grow beneath it, which indicates its natural herbicidal activity. In the Experiment Station tests, different plant seeds were sprayed with either dilute concentations of the organic solvent extracts or a hot water extract. One of the solvent extracts and the water extract were highly effective in inhibiting germination.

These findings indicate that the creosote bush contains chemicals that have the potential for being useful for both agriculture and medicine. It can provide substances for the control of bacterial, viral, fungal, and protozoan diseases in man and animals and it has a natural herbicide, which might be valuable for use in many situations. The antioxidant is a potential candidate for food preservation.

EFFECT OF ADDING GROUND CREOSOTE LEAVES IN BROILER FEED

Treatment	Weight gain after medication, grams[1]			
	D-2 days[2]	3-9 days	10-13 days	Total, D-13 days
Broiler feed	107	274	212	593
Broiler feed + 1% ground creosote leaves	63	379	217	659

[1]454 grams = 1 lb.
[2]D is day ground creosote leaves were added to feed—broilers 5 weeks old.

Estimating Densities of Plant Bugs and Predators in Early Cotton

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VIRTUALLY all of Alabama's cotton is under a scouting program to monitor population density and damage from bollworms and boll weevils. However, recent concern over early season insect management has increased efforts to monitor populations of plant bugs and beneficial predators. Collapse of predator populations attacking bollworms, for example, could result in earlier or heavier than usual bollworm populations. Working in and around the Tennessee Valley Substation, researchers in the Alabama Agricultural Experiment Station studied methods of monitoring early season predator and pest populations simultaneously, giving growers more information on which to base management decisions.

Insect population densities can be grouped into two broad categories, depending on the method of collection. Those based on a total count of insects per unit area, such as row-meters, are termed absolute density estimates. Although time consuming and laborious to obtain, absolute density estimates are more accurate and the basis from which ecological studies can be developed. Due to time and cost constraints, cotton scouts more frequently base estimates on numbers per unit effort, such as with a sweep net or drop cloth, to get a relative density. By comparing the scout's relative density to absolute density, growers can get a better overall picture of insect populations in their cotton fields.

The relationships between absolute and relative density estimates have been determined by Auburn researchers for early season arthropods in Alabama cotton. An average value for population density was estimated for a given field, based on data using two absolute techniques (whole plant bag sample (WPBS) and visual search) and two relative techniques (sweep net and drop cloth).

To evaluate the density estimate obtained with different scouting techniques, first the percentage of the absolute density was determined for each technique. This percentage varied greatly for the different species and stages (adult versus immature) studied, see table. Drop cloth estimates were an equal or higher percentage of the absolute density estimates than were sweep net estimates. Drop cloth estimates also resulted in significant relationships against absolute density for more taxa than did sweep net estimates. With the exception of big-eyed bug immatures, the percentage of the absolute density estimated by drop cloth or sweep net samples was low (10 to 30%).

Although the percent capture was low, the density estimate from scouting techniques can be easily converted to absolute density if the percentage is consistent. Thus, a scouting program can monitor true population densities if it captures an equal percentage of the absolute density throughout the season. One measure of this consistency, or precision, termed the R^2 value, see table, can vary from a low of 0 to a high of 100. The precision also varied among species and stages. In general, drop cloth estimates had equal or greater precision than those from sweep net samples in the Tennessee Valley tests. Due to the greater number of taxa that resulted in significant relationships, the greater percentage captured, and the equal or higher precision, the drop cloth was preferable to the sweep net for estimating population density in early season cotton.

For some groups, such as immatures of plant bugs and big-eyed bugs, the relative techniques were reasonably precise estimators of absolute densities. The drop cloth density of immature plant bugs, in numbers per row-meter, was consistently 28% and the sweep net catch per 10 sweeps was consistently 10%, of the absolute density per row-meter. For many of the taxa, however, factors other than absolute density are needed to explain the variation in the relative density estimates. In the case of adult plant bugs, although drop cloth estimates could be related to visual search estimates, neither relative technique was statistically related to WPBS densities. The WPBS estimate may well be more accurate than visual search. Thus, further work is needed to develop accurate, precise, and rapid sampling techniques for adult plant bugs.

Combining diverse taxa into one large group, such as "spiders" or "total predators," masks the unequal contribution of each taxa, and oversimplifies both the relationships among techniques and management decisions based on such a group. However, these may presently be the only data available to growers. Relationships using total predator counts (adults and immatures of big-eyed bugs, minute pirate bugs, lady beetles, damsel bugs, lacewings, and spiders) generally had greater precision than those using individual species and stages. Drop cloth estimates again were a higher percentage of the absolute density than were sweep net samples.

