



# HIGHLIGHTS

OF AGRICULTURAL RESEARCH

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Alabama Agricultural Experiment Station Lowell T. Frobish, Director  
Auburn University Auburn University, Alabama



## DIRECTOR'S COMMENTS

**O**n April 27, 1990, a plaque was placed at the Black Belt Substation to mark the site where the cause of fescue toxicity was discovered. Most Alabama cattle producers are aware that cattle grazing fescue pasture infected with the fungus endophyte, *Acremonium coenophialum*, often develop a chronic unthrifty condition, known as fescue toxicity, fescue toxicosis, summer slump, or summer syndrome.

AAES scientists were the first to document marked differences in the appearance and gains of steers grazing paddocks of fungus-infected and fungus-free fescue. It is still amazing what this research demonstrated—an 82% increase in average daily gain and a 42% increase in gain per acre on fungus-free paddocks. From this research came the general rule of thumb—for each 10% increase in endophyte level, there can be a reduction of 0.1 lb. in average daily gain of growing beef animals.

What is the significance of this research? For the first time, the agent causing poor performance on this important cool season grass was identified. This breakthrough led to development of a fescue that was devoid of the fungus, and to fescue management methods that could improve beef cattle production and give Alabama the potential to become a leading cattle-producing state. In addition, the research demonstrated the importance of perceptive observation, persistence, and good experimentation.

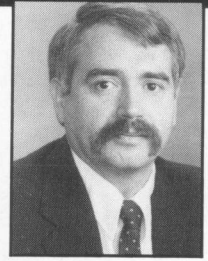
Among the most significant impacts of the research, however, was the team effort that emerged. Scientists from many disciplines came together to apply their expertise to a particular effort without concern about who received credit or who was in charge. No one dictated the team members or how to approach the problem. Although many of the original team members have retired or departed to new positions, new scientists have become involved in the team. (Some of both groups are shown in the above photograph.) Today's team is investigating the establishment of fungus-free pastures and how to manage them, and seeking answers to such questions as what does the fungus give to grass plants to protect them from their environment?

The plaque at the Black Belt Substation commemorating the discovery of the fungus responsible for fescue toxicity is really dedicated to the team of scientists, past and present, for their diligent effort, and to the cattlemen, seed dealers, and others who cooperated.

Lowell T. Frobish  
Director, AAES

## MAY WE INTRODUCE

Dr. John Hough, Assistant Professor of Animal and Dairy Sciences. A native of Iowa, Hough earned his B.S. degree in animal science at Iowa State University and M.S. and Ph.D. degrees in animal breeding at the University of Georgia. He came to Auburn after completing his doctoral studies.



Before beginning graduate school, Hough served as managing partner for Circle G Angus Farm in Georgia and was a show and sale cattle manager in Texas and Nebraska. Since arriving at Auburn, Hough has concentrated on animal breeding and genetics research with beef cattle. His work has included research on sire and dam selection techniques, predicting genetic performance of beef animals, and use of ultrasound imaging to evaluate live animals. Hough's report on the use of growth implants in fast and slow growing cattle is featured on page 12.



**ON THE COVER.** Finnish harvester and forwarder showed value in Alabama tests. See story on page 15.

### SUMMER 1990 VOL. 37, NO. 2

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# WEED CONTROL INCREASES PINE SEEDLING GROWTH

**U**SE OF HERBICIDES to reduce populations of herbaceous weeds increases survival and early growth of loblolly seedlings planted in old fields or pastures. This is due, at least in part, to decreased competition between weeds and pine seedlings for moisture, which is a growth-limiting factor for young pines.

Though the need to reduce woody competition when establishing pine plantations is well documented, the adverse effects of herbaceous weeds, including grasses, on young pines is less well known and generally has been ignored in pine plantation establishment. Recent Alabama Agricultural Experiment Station research indicates that nonwoody weeds can have a significant impact on the early growth of planted pines. One of these studies examined relationships among rates of herbicide application, resulting levels of herbaceous competition, soil moisture and nutrient levels, and pine seedling survival and growth during the first 2 years after planting.

