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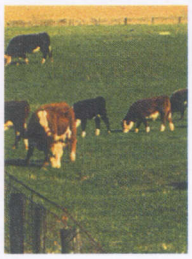
ALABAMA AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY

HIGHLIGHTS

OF AGRICULTURAL RESEARCH

In this issue



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COVER: Many factors affect crop yields, but one of the most vital is pollination. AAES research has shown that several pollinators are working the squash, pumpkin, and gourd crops in Alabama, helping ensure a dependable yield. See story on page 19.

from the Director

THE HOLIDAY SEASON is always a time for gratitude and optimism, especially in the Alabama Agricultural Experiment Station. We are grateful for the strong support of our research programs by the people of this state and trust that this will be further strengthened in the future. We are particularly pleased to have a dedicated faculty and staff, who on a daily basis generate the technology necessary to move our agricultural and forest industries into the 21st century.

We have every reason to be optimistic about the future. Recent reorganization of the Experiment Station has allowed us to fine tune some things that should make us even more productive in the future. Throughout the colleges and schools that conduct work under the auspices of the Alabama Ag Experiment Station, we can all say, It is NOT business as usual here.

As the holiday season passes and 1997 arrives, I want to thank all the scientists and support staff who make up the Alabama Agricultural Experiment Station for your good work and support. I want to reinforce our commitment to improving the quality of life of all Alabamians. I wish you and your family a merry Christmas and prosperous New Year.

Please stop by Comer 107 to see me as your schedule permits.

James E. Marion

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A QUARTERLY REPORT OF RESEARCH PUBLISHED BY THE ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN UNIVERSITY.

EDITOR'S NOTE. Mention of trade names does not indicate endorsement by the Alabama Agricultural Experiment Station or Auburn University of one brand over another. Any use of pesticide rates in excess of labeled amounts in research reported does not constitute recommendation of such rate. Such use is simply part of the scientific investigation necessary to evaluate various materials. No chemical should be used at rates above those permitted by the label. Information contained herein is available to all persons without regard to race, color, sex, or national origin.

THE BEAUTY OF RESISTANCE : Leaf Spot-Resistant Cultivars Identified for Indian Hawthorn

Austin Hagan, Ken Tilt, Randy Akridge, and John Olive

Indian hawthorn is an evergreen shrub that offers dense foliage, a mounded canopy, and dwarf-type growth habit, all of which make it a popular choice for residential and commercial landscapes in the southern half of Alabama. But it has one major foe, the disease Entomosporium leaf spot, which is caused by the fungus *Entomosporium mespili*. To combat this disease, AAES research has been identifying cultivars that are leaf spot resistant.

Entomosporium leaf spot, which occurs not only in indian hawthorn but also in other wood ornamentals of the rose family, is characterized by heavy spotting of the leaves followed by premature defoliation (leaf drop). The humid, mild weather patterns in South Alabama and neighboring states favor development of this disease and spread of the pathogen.

Fungicides provide good protection from this disease and can be used in some production nurseries. Due to health and environmental concerns, the intensive spray program needed to control this disease is not a practical option for residential and commercial landscapes. The best defense against this disease in landscape settings is to use disease-resistant cultivars; however little information has been available about which cultivars of indian hawthorn are most resistant. Recent AAES variety trials have identified cultivars of indian hawthorn with good resistance to Entomosporium leaf spot.

Figure 1. (left.) Indian hawthorn cultivar Olivia proved to be highly resistant to Entomosporium leaf spot. Figure 2 (right.) By early spring, several cultivars, including Harbinger of Spring, suffered complete defoliation.

In March 1994, 21 cultivars of indian hawthorn were established in a simulated landscape planting at the Brewton Experiment Field. Two additional cultivars, Snow White and Rosalinda, were added to the study in March 1995. The cultivars are listed in the table.

Prior to planting, soil fertility and pH were adjusted according to the results of a soil test. The plants were grown on beds mulched with aged pine bark and watered as needed with a trickle irrigation system, which is a management system that should help control the disease. Twice a year, the beds were topdressed with a slow-release fertilizer. A visual rating of Entomosporium leaf spot damage was made on May 28, 1995, and May 29, 1996, using a scale of 1 to 5 (1 = no disease, 5 = 76-100% leaves damaged or lost due to disease).

Spread of Entomosporium leaf spot on indian hawthorn occurs in the Brewton area primarily during the winter and early spring months. Frequent showers coupled with persistent cloud cover and mild temperatures often intensify disease on this shrub. By early summer, few fresh leaf spot symptoms appear on the leaves of

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any of the cultivars screened and their disease ratings declined.

Over the two-year test period, considerable differences in leaf spot prevalence among the various cultivars were seen (see the table). Although none of the cultivars remained completely free of leaf spot year-round, severity of symptoms was consistently lower on several cultivars. Overall, disease ratings for many cultivars were slightly higher in 1996 than in 1995.

Indian hawthorn cultivars that consistently exhibited the best resistance to Entomosporium leaf spot were Dwarf Yedda, Indian Princess, Olivia, and F1. In 1995, all the leaves on three of the four above cultivars remained almost spot-free. Although disease ratings were higher in 1996 for three of four cultivars than those recorded in 1995, the level of Entomosporium leaf spotting on the leaves generally remained low and disease-related damage unobtrusive. Typically, leaf spot symptoms were confined to a handful of leaves on each plant. With the notable exception of Dwarf Yedda in 1996, disease-related defoliation on these four cultivars was very light.

In 1995, the cultivar *R.* x *delacourii* also suffered very little leaf spot damage. In the months after hurricane Opal, however, nearly all the *R.* x *delacourii* died. Although the roots of the affected plants were rotted, no plant pathogens were found. Apparently, *R.* x *delacourii* is more sensitive than other cultivars of indian hawthorn to waterlogged or flooded soils. No other cultivars suffered these decline symptoms.

Incidence of Entomosporium Leaf Spot in Indian Hawthorn Cultivars, 1995-96

Cultivar	1995	1996
Springtime	3.9	4.7
Jack Evans	2.2	2.6
Harbinger of Spring	3.6	4.0
Eleanor Tabor	2.2	2.4
F2	2.2	2.6
White Enchantress	3.6	3.9
Majestic Beauty	2.0	2.7
F1	2.0	1.7
Heather	3.5	4.3
Janice	1.9	2.6
F6	3.5	3.6
Snow White	1.6	2.9
Pinkie	3.5	4.3
R. x *delacourii*	1.4	—
Enchantress	3.3	4.7
Olivia	1.1	1.9
Spring Rapture	3.2	4.7
Indian Princess	1.1	1.5
Rosalinda	2.5	3.4
Dwarf Yedda	1.0	2.0
Clara	2.3	2.3
F3	2.3	3.4

Nine additional cultivars demonstrated low to moderate levels of resistance to Entomosporium leaf spot. In one or both years, light to moderate leaf spot and some defoliation was seen on the cultivars Snow White, Janice, Eleanor Tabor, Majestic Beauty, Jack Evans, F2, Clara, F3, and Rosalinda. In 1996, symptoms were severe enough, particularly on the cultivars F3 and Rosalinda, that overall plant aesthetics were adversely affected.

The remaining eight cultivars of indian hawthorn were highly susceptible to Entomosporium leaf spot. In both years, heavy spotting of the leaves and severe defoliation was seen on the cultivars Pinkie, Harbinger of Spring, Enchantress, Heather, White Enchantress, Spring Rapture, F6, and Springtime. By April 1996, several cultivars had shed nearly all their leaves. Although all the above cultivars leafed-out during the late spring and early summer, they never developed the attractive dense, spreading, dark-green canopy that was characteristic of the leaf spot resistant cultivars of indian hawthorn.

Results of this study indicate that numerous indian hawthorn cultivars exist that can be maintained in home or commercial landscape settings with little or no need for fungicide applications. Based on these results, careful selection of cultivars for this resistance will help ensure indian hawthorn is an attractive, low maintenance addition to landscapes.

Hagan is a Professor of Plant Pathology, Tilt is an Associate Professor of Horticulture, and Akridge and Olive are both Superintendents of the Brewton Experiment Field and Ornamental Horticulture Substation, respectively.

RENOVATION TREATMENTS STUDIED ON HAYLAND

renovation

Mary Miller, Bob Goodman, LeAnn Self-Davis, Randy Raper, and Wayne Reeves

In row-crop production, tillage usually improves the capacity of the soil to store water and nutrients. In recent years, agricultural implements capable of soil tillage in permanent sods, including pasture and hay lands, have become available. An AAES study has been comparing the effects of two renovation tillage implements on productivity of tall fescue-bermudagrass pasture cut for hay. Results suggest that the effectiveness of renovation may depend, in large part, on soil moisture conditions.