In the Auburn tests, less than one-third of the absolute population of predators or plant bugs were estimated with the techniques used by scouts when monitoring insect populations in early-season cotton. To gain a better overall picture of insect populations in Tennessee Valley cotton, the relative-to-absolute calibrations in this study were used to estimate total predator densities from drop cloth scouting data. Densities were thus estimated to exceed 66,000 per acre, or approximately one per plant, in about one-third of the dates and fields sampled throughout the 2 years. For several weeks densities came close to 200,000 per acre in these fields. Such under-estimations from the scouting techniques help explain how predator populations, at densities commonly reported in cotton, can control early-season bollworm outbreaks.

PERCENTAGE OF THE ABSOLUTE DENSITY (FROM WPBS AND VISUAL SEARCH) THAT WAS ESTIMATED BY DROP CLOTH AND SWEEP NET SAMPLES. THE R^2 VALUE GIVES A MEASURE OF THE CONSISTENCY, OR PRECISION, OF THE PERCENTAGE

Plant bug, predator	WPBS compared to				Visual search compared to			
	Drop cloth		Sweep net		Drop cloth		Sweep net	
	Pct.	R^2	*Pct.*	R^2	*Pct.*	R^2	*Pct.*	R^2
Adult								
Tarnished plant bug	NS[1]		NS		23	61	NS	
Minute pirate bug	6	20	NS		9	50	NS	
Lady beetles	12	37	NS		NS		10	22
Immatures								
Tarnished plant bug	NS		NS		28	66	10	72
Big-eyed bug	55	89	19	69	77	85	22	57
Minute pirate bug	NS		NS		7	58	NS	
Spiders	NS		NS		24	86	NS	
Total insect predators	35	75	13	66	29	62	7	25
Total arthropod predators	28	73	12	53	30	76	8	27

[1]Relationship was not statistically significant.

Ammonium Nitrate Improves Nitrogen Balance

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FERTILIZER nitrogen (N) applied to potted ornamental plants is absorbed by the plant, retained by the potting medium, or lost, by leaching or as a gas. Quantity of N lost from the pot represents fertilizer waste and a potential pollution hazard. Furthermore, plant growth may be adversely affected if N loss is large. Research at the Alabama Agricultural Experiment Station has resulted in a fertilizer N balance sheet for geranium, a popular potted crop. The balance sheet shows that N fertilizer source affects the portion of N retained by the plant and potting medium, and the amount lost from the pot.

Seedlings of Jackpot variety were transplanted to 4-in. pots of sphagnum peat moss, pine bark, and perlite (1:1:2). Beginning at transplanting and continuing to flowering (90 days), four water-soluble fertilizer materials were applied at the rate of 200 p.p.m. N: ammonium sulfate, ammonium nitrate, calcium nitrate, and urea. Each pot received a total of 145 fl. oz. of fertilizer solution in 43 applications. In a fifth treatment, Osmocote 14-14-14 controlled-release fertilizer (3- to 4-month formulation) was used at 17 lb. per cu. yd. of medium and irrigated with 145 fl. oz. of water. Total amount of fertilizer N applied in all treatments equalled 860 mg per pot. Analysis of the potting medium prior to planting showed that a pot of medium contained 264 mg N from organic matter. Therefore 1,124 mg N (fertilizer N + potting medium N) were potentially available to each plant during the experiment.

At the end of experimentation, shoot and root dry weights were measured. Nitrogen analysis data collected by sampling pot leachate during the experiment and taking plant (shoots and roots) and potting medium samples at the end of the experiment were used to construct the N balance sheet, table 1.

Ammonium sulfate reduced shoot and root growth, compared to the other N fertilizer treatments, table 2. Poor growth and yellowing of the upper leaves made ammonium sulfate plants commercially unacceptable. Differences in shoot and root growth and appearance were small among the other N sources.

Choice of N fertilizer affected plant absorption of N, with ammonium nitrate plants containing almost one-half of the potentially available N, table 1. Treatment with calcium nitrate, urea, and Osmocote resulted in less N absorption and ammonium sulfate had the least. Nearly one-half of potentially available N in ammonium sulfate and calcium nitrate was lost by leaching. With ammonium sulfate this was due to low N and water absorption resulting from poor root growth, whereas with calcium nitrate it was due to nitrate-N leaching. Leaching of N was reduced by the use of urea, Osmocote, and ammonium nitrate. Retention of N by the medium was increased by Osmocote, indicating that some N remained in the fertilizer granules at the end of the experiment.

Some N could not be accounted for in all treatments, but unaccounted-for N was greatest with urea and ammonium sulfate. Unaccounted-for N represents N lost from the growing medium as a gas; both ammonium sulfate and urea fertilizers are subject to loss by ammonia volatilization.

In summary, the N balance sheet shows that choosing ammonium nitrate or Osmocote as N fertilizers for geranium will result both in acceptable growth and greatest fertilizer efficiency, since 65 and 64%, respectively, of potentially available N was absorbed by the plant or retained by the medium. Calcium nitrate and urea fertilization produce acceptable plants, but the large leaching loss of N with calcium nitrate and combined N loss due to leaching and ammonia volatilization with urea make these fertilizers less desirable. Further research is being conducted on N fertilizer efficiency of potted plants and gaseous N loss from greenhouse and nursery potting media.