An old abandoned pasture, located north of Auburn, was selected for study. The site had more than 90% grass and herbaceous cover and scattered colonies of blackberries. The soil is a Pacolet sandy loam. In March 1987, 48 plots of 1-year-old loblolly pine seedlings were planted at 8-ft. X 8-ft. spacings. Soil moisture and nutrient measurements were taken at regular intervals. Oust® herbicide (75% sulfometuron methyl, as dispersible granules in water) was broadcast in May at treatment rates of 0 (control), 1 oz., 2 oz., 4 oz., and 8 oz. of product per acre.

The percent of ground space covered by live herbaceous plants was measured in August of the first year. Survival and growth of the pine seedlings were monitored through the first two growing seasons following planting.

The application of at least 2 oz. per acre of Oust decreased herbaceous cover

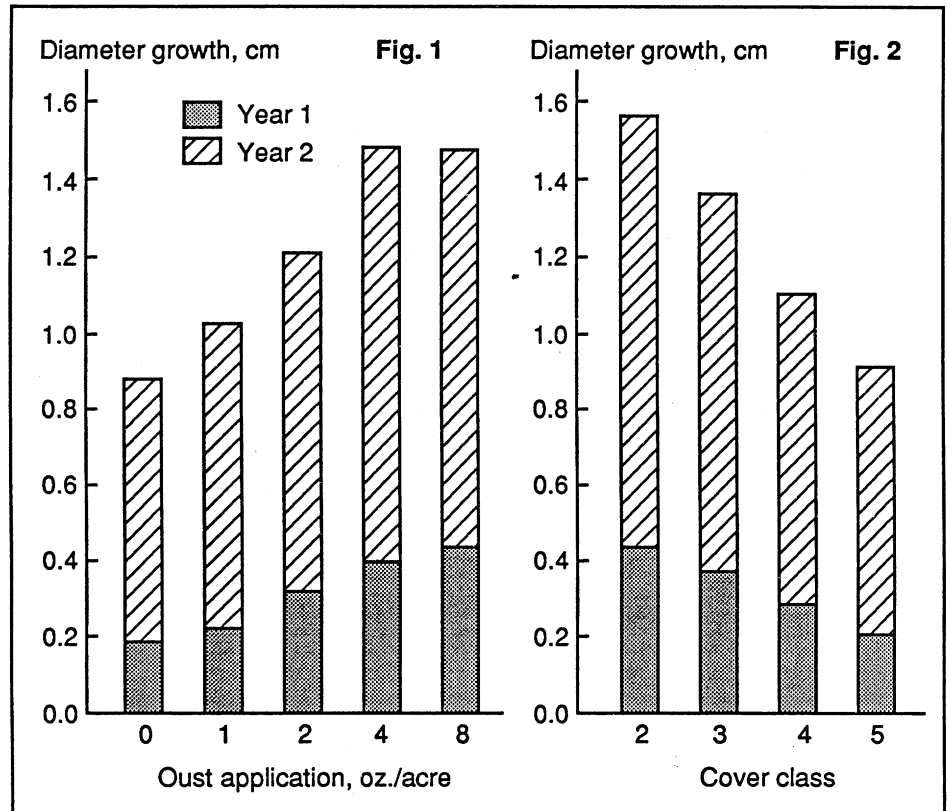


FIG. 1. Two-year ground line diameter growth of loblolly pine seedlings at five OUST herbicide application rates. FIG. 2. Two-year ground line diameter growth of loblolly pine seedlings at four levels of herbaceous competition (cover class 2 = 5-25% live cover, 3 = 26-50%, 4 = 51-75%, 5 = 76-100% live cover of non-woody vegetation).