Little previous research information has been available relative to the effectiveness of renovation tillage for enhancement of forage yield or infiltration of rainfall and/or nutrients. Limited data from other regions has generally shown no vegetation response to renovation tillage. In some cases, yield decreases have been reported. The study examined responses of hayland to two types of tillage implements.

At least two basic types of tillage implements are commercially available for use in pasture renovation. The Aer-Way Renovator is an example of a ground-driven rolling-tined aerator/cultivator that resembles "pitting" implements used on rangeland. It is being marketed as an implement to improve pasture productivity through increased retention of rainfall and nutrients. The second class of implements includes the Paraplow or the more recently available Paratill, which loosen the soil by relatively deep tillage but do not invert it.

The study was conducted on Hartsells fine sandy loam soil at the Sand Mountain Substation, Crossville. Livestock were excluded from a two-acre area of a pasture that had been continuously used for grazing cattle since 1981. The experimental treatments were: 1) renovation with the Paraplow, 2) use of the Aer-Way pasture renovator and, 3) no renovation. Each treatment was replicated three times. Renovation treatments were applied each spring for three years. Researchers monitored hay yield and quality, vegetative cover composition, and root length density.

Cattle were excluded from plots so that hay yield data could be collected and because the presence of cattle on the land would have required more frequent renovation treatments because of soil compaction. Penetrometer measurements taken on soil that had been grazed indicated that soil compaction from cattle recurred soon after renovation, while the effects of renovation on soil physical properties continued for some time on plots where cattle were excluded.

No consistent yield increase resulted from annual renovation (see graph). The only statistically significant finding was that the yield of the Paraplow plots was significantly less than the Aer-Way or control plots in the June 1996, measurement. No other differences reported in this study were statistically significant at the 10% probability level. There were yield increases some years, and yield decreases in other years when compared to no renovation tillage. While limited replications and short duration of the experiment make statistical comparisons difficult, there were certain weather characteristics in each year that might have resulted in the slight yield advantage apparently evident for either of the renovators or, indeed, for the control plot.

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Total and Per-Acre Cost of Pasture Renovation[1]

	Paratill		Aer-Way	
Acres	Total	Per acre	Total	Per acre
40	$1,810.63	$45.27	$1,048.97	$26.22
100	2,335.30	23.35	1,385.93	13.86
250	3,646.96	14.59	2,228.31	8.91
1000	10,205.26	10.21	6,440.24	6.44
Shared ownership		8.74		5.62
Variable costs		4.64		3.14

[1]By acres covered per year, with shared ownership of renovator, fixed and variable costs except where noted.

In 1994, the Paraplow plots apparently produced more forage than either the Aer-way or control. The year 1994 was a record year for crop production throughout Alabama, and cumulative yields in this experiment were highest in 1994. Rainfall was especially timely through the spring and summer months. Thus, any root-damaging effects of deep renovation tillage might have been minimized by excellent growing conditions.

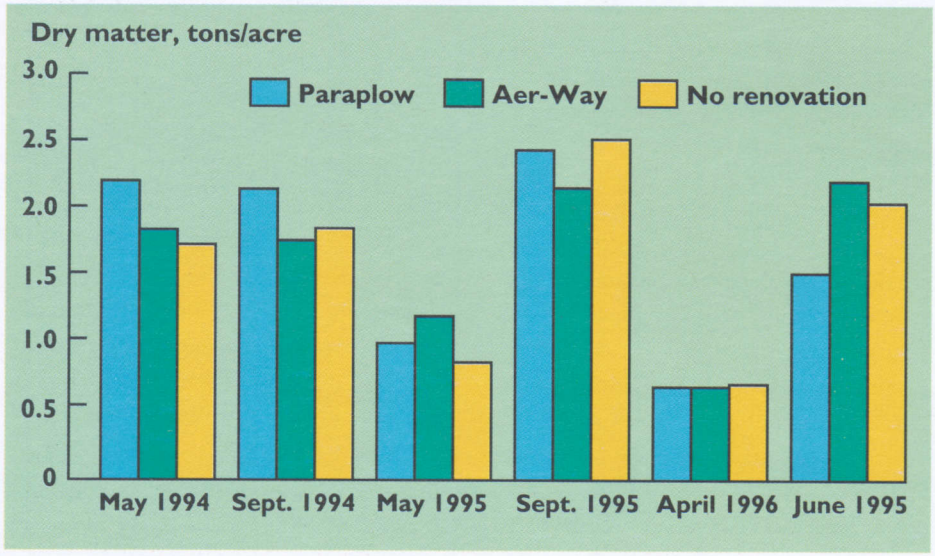
The spring of 1995 was especially dry. Renovation was followed by very little regrowth of plants. Cover composition measurements in May 1995 indicated that treatment with the Paraplow resulted in greater amounts of residue compared to Aer-Way or to no renovation tillage. This was attributed to damage to the root systems by the Paraplow and subsequent death of grass shoots. This effect may have been enhanced by the relatively harsh winter of 1994-95. In any case, the control treatment under those moisture conditions was apparently superior to either renovation treatment. Moisture conditions improved by the fall, allowing yields on both renovation treatments to exceed the control; however, cumulative yields for 1995 were low compared to 1994.

Weather patterns in 1996 were similar to the previous year, with dry weather early in the year, then seasonal mini-droughts during the summer with adequate moisture only periodically. In April, yields were very low, and none of the three treatments had any advantage. In June (in an extra measurement) moisture conditions had improved and yields were higher, but growing conditions were not favorable enough to allow the deeper-tilled Paraplow plots to recover from any root damage.

Yields in the fall of 1996 were approximately equal for all treatments, and cumulative yields for the year were comparable to 1994. The difference between 1994 and 1996 was that the Paraplow plots seemed to show a slight yield advantage in 1994, but 1996 yields on the Paraplow plots seemed to be slightly lower than either the control or Aer-Way plots.

Preliminary interpretation of these results seems to indicate that damage to root systems observed with the Paraplow may be a factor in reduced forage production under drought conditions such as those experienced in 1995 and early in 1996. However, soil loosening at a deeper depth that occurs with Paraplow treatment may be a factor in increased forage production in high moisture conditions, such as were experienced in 1994. Renovation with the Aer-Way appears more likely to favorably affect forage production under droughtier conditions. These hypotheses may be further tested when results of the companion experiment, where cattle were allowed access to treatments, become available. Further, additional experiments that alter the renovation regimen may also be warranted.

These preliminary data indicate a yield increase for pastures treated with renovation tillage may occur under some environmental conditions. The differences reported in this study were not statistically significant, and further research is warranted, but if the data are correct, renovation could provide positive net returns to hay producers. For example, if hay price was $60 per ton, and if renovation resulted in a 10% increase in production, break-even renovation total cost would be in the range of $6-9 per acre. Unfortunately, achieving such a low total cost of renovation is unlikely for most Alabama producers unless renovators can be held in some form of shared ownership to hold fixed costs per acre for renovation at a very low level.



Yield data from renovation studies, 1994-96.

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tomato

Alabama Tomato Growers Meeting Federal IPM Guidelines

Ellen Bauske, Geoffrey Zehnder, Edward Sikora, and Joseph Kemble

U.S. CONSUMERS have indicated increasing concern regarding the use of pesticides in food production. As a result of public concern, the federal government mandated that by the year 2000, 75% of all cropland should be farmed using Integrated Pest Management (IPM) practices. To reach this end, IPM must be clearly defined and the current level of IPM use in the region determined. Applicable research and technology can then be identified and educational needs and appropriate distribution methods determined to promote IPM to target producers.

Fresh-market tomatoes are an excellent model crop for development and implementation of IPM strategies. Over 30,000 acres of tomatoes are grown in the Southeast annually. Growing conditions, cultural practices, and pests are similar across the region. Also, tomatoes are a "high-input" crop, increasing the potential for significant financial savings as a result of utilizing IPM practices.

A survey was developed by farmers, consultants, and university personnel from the Southeast. The survey was distributed to tomato growers by mail, at county meetings, and other relevant venues. Frequency of use was rated for each practice listed on the survey (always = 3; often = 2; sometimes = 1; and never = 0). The total possible score was calculated and the level of IPM use determined. A score of 0-50% was considered a low level of IPM use, 51-75% a medium level, and 76-100% a high level. Growers were also asked to identify insect, disease, and production problems as well as any technology or research developments that they felt would benefit the industry.

Alabama tomato producers are concentrated in Blount and St. Clair counties in the North and in Geneva county in the South. Farm size in Alabama averages about 22 acres (see table).