TABLE 1. NITROGEN BALANCE SHEET FOR 4-INCH POTS OF JACKPOT GERANIUM

Treatment	Recovery of available N[1]			
	Plant[2]	Leachate	Medium	Unaccounted-for
	Pct.	*Pct.*	*Pct.*	*Pct.*
Ammonium sulfate	27	43	19	11
Ammonium nitrate	47	32	18	3
Calcium nitrate	33	46	18	3
Urea	37	21	19	23
Osmocote	38	30	26	6

[1]Available N — sum of fertilizer N applied and medium N at planting (1,124 mg N/pot = 100%).
[2]Plant — shoot and root samples combined.

TABLE 2. EFFECT OF N FERTILIZER ON GROWTH OF JACKPOT GERANIUM

Treatment	Dry wt.	
	Shoots	Roots
	Grams	*Grams*
Ammonium sulfate	7.9	2.1
Ammonium nitrate	14.9	3.5
Calcium nitrate	14.4	3.3
Urea	13.2	3.3
Osmocote 14-14-14	13.3	3.0

Proper Irrigation Scheduling Reduces Container Medium Temperature and Increases Hershey's Red Azalea Growth

G.J. KEEVER, Horticulture Research, G.S. COBB, Ornamental Horticulture Substation

HIGH TEMPERATURES within nursery containers are often responsible for reduced root and shoot growth and can lead to longer production cycles. Cultural practices that provide limited success in reducing high temperatures include the use of reflective containers, nonreflective bed mulches, reduced pot spacing, and overhead shade. Results obtained in a 2-year study at the Alabama Agricultural Experiment Station show that irrigation scheduling can also be used to alleviate high temperatures in container growth media.

This Experiment Station study was initiated to evaluate the influence of irrigation scheduling on medium temperature fluctuations and growth of Hershey's Red azalea. In March 1983 and 1984, azaleas were potted in 1-gal. black polyethylene pots in amended pine bark and placed on a white shell mulch in full sun. Four overhead irrigation treatments were employed beginning in the spring of each year: (1) 8 p.m. irrigation for 1 hour (control); (2) 1 p.m. irrigation for 1 hour; (3) 10 a.m. and 3 p.m. irrigations for 30 minutes each; and (4) 9 p.m. irrigation for 1 hour plus hourly intermittent irrigations for 2 1/2 minutes, 9 a.m.-5 p.m.

Growth medium, canopy, and air temperatures were monitored continuously during the summer. In November of both years, root and shoot growth were compared among irrigation treatments.

Results of the study showed that maximum growth medium temperatures occurred at 4 p.m. and were lowest with 30-minute split irrigations at 10 a.m. and 3 p.m. (95°F) and with 1-hour irrigations at 1 p.m. (96°F). Growth medium temperatures were depressed 7 to 13°F for 1 to 3 hours with day irrigations compared with irrigating at 8 p.m. or at 9 p.m. plus intermittent hourly irrigations. Day irrigation (10 a.m., 1 p.m., 3 p.m.) also depressed maximum canopy temperatures 8°F for 2 to 3 hours. Intermittent irrigation reduced the maximum canopy temperature 2 to 3°F compared with the 8 p.m. irrigation.

Shoot growth, as indicated by growth index and top dry weight, was greatest with split irrigations at 10 a.m. and 3 p.m. or a single irrigation at 1 p.m. Canopy growth was similar with plants irrigated at 8 p.m. and 9 p.m. plus intermittent irrigation. Relative root rating was highest for plants irrigated at 1 p.m., followed by plants irrigated at 10 a.m. and 3 p.m.

Reduced maximum growth medium and canopy temperatures and greater canopy and root growth support the utilization of overhead irrigation during the day. Although the exact timing of irrigation to achieve maximum growth is not known, results suggest that single applications applied 2 to 4 hours before maximum air temperature is reached or split applications at 10 a.m. and 3 p.m. are beneficial. Hourly intermittent irrigation offered no benefit except a slight cooling of the canopy.

EFFECTS OF IRRIGATION SCHEDULE ON GROWTH INDEX, TOP DRY WEIGHT, AND RELATIVE ROOT RATING OF HERSHEY'S RED AZALEA

Daily irrigation schedule[1]	Growth index[2]	Top dry weight	Relative root rating[3]
		Oz.	
8 p.m., 1 hr.	27.8	1.5	3.0
1 p.m., 1 hr.	32.6	1.6	3.9
10 a.m. and 3 p.m., 30 min. each	34.2	1.7	3.2
9 p.m., 1 hr. plus 2½ min. hourly irrigations, 9 a.m.-5 p.m.	31.1	1.4	2.8

[1]0.5 acre-inch per day.
[2]Height + width + width ÷ 3.
[3]Rating: 1 = least developed, 4 = most developed (coverage of entire root ball surface).

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