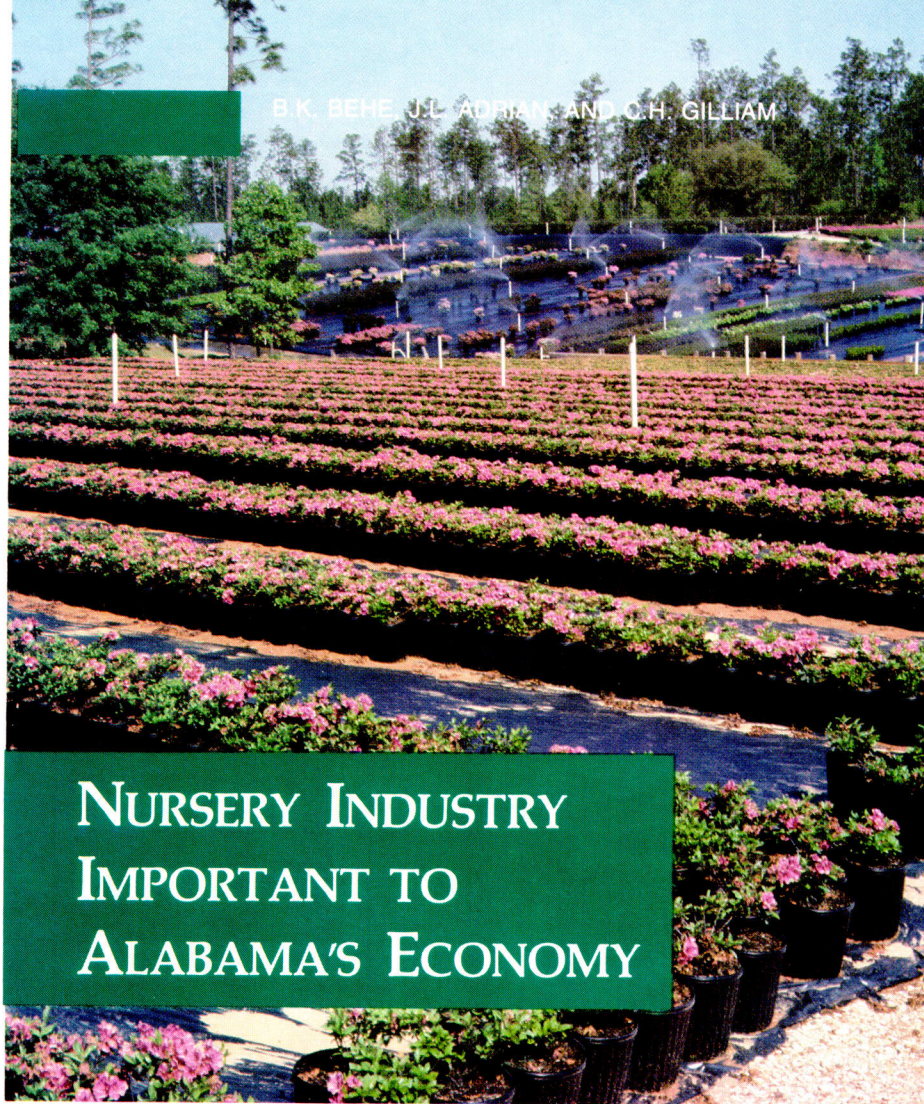
during the first year and increased pine seedling survival, height growth, and diameter growth through two growing seasons. The 4-oz. rate appeared optimum, since there was no significant increase in beneficial effects when 8 oz. were applied, figure 1. The average remaining live cover at the highest rate was 29%, indicating that another herbicide or a combination of herbicides could be used to more thoroughly reduce competition.

There was a negative relationship between the amount of live competing plant cover and 2-year survival and both height and diameter growth of pine seedlings. The greater the cover of weeds, the lower the survival and growth of pine seedlings. The relationship was strongest with diameter, which is clearly illustrated when the plots are grouped

by competing vegetation cover classes, figure 2.

The amount of live weed cover was negatively related to soil moisture. Higher soil moisture levels were found in the plots with lower vegetative cover, particularly during low-rainfall periods of growing season. The differences were typically not large, but may have been sufficient to affect growth. Two-year seedling survival and diameter growth also were correlated with soil moisture levels, but generally only during specific growing season periods. Moisture utilization by the pines themselves probably diluted these relationships. No clear relationships could be detected between soil nutrient levels and either vegetative cover or pine growth.

Golden is Associate Professor of Forestry.



## NURSERY INDUSTRY IMPORTANT TO ALABAMA'S ECONOMY

**P**RODUCTION of ornamental plants is a major agricultural industry in Alabama. In fact, nursery crops as a group bring in more cash receipts than either peanuts, cotton, or soybeans in the State. Furthermore, these nursery crops form the foundation for such businesses as landscape contracting and design, garden centers and other retail outlets, and installation and maintenance of recreational facilities, thereby contributing to other economic activity.

Size and scope of Alabama's nursery industry were learned in an Alabama Agricultural Experiment Station survey of nursery operations as part of a national study. Of Alabama's 250 nurseries, 29 were randomly chosen to be representative of the total for the study. Information was gained from the 29 through a mail survey, concerning such things as business organization, types of plants produced, labor force, seasonality of sales, market area, problems, and outlook for the future.