Overall, Alabama producers ranked fifth in the region in IPM implementation with an average score of 57%. However, there is little indication that they are over-applying pesticides. Alabama's farmers make the fewest fungicide applications in the Southeast and use fewer insecticide applications than producers

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Summary of IPM Survey Results

State	No. growers	Avg. farm size, acres	Avg. score	Pct. medium and high IPM categories		Avg. no. applications		
				Growers	Acreage	Fungicide	Insecticide	Herbicide
Alabama	25	22.1	57.0	65	66	9.7	9.8	2
Georgia	15	69.5	68.0	100	50	14.6	13.2	1.5
Kentucky	29	6.8	65.8	93	99	10.2	7.2	2.1
North Carolina	35	13.3	54.3	66	94	11.6	7.7	1.7
North Florida	12	213.3	74.6	100	100	19.5	16.4	1.9
South Carolina	18	132.2	71.7	94	99	11.8	9.9	18.
Tennessee	21	20.6	53.5	67	63	—	—	—

in Georgia and North Florida. IPM does not necessarily result in lower pesticide use. In some cases growers may be under-managing pest problems and IPM will actually result in increased pesticide usage. On the other hand, many professionals use very conservative thresholds in their disease and insect scouting programs and this may result in relatively high levels of pesticide use.

The results of this survey show that in four of the seven southern states more than 75% of the tomato acreage is in the medium- or high-IPM category. These states have met or exceeded the state IPM teams' criteria for practicing IPM and have met the federal mandate of IPM on 75% of the fresh-market tomato cropland (see table). The other three states, including Alabama are well on their way to achieving the federal mandate.

In the process of creating this survey, the state IPM teams have outlined a clear definition of IPM in fresh-market tomato production. These survey results establish a baseline which can be used to measure the success of programs designed to increase IPM adoption. The survey also provided an opportunity for farmers throughout the region to identify pest problems of importance to them. It can be used to influence the Extension/research agenda in the universities in the Southeast.

Bauske is an Extension Associate of Horticulture, Zehnder is an Associate Professor of Entomology, Sikora is an Assistant Professor of Plant Pathology, and Kemble is an Assistant Professor of Horticulture.

COTTON RESPONDS TO POSTEMERGENCE HERBICIDES

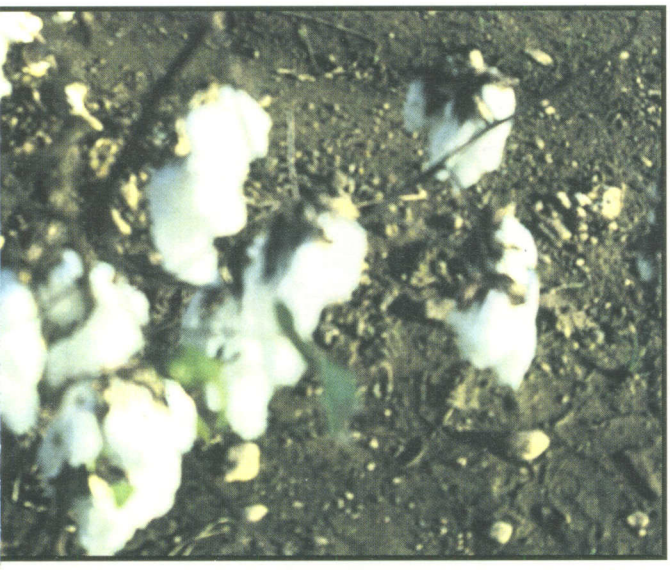
Dale Monks, Michael Patterson, Dennis Delaney, Don Moore, and Larry Wells

Staple, the trade name for a new cotton herbicide containing pyrithiobac, proved effective in over-the-top broadleaf weed control when combined with arsenical herbicides in AAES research at three sites statewide. Though the arsenical herbicides caused some yield loss and delayed maturity at some sites in some years, this was not significantly affected by the addition of Staple in a tank mix.

The organic arsenical herbicides MSMA and DSMA have been used for many years for controlling weeds in cotton. MSMA was registered for use by U.S. cotton producers in 1964 as a postemergence-directed treatment on cotton ranging from 7.6 cm tall to first bloom (one inch equals 2.6 cm). MSMA is labeled for postemergence salvage treatments in some states, such as Georgia, for postemergence control of broadleaf weeds, grasses, and nutsedge in cotton while DSMA is labeled for the same use in Alabama, due to lower crop injury. Staple, which was marketed for the first time in 1996, controls several broadleaf weeds without adversely affecting cotton growth and yield when applied postemergence. Favorable results in many studies suggest that total postemergence programs for cotton producers may be feasible in certain situations. The weed species that may limit the usefulness of Staple in the Southeast is sicklepod, due to lack of postemergence control. Since MSMA has been shown to increase the activity of some herbicides on many weeds, it may have potential for increasing sicklepod control when tank-mixed with Staple. However, tank-mixing herbicides from different chemical families can increase the potential for crop injury.

To evaluate the effect of Staple and MSMA or DSMA combinations on cotton growth and development, experiments were conducted in Prattville and Headland in 1994 and 1995.

Treatments included Staple, MSMA, and DSMA applied alone, and Staple tank-mixed with MSMA or DSMA and an untreated check for comparison. Herbicides were applied postemergence over-the-top of the crop



canopy prior to the pinhead square stage of cotton development with a conventional-type sprayer. The varieties planted in Headland were 'Suregrow 1001' and 'Delta and Pineland (DP) 90' in 1994 and 1995, respectively. The varieties planted in Prattville were 'DP 90' and 'DP 51' in 1994 and 1995, respectively.

Cotton response was evaluated two weeks after treatment using visual ratings where 0 = no effect and 100 = plant death. Maturity effects were determined prior to harvest by recording the number of total bolls from six meters of row (one meter equals 39 inches) and the number of open and closed bolls from two meters of row in each plot. The plots were chemically defoliated and the center two rows machine-harvested once after all mature bolls were open.

Cotton in 1994 at Prattville was injured by applications of MSMA and DSMA applied alone and tank-mixed with Staple. Although there was no difference in injury between MSMA and DSMA applied alone, DSMA tank-mixed with Staple gave less injury than MSMA tank-mixed with Staple. In 1995, MSMA applied alone or tank-mixed with Staple resulted in higher injury than all other treatments. Adding Staple to MSMA or DSMA did not increase injury over the two products applied alone, regardless of location and year.

Cotton in 1994 at Headland was injured by all treatments utilizing MSMA and DSMA (Table 1). Although DSMA is generally considered less injurious than MSMA when applied at similar rates, no differences were recorded. The addition of Staple to MSMA or DSMA did not increase cotton injury over each chemical applied alone. At the same location in 1995, no injury was recorded regardless of the treatment.

The total number of bolls was reduced by MSMA plus Staple compared to the untreated control in 1994 at Prattville. Adding Staple to MSMA and DSMA did not affect the number of total bolls over the same treatments applied alone. There were no differences in total bolls in 1995. In 1994, percent open bolls was reduced by MSMA and DSMA applied alone and MSMA tank-mixed with Staple when compared to the untreated control. No effect was measured in 1995. Staple tank-mixed with MSMA or DSMA did not delay maturity greater than the two arsenical herbicides applied alone. Seed cotton yield was not affected by Staple or DSMA applied alone or tank-mixed. MSMA applied alone and tank-mixed with Staple decreased cotton yield compared to the untreated control and Staple applied alone.

No treatment affected boll development either year in Headland (Table 2). The total number of bolls averaged 221 per six meters of row for each treatment. Cotton maturity was not affected by any treatment, with an average of 71% open. Seed cotton yield at Headland was not affected by any treatment with an average of 2,280 kilograms per hectare (multiply by .893 to determine pounds per acre).

Table 1. Effect of Staple, MSMA, and DSMA on otton Injury and Growth Two Weeks After Treatment

Treatment	Rate	Cotton injury			
		Prattville		Headland	
		1994	1995	1994	1995
	kg/ha[1]	pct.	pct.	pct.	pct.
Control	—	0	0	0	0
Staple	0.069	1	16	5	0
MSMA	1.12	44	28	24	0
DSMA	1.68	38	13	21	0
Staple + MSMA	0.069 + 1.12	50	29	18	0
Staple + DSMA	0.069 + 1.68	36	18	19	0

Table 2. Effect of Staple, MSMA, and DSMA on Cotton Maturity and Yield

Treatment	Rate	Prattville					Headland[1]		
		1994 total bolls	1994 open bolls	1995 total bolls	1995 open bolls	Seed cotton yield	Total bolls	Open bolls	Seed cotton yield
	kg/ha[2]	no./6m[3]	pct.	no./6m	pct.	kg/ha	no./6m	pct.	kg/ha
Control	–	218	58	147	92	1,930	206	69	2,160
Staple	0.069	205	53	145	85	1,960	224	69	2,500
MSMA	1.12	191	45	121	88	1,640	224	75	2,210
DSMA	1.68	198	41	142	91	1,810	249	72	2,280
Staple + MSMA	0.069 + 1.12	186	39	143	89	1,590	206	70	2,330
Staple + DSMA	0.069 +1.68	232	48	117	90	1,770	214	73	2,210

[1] Data were pooled over years due to absence of an interaction.
[2] To convert kg/ha into pounds per acre, multiply the yield by .893.
[3] One meter is equal to 39 inches.

Monks is an Assistant Professor, Patterson is a Professor, and Delaney is an Extension Resource Conservation Associate of Agronomy and Soils. Moore is Superintendent of Prattville Experiment Field and Wells is Superintendent of Wiregrass Substation.

Assistance Foresters in Nonindustrial Private Forest Management:

Alabama Landowners Perspectives

Daowei Zhang

An AAES study reveals that public and private assistance foresters play a particularly strong role in advising the state's nonindustrial private forest (NIPF) landowners, having assisted in about 50% of all NIPF management activities in Alabama over the past 10 years. NIPF landowners own about 72% of the forest land in Alabama, but many rely on assistance foresters' expertise and information to ensure efficient markets and sound forest management.

Assistance foresters include three groups of foresters: public foresters who work for county, state, or federal agencies and whose services are provided without charge; consulting foresters who run their own forestry consulting business and who charge a fee for services; and industry foresters who work for forest industry firms and provide services to NIPF landowners on behalf of the firms. Assistance foresters' services cover all aspects of forestry, including management plan preparation, timber harvesting, marketing, reforestation, timber stand improvement, and wildlife management. Assistance foresters influence not only the benefits obtained from timber sales and forest management for NIPF landowners, but also the long-term health and productivity of forest lands, which are important to the general public.

In spring 1996, AAES forestry researchers began a survey focusing on profiles and perceptions of assistance foresters' services, distribution and quality of services, and landowners activities and characteristics. A representative sample of 616 Alabama NIPF landowners were surveyed, with a response rate of approximately 43%.

During the last 10 years (see table), 65% of the landowners have cut timber from their lands. Sixty-four percent of them have sold timber, and 50% of them have planted trees. Only 15% of landowners have sprayed pine forests to control weeds, undesirable species, insects, or diseases. Twenty-two percent of the landowners have intentionally burned their forest for management purposes, and 27% have developed a forest management plan. Finally, 50% of the landowners have improved wildlife habitats on their lands, and 33% of them have performed other kinds of forest management such as site preparation, marking property boundaries, and establishing recreational facilities. These results indicate that NIPF landowners

are fairly active in managing their forests. Only 17% of the respondents have not conducted any management activities in the last 10 years.

Assistance foresters played a major role in helping landowners conduct these management activities (see table). Of the landowners who conducted these management activities, 57% have used assistance foresters in timber harvesting, 54% in timber marketing, 65% in tree planting, 77% in spraying, 75% in burning, 83% in preparing forest management plans, and 31% in improving wildlife habitats.

The roles of the three groups of foresters vary slightly in different activities. Consulting foresters have played the largest role in all management activities. Of the activities in which assistance foresters are involved, consulting foresters have participated in about 45-50% of all management activities (see table). However, public and industry foresters have made significant contribution as well. Since many NIPF landowners have not used assistance foresters, and some of them have not even heard of these services, it seems that there is room for each group to expand their services.

Figure 1 shows the distribution of services in all forest management activities among landowners with different sizes of forest lands. Public foresters provide more services to small landowners (less than 51 acres) than consulting and industry foresters. On the other hand, consulting and industry foresters provide more services to large landowners who own more than 500 acres.

Figure 2 shows the relationship between services provided and landowners income. Public foresters provide 37% of their services to landowners who have less than $50,000 annual income. continued on page 12

Forest Management Activities Conducted by NIPF Landowners in Alabama and the Involvement of Assistance Foresters: 1986-1995

	Total respondents[1]	Engaged in practice	Assistance foresters provided services			
			No.	Public	Consulting	Industry
	no.	*no.*	*no.*	*pct.*	*pct.*	*pct.*
Timber harvesting	267	172	98	25.2	47.8	27.0
Timber marketing	262	168	90	18.3	53.8	28.0
Tree Planting	266	133	86	35.1	41.5	23.4
Spraying	257	38	29	26.5	50.0	23.5
Burning	261	58	44	36.4	50.0	13.6
Management plan development	161	72	60	29.2	47.7	23.1
Wildlife habitat improvement	260	131	41	41.7	41.7	17.6

[1]A total of 271 questionnaires were returned. If a respondent did not answer a given question, his or her response was not counted in the numbers presented in this table. For example, 267 respondents answered "yes" or "no" to the question concerning timber harvesting; four respondents left this question blank and thus were not counted in the analysis of timber harvest activity.

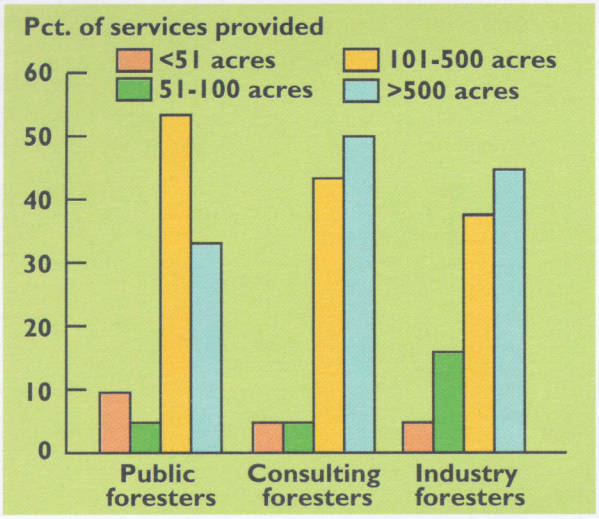


Figure 1. Distribution of services provided by assistance foresters in all forest management activities among landowners with different size of forest lands.

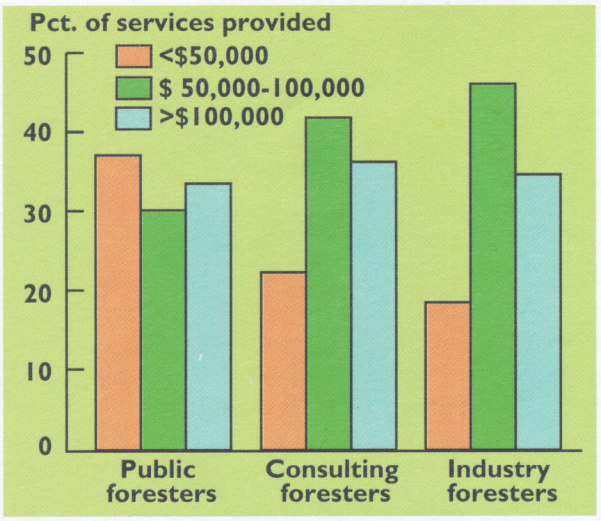


Figure 2. Relationship between services provided and landowners' income.

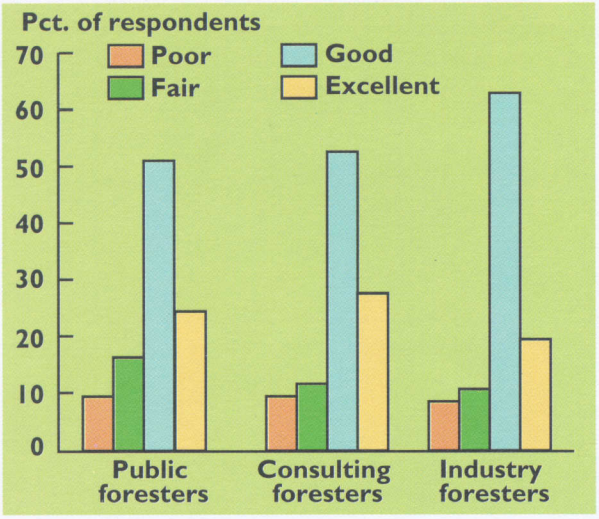


Figure 3. The overall rating of assistance foresters' services by NIPF landowners.

Consulting foresters and industry foresters provide 22% and 19% of their services, respectively, to this group of landowners. Industry and consulting foresters provide more of their services to landowners who have annual incomes of $50,001 to $100,000. The percentage of services provided to landowners who have incomes more than $100,000 is roughly equal among the three groups of assistance foresters.

These results suggest that public foresters provide more of their services to landowners who have smaller acreage and lower incomes. While industry assistance is often free, economies of scale might also make industry foresters focus on medium and large landowners. Consulting foresters assist large and wealthy landowners more than public and industry foresters.