The majority (72%) of nursery businesses are incorporated, while 21% reported sole proprietorship organization and 3% each were partnerships and other forms of organization. Nearly half reported that some of their business operations were computerized. Accounting (45%) and word processing (40%) were the most commonly computerized segments of their work.

Permanent full-time employees reported varied from 1 to 390. Temporary employees ranged from 1 to 150. On the average, the businesses had 45 year-round employees and 4 seasonal workers. The seasonal nature of sales demanded that more employees be hired just prior to and during the period of peak sales.

Nursery businesses grow and sell a wide variety of plants. Many specialize in a limited number of plants because it is difficult to offer customers the full range of products. The largest percentage of sales for nursery firms was accounted for by broad-leaved evergreen

shrubs (47%). Deciduous shade and flowering trees and narrow-leaved evergreen shrubs contributed an additional 24% of sales. Vines and ground covers accounted for an average of 19% of firm sales.

Nearly half (48%) of the firms indicated they sold plants only in plastic or polyethylene containers. The others used two or more types of containers. Twenty-one percent of the products from all businesses were sold as balled and burlapped plants. Less than 1% of the plants were sold as balled and potted or processed balled, or in field-grown bags.

Among the surveyed nurseries, 31% named market demand as the most limiting factor for business expansion. The next most limiting factors were competition and capital for growth, followed closely by labor concerns.

Nursery sales varied by month, with the highest percentage of sales occurring in the spring (March through May) and a smaller peak of sales in the fall months. This seasonal nature of sales was cited as putting stress on the cash flow and other operations of the business.

Only about 15% of ornamental plants produced in Alabama were reportedly sold in the State. Georgia accounted for the same proportion of sales, while 12% were shipped to Tennessee and 2% each to Florida and Texas. Fourteen percent of the nurseries shipped a portion of their products out of the country.

Cost of production was the most important factor considered by producers when establishing a selling price. The quality of the plant, market demand of the product, and competition in the market (the price at which the other growers were selling the same product) were other considerations as nursery managers set prices.

Information gained in the study confirmed the importance of Alabama's nursery industry. Nursery businesses in Alabama were found to be sophisticated, as evidenced by the high proportion of corporations, and to produce a diversified product mix. Nurseries are major employers in many areas, as indicated by their reported labor force.

Behe is Assistant Professor of Horticulture; Adrian is Professor of Agricultural Economics and Rural Sociology; Gilliam is Professor of Horticulture.

# N NEEDS DIFFERENT FOR CORN IN CONSERVATION TILLAGE SYSTEM WITH CRIMSON CLOVER

**U**SING WINTER annual legumes in conservation-tillage systems reduces soil erosion, improves soil productivity, conserves soil water, and contributes to the nitrogen (N) requirement of subsequent summer grain crops. This practice has gained limited acceptance by row crop producers but may achieve greater acceptance because of conservation compliance guidelines of the 1985 Food Security Act.

Before conservation-tillage systems can be used efficiently, more information about effective management of this system is needed. Fertilizer N is the single most expensive input for corn production, but N management practices developed for conventional corn production may be unsuitable for corn grown in conservation-tillage systems with winter legumes. A 3-year cooperative research project by the Alabama Agricultural Experiment Station and the USDA Agricultural Research Service was designed to determine management practices for maximizing the efficiency

of fertilizer N applied to continuous corn grown in a conservation-tillage system with crimson clover.

Tibbee crimson clover was planted at the E.V. Smith Research Center in mid-October during each year (1986, 1987, and 1988) of the study. In early April, Pioneer Brand Hybrid 3320 corn was planted in 30-in. rows using strip-tillage (no-tillage with in-row subsoiling) 7-10 days after the clover was sprayed with Gramoxone®. The same plots were used during all 3 years of the study.

Ammonium nitrate at rates of 30, 60, or 120 lb. N per acre was applied to corn at planting, or 3, 6, or 9 weeks later. Since splitting N applications, or side-dressing, is recommended for applying N fertilizer on corn, split applications (1/3 at planting and the remainder 6 weeks later) of 60 and 120 lb. N per acre were also included. Corn was also grown in control plots of rye and clover without the benefit of any N application to determine the amount of N contributed by clover and used by the corn.