In order to reveal the perceptions and reactions of NIPF landowners to the services provided by assistance foresters, respondents were asked to rate each of the services they received from each group of foresters into four categories: poor, fair, good, and excellent. Figure 3 shows the results for the overall ratings of each group of foresters in all management activities. Generally speaking, landowners have a favorable impression of all three groups: excellent and good appear in more than 75% in the overall rating for every group. Though not reported here, detailed ratings in individual management activities show similar results.

Landowners were asked to indicate from whom (or what) they heard about the particular assistance forester they initially contacted and requested services. Thirty-seven percent of them heard about the particular foresters from another landowner, and 18% from a friend other than a landowner. Telephone directories, landowner conferences, and advertisements in magazines, newsletters, or newspapers account for another 15%. The other sources were other foresters, lawyers, and federal, state, and county agents. These results suggest that reputation and networking are important in order for assistance foresters to find and retain clients and to expand their clientele.

Landowners were asked to give their opinions on two questions related to public forester assistance. When asked whether the number of public foresters should be increased, decreased, or stay roughly the same, 33% of the respondents replied stay roughly the same, 42% have no opinion, and 21% indicated they should be increased. Only 5% indicated that public foresters should be decreased. Since services from Alabama's public foresters are free, the respondents were asked how much they might be willing to pay if public foresters charged for their services. Fifty percent said they would pay nothing. Another 45% were willing to pay $20-$100 for a day. Only 4% of the respondents would be willing to pay more than $100 a day.

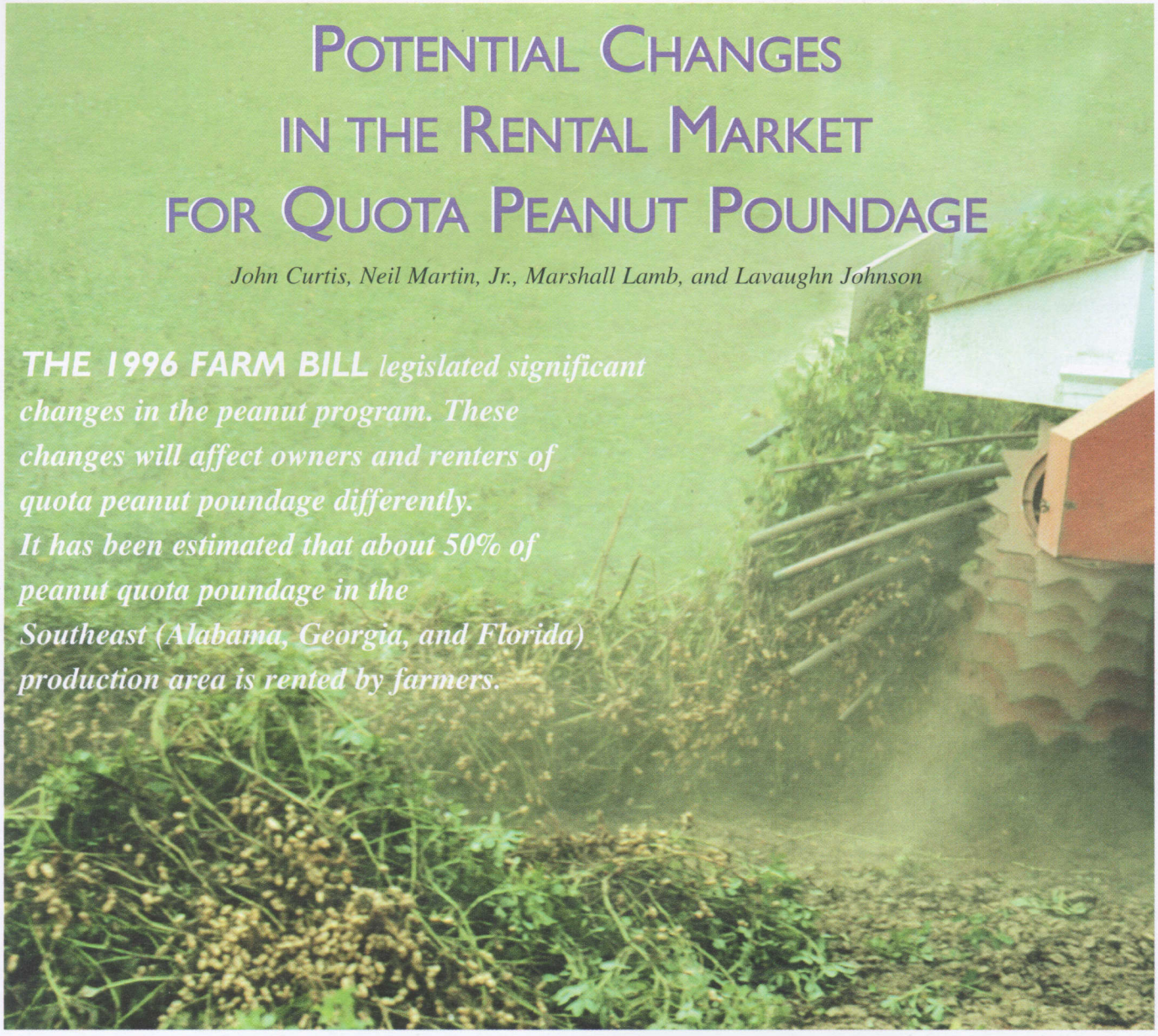
These results indicate that NIPF landowners do not support a decrease in the number of public foresters in Alabama. Their responses on the question of willingness-to-pay are divided, with roughly half in favor of paying and half against. Several landowners commented that they should not pay for services provided by public foresters because they have already paid tax. Others mentioned that they would want to know what services public foresters provided to them before offering any payment. Still others commented that landowners should pay for services provided by public foresters.

Zhang is an Assistant Professor of Forestry.
The author wishes to thank Sarah Warren and Conner Bailey for their help.

peanut

Potential Changes in the Rental Market for Quota Peanut Poundage

John Curtis, Neil Martin, Jr., Marshall Lamb, and Lavaughn Johnson



***THE 1996 FARM BILL** legislated significant changes in the peanut program. These changes will affect owners and renters of quota peanut poundage differently. It has been estimated that about 50% of peanut quota poundage in the Southeast (Alabama, Georgia, and Florida) production area is rented by farmers.*

By lowering the fixed quota support price to $610 per ton and reducing the national quota level (total tonnage of peanuts guaranteed at $610 per ton) for the seven-year life of the new Farm Bill, 1996-2002, instability was created in the quota rental market. Producers believe that quota rent should be lower because the price of peanuts is lower. However, quota owners feel the price should remain at current levels because there is less quota available for rent, hence less supply of quota.

In the first year of the new Farm Bill, 1996, quota rent prices slightly increased as a whole. One explanation might be that farmers felt that they must replace reduced quota that they lost as part of the Farm Bill and/or produce even more quota peanuts since they were to receive a lower price per pound. This likely sustained the recent price levels of quota rent.

In order to determine what might happen over the next few years, a study was conducted to determine at what level quota prices would need to go before quota renters would be better off growing alternative crops, such as cotton or corn and at what price owners would be better off to rent-out their quotas rather than grow quota peanuts themselves. It was hypothesized that renters will not be able to continue to pay past quota rental prices with the reduction in the quota support price, but that a quota rental market will exist as long as renters can pay more for quota than owners would require to use the quota themselves. continued on page 14

A representative farm was modeled over a five-year period for five situations. One situation was to grow no quota peanuts. The remaining four situations included peanut production at different quota rental prices.

A parallel set of situations was also analyzed for quota owners. Prices used in this analysis were $610 per ton for quota peanuts, $315 per ton for additional peanuts, and two price levels for alternative crops. Low and high alternative crop prices were $2.53 and $3.25 per bushel for corn and $.64 and $.75 per pound for cotton, respectively.

The economic potential of each renter and owner situation was measured as the average annual income over five years. This provided a numerical value for each situation which could then be used to determine break-even quota rental levels for various renter and owner situations. Fifty iterations of the model were run for each situation. Data for all situations were created at the same time with the same states of nature. For example, if a peanut crop failure happened in any particular analytical year, renters at all rental rates and owners were affected alike.

The farm that was used as a base for this model consisted of 500 acres of non-irrigated farm land. For the RENTER model all crop land was rented at $20 per acre. In the OWNER model, all land was considered to be owned. In the models run, the income ranged from about $86,000 to $140,000. Owners typically made 10-15% more than renters, and new crop prices (higher) generally returned 30-50% more income than old (lower) crop prices.

Results are presented in Tables 1 and 2. For RENTER 1 (low competing crop prices), the farmer would receive an equivalent annual net income stream of $87,809 over five years when he paid $.08 per pound for quota, and $89,720 when he paid $.06 per pound. If, however, he had grown no quota peanuts and only the alternative crops, his annual net income would have been $88,814. Thus, the farmer could afford to pay only up to about $.07 per pound for quota pounds.