Based on the total amount of N taken

up by corn, the clover cover crop contributed 47, 60, and 99 lb. N per acre in 1986, 1987, and 1988, respectively. Generally, time of fertilizer application had no effect on total N uptake by corn, except in 1988 when corn exhibited a greater N uptake when the fertilizer was applied at planting.

Split applications did not result in greater N uptake in any year. Although application time did not affect the total amount of N taken up by corn, it did affect grain yield.

There was no yield benefit to split applications of N in 1987 and 1988. The single exception was in 1986, the first year in the system and a year of severe drought, when the split application of 120 lb. per acre resulted in the highest yield (133 bu. per acre). There were no other effects of N application time on grain yield in 1986; however, in 1987 and 1988, delaying N application beyond 6 weeks after planting decreased yield, table 1.

Grain yield peaked with 120 lb. N per acre in 1986 and from 30-60 lb. N per acre in 1988, table 2. The decrease in fertilizer N requirement through time correlates well with the increase in total N uptake contributed from clover with successive years in the system.

Results from this study suggest a need for modifying standard recommendations for N fertilizer application practices for nonirrigated corn grown in winter legume conservation-tillage systems on Coastal Plain soils. Nitrogen requirements of continuous corn grown in this type system decrease after the system is established due to residual effects of clover N. Split applications of N fertilizer probably will not improve N efficiency or grain yields in a winter legume conservation-tillage system because late-season N requirements are provided by the decomposing legume cover crop.

TABLE 1. EFFECT OF N APPLICATION TIME (AVERAGED OVER N RATE) ON GRAIN YIELD OF CORN GROWN IN A CONSERVATION-TILLAGE SYSTEM WITH CRIMSON CLOVER

Year	Grain yield/acre, by N app. time (weeks after planting)			
	0	3	6	9
	Bu.	Bu.	Bu.	Bu.
1986.....	104	104	108	109
1987.....	107	112	106	81
1988.....	124	121	119	111
Av.....	112	113	111	100



TABLE 2. EFFECT OF N FERTILIZER RATE (AVERAGED OVER APPLICATION TIME) ON GRAIN YIELD OF CORN GROWN IN A CONSERVATION-TILLAGE SYSTEM WITH CRIMSON CLOVER

Year	Grain yield by N rate/acre			
	0	30 lb.	60 lb.	120 lb.
	Bu.	Bu.	Bu.	Bu.
1986.....	77	92	92	107
1987.....	68	92	103	108
1988.....	106	116	123	117
Av.....	84	100	106	111

Reeves is Research Agronomist (coop. USDA, ARS-NSDL); Touchton is Head of Agronomy and Soils.

# MARITAL QUALITY IS THE MAJOR FACTOR IN WELL-BEING OF RURAL COUPLES

**C**OPING WITH financial problems and social change has placed much stress on rural families in recent years. Unfortunately, little information has been available to guide families in their attempts to deal with such stress. To help bridge this information gap, a project now underway at the Alabama Agricultural Experiment Station is relating coping strategies, marital quality, and life stress to husbands' and wives' sense of well-being.

Early results indicate that marital quality is the major factor in how well families cope with stress. In fact, this was the only factor investigated that appears to serve as a predictor of well-being among rural couples. Husbands and wives who reported high levels of marital quality were more likely to describe their lives as interesting, enjoyable, worthwhile, friendly, full, hopeful, rewarding, and as bringing out the best in themselves—standard measures of well-being.

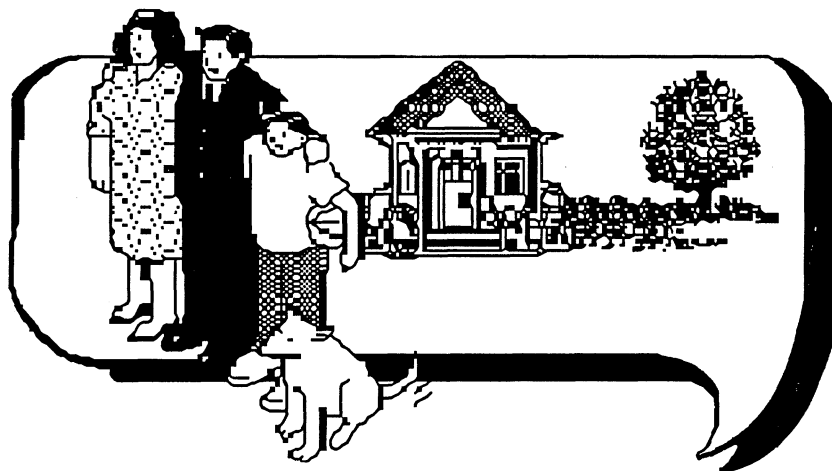
For the AAES study, completed questionnaires were obtained from both spouses in 92 randomly selected Alabama couples living in rural areas. The majority (78%) lived on farms. The remainder reported living in a rural area (not on a farm) or in a town of less than 10,000 population.