RENTER 2 (high competing crop prices) makes more net income when planting alternative crops than when renting quota at even the $.04 per pound level. However, about equal net income was obtained even at $.10 per pound quota rent, but only four acres of quota peanuts were planted. This is not an economically feasible size for peanut production. Therefore, he should really not grow peanuts unless he can pay as little as $.04 or less for quota pounds because only then would he plant enough acres to make it economically viable.

The OWNER 1 model was set up the same way as the RENTER 1 model with low competing crop prices except that this farmer owned rather than rented quota pounds. The results from Owner 1 showed that as long as the farmer could rent out his quota pounds for $.05 per pound, he would be better off to rent them out and to grow other crops on his farm. This does not, however, take into effect the fixed cost of peanut specialized machinery which might raise this price by a cent or two.

OWNER 2 was modeled with higher competing new crop prices (same as RENTER 2). In this situation, the owner would be just as well off to rent his quota out at $.01 per pound than to grow peanuts.

The results from this study indicate that provisions in the 1996 Farm Bill will cause quota rental prices to decrease from the commonly seen $.10 per pound level under the past Farm Bill. The break-even rental price for quota was $.07 per pound when competing crop prices were relatively low, and $.04 per pound when competing crop prices were relatively high. The rental price was also found where a quota owner would be better off to rent out his quota than to grow it. The price an owner would need to receive to rent out his quota would be $.05 per pound for low competing crop prices, and $.01 per pound for high competing crop prices. Since this analysis indicates that renters will be willing to pay more for quota than owners will require, there should still be a healthy market for quota poundage over the life of the 1996 Farm Bill.

Table 1. Average of Annual Net Returns from Fifty Observations (Runs) of the Five Year RENTER Model for Five Quota Rent Scenarios and Two Price Levels

Item	RENTER 1[1]	RENTER 2[2]
Did not allow quota peanuts	$88,814	$127,327
$.10/lb. quota rent	86,308	127,513
$.08/lb. quota rent	87,809	123,666
$.06/lb. quota rent	89,720	123,921
$.04/lb. quota rent	93,739	126,669

[1] Old crop prices (corn $2.53 per bushel and cotton $.64 per pound).
[2] New crop prices (corn $3.25 per bushel and cotton $.72 per pound).

Table 2. Average of Annual Net Returns from Fifty Observations (Runs) of the Five Year OWNER Model for Two Quota Scenarios and Two Price Levels

Item	OWNER 1[1]	OWNER 2[2]
Did not allow quota peanuts	$97,838	$136,947
Did allow quota peanuts	109,845	140,388

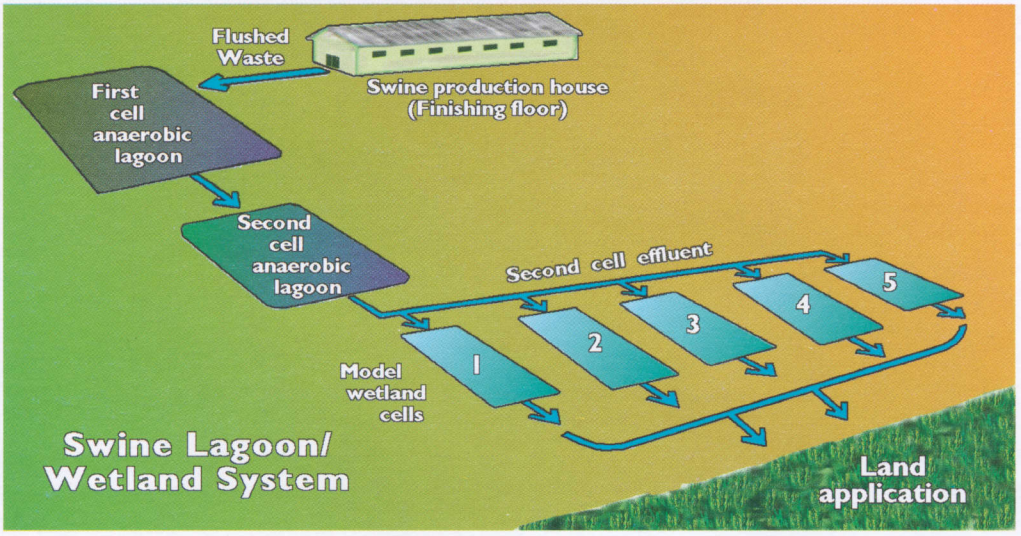
[1] Old crop prices (corn $2.53 per bushel and cotton $.64 per pound).
[2] New crop prices (corn $3.25 per bushel and cotton $.72 per pound).

Curtis is a Graduate Research Assistant, Martin is a Professor, Lamb is a Research Fellow, and Johnson is a Professor and Head of Agricultural Economics and Rural Sociology.

waste

Common Reed Top Aquatic Plant in Waste Management Wetlands

D.T. Hill and John Rogers



USING PLANTS to absorb the over-supply of nutrients produced by animal waste is not a new concept, but determining which plants provide optimum uptake is an ongoing challenge for Alabama livestock producers. Auburn researchers recently determined that plants in the Phragmites species, including common reeds, provide excellent uptake of nutrients and subsequently produce high levels of biomass.

Constructed wetlands are being studied in Alabama and nationally as a pre-treatment for many kinds of agricultural waste, including livestock lagoon effluent, prior to its application to pastures and cropland. Not final disposal sites, these units are treatment processes which offer a method of reducing the nutrients in waste and providing for reuse of the nutrients.

Constructed wetlands are new to agricultural operations, being seriously considered as an alternative treatment process since the late 1980s. Hence, a study was conducted at the Swine Nutrition Unit on the Auburn campus to provide much needed data and knowledge to help Alabama producers make intelligent management decisions as to the potential and practicality of applying these filtered nutrients to common agricultural practices.

In this study, the effluent from the second cell of a two-cell anaerobic lagoon system (see figure) was used to treat waste from a swine house. This effluent was used as the input to five model wetland ponds, each with a monoculture of five different plant species, including *Sagittari latifolia*, arrowhead; *Phragmites australis*, common reed; *Scirpus acutus*, bulrush; *Typha latifolia*, cattail; and *Juncus roemerianus*, common rush. All of these plants are commonly found in wetlands.

Each model wetland pond was in the same environmental condition and provided the same influent from the second cell of the anaerobic lagoon for three months. The ponds were operated using a 12-day liquid detention time. During this period, three replications were made by harvesting the plants and measuring the dry biomass produced.

The nitrogen content of all five wetland plant species during this study was essentially the same, which demonstrates that nutrient uptake by the different species was approximately identical for the same plant mass. This means that the species which provides the greatest dry matter production will also provide the greatest nutrient removal when harvested. This is because nitrogen removal is proportional to dry matter production regardless of species.

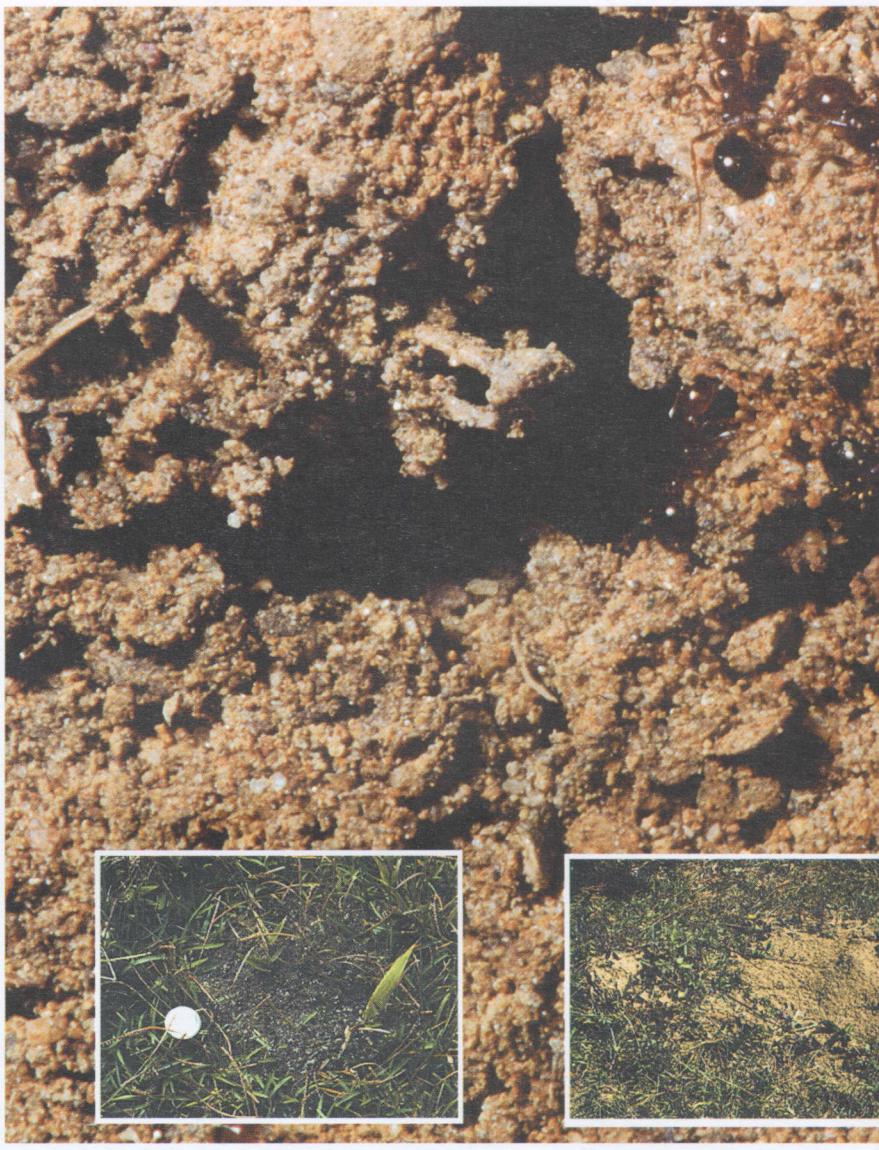
The species ranking in dry matter production was: common reed, 20.4 grams per square meter per day; cattail and bulrush, 9.0; arrowhead, 7.5; and common rush, 0.9. From a management and environmental standpoint, common reed was by far the preferred species. Cattail, bulrush, and arrowhead were essentially the same, but less than half as productive as common reed, and common rush was the least competitive. This information is useful in selecting the best wetlands plant species for management of nutrients and environmental pollution abatement for agricultural operations that choose to use constructed wetlands for livestock production waste management.