Average age of the respondents was 56 for wives and 60 for husbands. They had lived in Alabama an average of 53 years. About 9 out of 10 (89%) were in their first marriage, and they had been married an average of 34 years.

Among the husbands, about one-third each had less than high school, high school, and beyond high school educations. Fewer wives (23%) reported less than high school education, and 38% each had high school and beyond high school educations.

Median income reported was in the \$20,000-\$30,000 range.

Descriptive data indicated that couples used a variety of coping



strategies to deal with difficulties in their lives. Both husbands and wives reported they typically sought spiritual support and faced situations head-on with confidence in their ability to handle problems. They reported somewhat less frequently that they relied on relatives, friends, neighbors, and extended family in times of need. They were least likely to seek professional counseling, assistance from community agencies, and information and advice from the family doctor.

Mean levels of marital quality for husbands and wives were comparable to the findings of research conducted with other populations. Using a rating scale in which below 90 indicates severe marital conflict, 90-100 indicates dissatisfaction, and scores above 110 indicate satisfaction, the average marital quality score of the sample was 114. Thus, marital quality was satisfactory among the surveyed couples. Responses of husbands and wives about perceived marital quality indicated they had similar, but not identical, perceptions of quality within marriage. Findings indicate that higher levels of marital quality were associated with higher levels of well-being.

Information gained about the measure of life stress indicated that couples had faced an average of eight family life stressors (out of a possible 71)

in the preceding year. This number is consistent with national data. Family life stressors are considered to be life events and changes that require readjustment and adaptation by the family.

The life stressors most frequently reported in the last year by the couples were those associated with increased strain on the family's money supply and strains arising from a family-owned business or investment. Next most frequent strains reported included increased tension and conflict between family members and increased difficulties associated with being a parent. The third most likely type of stressor experienced was change associated with work, including changing jobs, being fired, retirement, and job promotions. Couples were least likely to report stressors due to changes in the marriage, death of a family member or friend, family members moving in or out of the home, illness, or legal problems.

The analysis conducted to determine whether coping strategies, marital quality, and life stress affected husbands' and wives' well-being indicated that only marital quality was predictive of well-being. For both husbands and wives in the study group, as marital quality increased, levels of well-being increased.

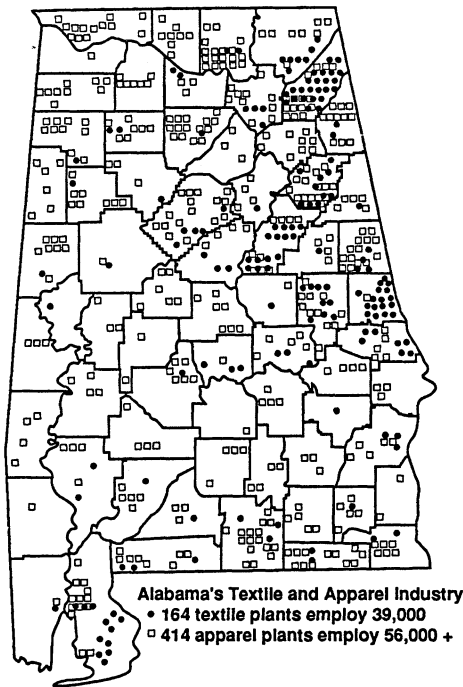
Lamke is Associate Professor of Family and Child Development.

# EMPLOYEE ISSUES IMPORTANT TO GROWTH OF ALABAMA'S TEXTILE AND APPAREL INDUSTRY

**A**LABAMA'S textile and apparel industry is one of the largest and most productive industries in the State. More than 550 plants ranging in size from more than 1,000 employees to fewer than 100 employees can be found Statewide, with at least one plant in every county. Apparel manufacturing alone employs more than 56,000 workers in the State, approximately 15% of Alabama's manufacturing work force. Alabama also remains one of the most competitive textile and apparel producing states in the nation. From 1978 to 1988, when foreign competition severely affected the industry nationwide and caused the shutdown of many plants, the number of textile and apparel plants in Alabama increased 127%.