Hill is a Professor and Rogers is a former Research Assistant in Agricultural Engineering

fireants

INDIVIDUAL MOUND TREATMENT FOR CONTROL OF RED IMPORTED FIRE ANTS

James Vogt and Art Appel



(Left inset) Young colonies may escape detection by the homeowner (quarter included for mound on the left (now beginning to erode and collapse), and constructed a new mound. areas of bare soil on lawns.

When fire ants colonize your yard, getting rid of these painful pests as quickly and effectively as possible is a top priority. AAES researchers conducted a study recently to evaluate the effectiveness of several registered fire ant pesticides that are available to homeowners and can be used with no special training in pest control.

The red imported fire ant arrived in the U.S. in the 1930s, without any associated natural enemies, and has since spread to infest an area from coastal North Carolina south to Florida and west to central Texas. In the urban environment, fire ants can cause several problems. Mound-building activity in or beside central heating units and other electronic equipment can be destructive to the equipment itself, and is at the very least a nuisance. Mounds can also damage mowing equipment. Ants sometimes enter homes and carry soil indoors. Occasionally fire ants nest in potted plants. In yards, pet food can become infested with foraging worker ants. The primary concern facing homeowners is the danger of multiple stings and the possible accompanying reactions. Reactions can range from localized swelling and edema to severe cases in which respiratory distress may occur.

Homeowners must address several questions when deciding on a control strategy. Is immediate kill necessary, or is a slower-acting pesticide acceptable? Is it necessary to minimize risk of accidental exposure to pesticides, in cases where children or pets are present? What is the accept-

e). (Center inset) This colony has abandoned the nset) As colonies relocate they can leave unsightly

able cost of control? These and other factors will direct the homeowner to the most appropriate control measure for their home.

Researchers tested six fire ant control products, each representative of common pesticide formulations and/or methods of application (see table for list of products). All products were applied to individual fire ant mounds according to label instructions. Mounds were marked with surveying flags in three locations (two in Lee County and one in Macon County), and a total of eight mounds were treated with each product. Mound activity was estimated by scratching the surface of each mound with a small stick and estimating the number of ants on the top of each mound 30 seconds after scratching. Mound activity was estimated one day before treatment applications and one, seven, 14, and 30 days after treatment. Results of the test are summarized in the figure.

It should be noted that the bait formulations tested — Ortho Fire Ant Bait, Combat Outdoor Ant Killing Granules, and Amdro Insecticide Bait — may require four to six weeks to work. These products have proven highly effective in other studies, but it takes more time for them to be distributed to all ants in a colony, particularly the queen. Also, these bait formulations can be applied as broadcast treatments to control fire ants over large areas. However, this test was designed to demonstrate products that provide prompt fire ant control in relatively small yards.

Two products — Hyponex Fire Ant Control and Spectracide Fire Ant Killer Granules — provided complete colony control within 24 hours of application. The active ingredients in both products are considered to be hard insecticides, which are effective against numerous insect species. Both products were watered into mounds according to label instructions, increasing the effort necessary for application.

Care must be taken during application to disturb the mound as little as possible, to avoid causing colony movement. Colony relocation is a natural process, but can be induced by disturbance to the mound. Colonies moved during the test regardless of treatment, with the exception of Hyponex and Spectracide. However, no conclusions about colony movement can be drawn from this study. The two treatments with the highest incidence of colony movement (seven total movements) were the untreated controls and Ortho Ant-Stop Fire Ant Killer. Ortho Ant-Stop, a non-bait product, provided rapid kill of some colonies, but other colonies moved and built new mounds nearby. Generally, when an old mound is found vacant and a new mound is seen within several feet, it is safe to

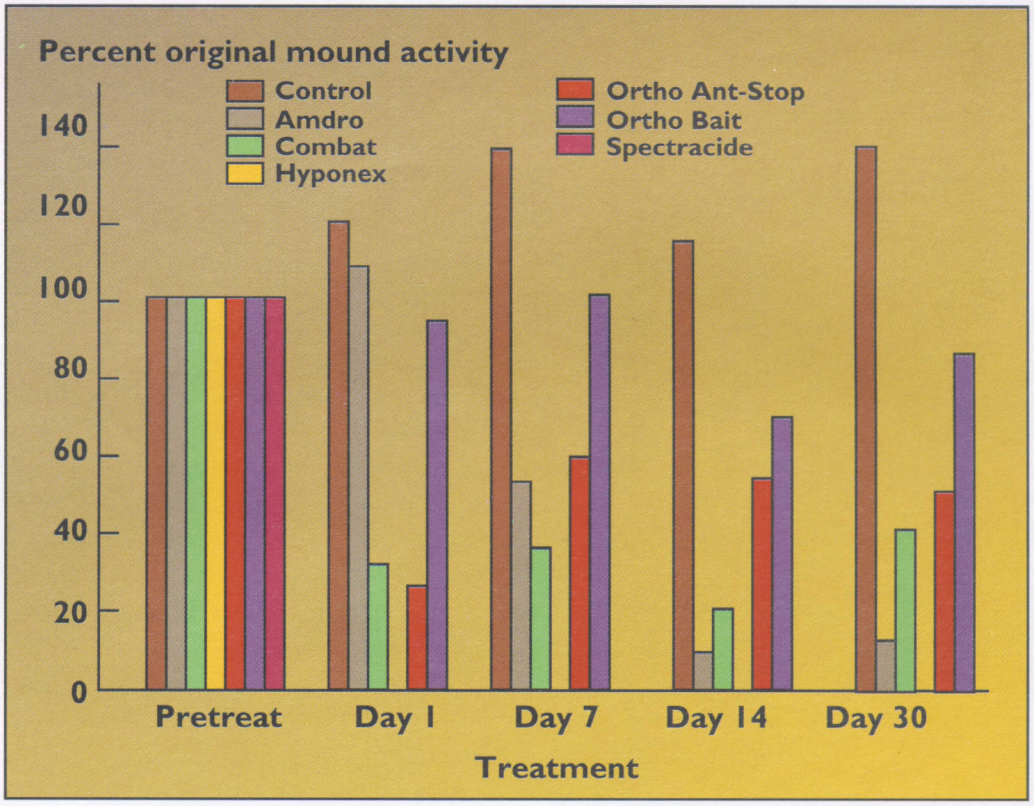
continued on page 18

Description and Cost Analysis for Insecticides Available for Use Against Red Imported Fire Ants

Product	Active ingredient	Size purchased	Cost	Application rate	No. mounds treated	Approximate cost per mound
Amdro	Hydramethylnon (0.73%)	1 lb.	$8.93	5 tbsp.	17	$0.53
Combat	Hydramethylnon (1%)	11.2 oz.	7.37	1 oz	11	0.67
Hyponex	Chlorpyrifos	4 lb.	3.96	1/2 cup	27	0.15
Ortho Ant-Stop	Acephate (75%)	8 oz.	7.97	2 tsp.	54	0.15
Ortho	Fenoxycarb (1%)	10 oz.	9.97	1 tbsp.	20	0.50
Spectracide	Diazinon (5%)	3.5 lb.	4.98	1/2 cup	22	0.23

assume that this is a sign of colony movement.

The bait formulations Amdro and Combat provided reasonable levels of control by day 14 (90% and 80% reduction in mound activity, respectively). However, Ortho Fire Ant Bait did not provide good control during the test. The active ingredient in this bait is a slow-acting insect growth regulator (IGR) that disrupts the reproductive cycle of the queen. Fire ant workers can live for several months, so an IGR bait is not suitable if very rapid control is required.



Decline of red imported fire ant colonies, expressed as percent of original (pre-treatment) mound activity. Numbers larger than 100% indicate an increase in mound activity while numbers less than 100% indicate a decrease in mound activity.

Baits do have advantages, primarily due to effectiveness against small, inconspicuous colonies not large enough for the homeowner to detect. Also, they generally require less effort for application and can be used over large areas. One control strategy often used is the broadcast application of a slow-acting bait, followed approximately one month later by individual mound treatments. This takes advantage of the baits effectiveness against less conspicuous colonies, while insuring elimination of larger colonies. It is very important when applying baits to be certain that weather conditions conform to suggestions on the label, since baits rely on foraging ants for their introduction into the colony.

Cost analysis for all treatments is presented in Table 1. Results of this study indicate that the cheapest, most effective means of controlling individual fire ant colonies is application of Hyponex Fire Ant Killer, at approximately 15 cents per mound. The most expensive product tested was Combat Outdoor Ant Killing Granules, at 67 cents per mound. In addition to this information, homeowners must consider the time and effort required for application and the required speed of control when deciding on a product to use. For example, Hyponex requires transportation of water to treated mounds, whereas Combat is fitted with an automatic dose-measuring device and requires no water.

Results of this study are not meant to be an endorsement of any of the products tested, but as an aid to the homeowner in addressing the above questions. In addition, the products tested do not represent all available treatment options. A more inclusive list of available products can be found in the Agriculture and Natural Resources Timely Information Sheet number T-13, *How to Treat for Fire Ants In and Around Homes*, which is available at local county Extension offices. Additional information also can be found in the 1996 Pesticide Handbook.

Regardless of the means homeowners use to combat fire ants, it appears that fire ants are here to stay, and re-application will be necessary to control them. Colonies are capable of remarkable feats of movement from place to place (they can move several feet overnight), so in neighborhoods where residents wish to reduce fire ant populations it is desirable to communicate with neighbors and coordinate control efforts. Remember that once a colony is destroyed, neighboring colonies may move in to claim the area once occupied by the dead colony. It is evident, however, that with some effort and dedication, the homeowner can maintain a lawn that is relatively free of fire ants.

Vogt is a Graduate Research Assistant and Appel is an Associate Professor of Entomology.

pollinators

Squash and Pumpkin Pollinators Plentiful in Alabama

T'ai Roulston, Blair Sampson, and James Cane

NATIONAL PUBLICITY about honey bee declines has led to worries of inadequate pollination, although diverse crops may be enjoying adequate pollination provided by native, unmanaged bees. AAES researchers found plentiful pollinator activity on Alabama summer squash and pumpkins, despite the frequent absence of honey bees. The most important pollinators were squash bees on mid-season plantings of squash and bumble bees on pumpkins and late plantings of squash.

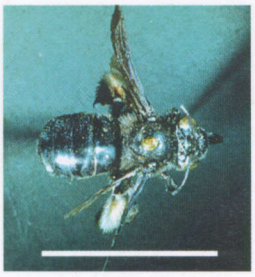
Honey bees were brought to America aboard the ships of early European colonists for honey and wax production. They now range across most of the country due to the activities of bee keepers and the proliferation of feral colonies. Because honey bees are prolific, relatively easy to manage, and good pollinators of many crops, they have been extensively adapted for crop pollination. Recently, however, parasitism by varroa mites has greatly reduced feral populations of honey bees and killed the hives of many bee keepers. This has led to concern that crops would receive inadequate pollination. But North America is home to thousands of native bee species, many of which are important pollinators of wild and cultivated plants, such as squash, pumpkins, and gourds

Honey bee (scale line = 1/2" in all photos)

AAES researchers conducted a census of honey bees and native bees visiting flowers at six squash and three pumpkin fields in East-Central Alabama. Most common visitors could be identified in flight. Three hundred flowers were surveyed at each pumpkin field, and 40-300 flowers at each squash field. At small plantings, most open flowers were examined. At larger plantings, rows of plants in full bloom were chosen and every flower in the row was checked until reaching a total of 300 flowers. The types of summer squash surveyed were zucchini, yellow straight-neck, and yellow crook-neck (both early and late plantings). The pumpkin varieties were Staff, Big Max, Spooktacular, and Spirit.

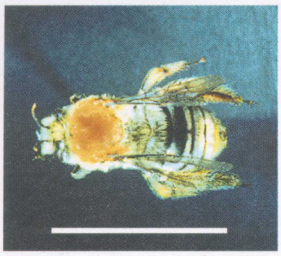
While it might seem that crops as different as zucchini and pumpkin should have different pollinators, all squash and pumpkins have similar flowers and many are considered to be the same species. Since ornamental gourds are closely related, these results may also apply to their cultivation in Alabama. Findings from the census are sufficient to describe bee activity in Central Alabama, and they likely reflect pollinator populations throughout the state.

The primary pumpkin pollinators were bumble bees. In August, bumble bees were abundant at all three pumpkin fields in the census — an average of nine bees per 100 flowers. They accounted for over 50% of total bee visitors. The remaining pollinators included honey bees, sweat bees, leaf-cutting bees, and squash bees. Two of the pumpkin fields had hives of honey bees nearby. In one of these fields, honey bees were found in similar abundance to bumble bees, but at the other field, none were found on pumpkin flowers. Bumble bees were also the predominant visitors at two late-season plantings of summer squash blooming at this time.



Melissodes bimaculata

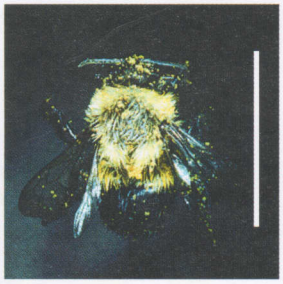
The main pollinators of early plantings of summer squash, those flowering in June, were squash bees. Native squash bees predominated at all five squash fields — continued on page 20



Peponapis (squash bee)

one bee for every two to seven flowers — and accounted for 91% of total visitors. They are clearly the primary pollinators of small acreages of squash in East-Central Alabama, as they are in many other parts of the country.

Squash bees (the genera *Peponapis* and *Xenoglossa*) are native to the Americas, occurring from Argentina north through much of the United States. Unlike honey bees, squash bees do not live in social colonies. Each female digs her own vertical tunnel in the ground, usually near the host plants, and spends the morning gathering nectar and pollen to feed her offspring. A squash bee's foraging activity is highly synchronized with the host plants' bloom: the bee emerges from her burrow near dawn as the flowers open, quickly gathers pollen and nectar, and ceases foraging by late morning when the flowers close. Males, in contrast, patrol host flowers all morning looking for unmated females, then crawl into a wilting flower to pass the afternoon and night. Where squash bees are present, males (which cannot sting) can be found by opening wilted squash flowers in the afternoon. In addition to being effective pollinators, squash bees, if present, will always visit squash, unlike bumble bees and honey bees which may find better rewards at other flowering species. Where squash, pumpkins, or gourds are not planted every year, squash bee populations cannot build up, and other bees will be necessary for pollination.



A bumble bee

Generally, growers need to tend to their pollinators only when there are indications of insufficient pollination, such as poor fruit set, early fruit abscission, and small, or misshapen fruits. Most insecticides are directly toxic to bees, or will kill them if taken up in nectar or pollen. However, insecticides may be used with care. Since squash and pumpkin flowers open only once and wilt a few hours later, usually by noon, bees are primarily at risk from insecticides in the morning hours.

One market grower whose field was part of the AAES census reported spraying his 400 yellow summer squash plants weekly with either carbaryl or Malathion, but only at dusk. His crop enjoyed good pollination by a burgeoning population of squash bees (one bee in every six flowers). He brought nearly 4,000 pounds of summer squash to market.

A type of sweat bee

Overall, plentiful pollinator activity was found on Alabama summer squash and pumpkins. Crop management practices that consider the life cycles and daily activity patterns of native pollinators will often ensure adequate squash and pumpkin pollination with wild bees and minimize the circumstances for which growers will need to hire honey bees.

Roulston and Sampson are Graduate Research Assistants and Cane is an Associate Professor in Entomology. Debbie Folkerts, an Assistant Professor of Botany and Microbiology, produced the bee photographs used in this article.

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