Because the tax revenues and jobs provided by this industry are so vital to Alabama's economy, especially to the rural areas of the State where textile jobs provide important off-farm incomes for families, more information about this industry is needed to support its continued growth. An Alabama Agricultural Experiment Station study was conducted to identify the industry's needs and look for ways to preserve its competitive edge.

Researchers conducted personal interviews with industry management personnel (plant managers to company presidents) in 25 Alabama apparel companies during 1989. These companies ranged in size from more than 8,600 employees to less than 50 employees. Merchandise produced by these companies included men's shirts, sweats and tee-shirts, knit and woven sportswear, lingerie, protective clothing, textile and apparel products for hospitals and other institutional uses, uniforms, tailored clothing, and jeans. The interviews included a variety of questions designed to determine the needs and issues affecting the industry.



The primary concern expressed by the company managers was the lack of sufficient quality and quantity of labor. Many of the managers interviewed noted that quick response, or the ability of a company to rapidly respond to consumer demand, was vital to their success. Some managers cited quick response as the primary competitive edge now available to American firms. But quick response requires a flexible work environment in terms of workers, equipment, and manufacturing approaches. The success of a quick response approach hinges on employees who are well trained and adaptable.

The managers identified employee development as the major issue facing their industry. They expressed a need for people with apparel-related college degrees who could move into mid-level management positions to help meet the challenges of changing technology, distribution channels, sources of raw

materials, and consumer demand. In addition, entry-level operators and mechanics possessing a good work ethic and willingness to learn and adapt are needed.

Another essential ingredient for continued growth of the industry expressed by industry managers is job skill upgrading for current employees. This would give employees the opportunity to learn to work with equipment and production changes occurring in today's work environment.

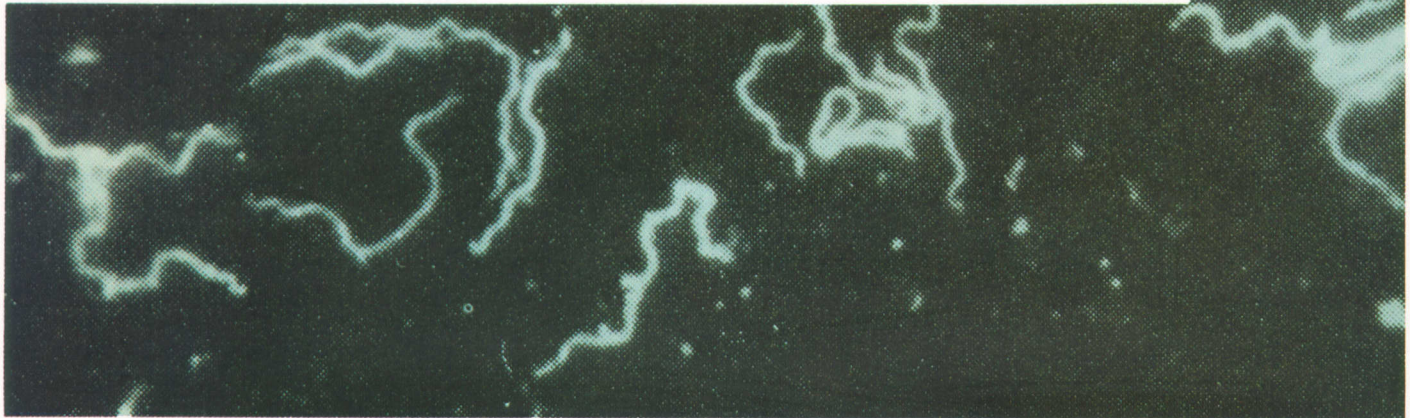
Industry management specified education and training needs such as (1) initial training (either pre-employment or on-the-job) to learn the specific job skills required, (2) cross-training to enable workers to perform several operations skillfully, (3) basic education competencies in math and reading, (4) skills emphasizing oral, written, and interpersonal communication, especially for first-level supervisors and employees involved in team programs such as modular manufacturing, and (5) on-the-job training for all levels of current employees.

Managers said the current labor shortage exists not only among trained operators, but also among untrained workers responding to employment opportunity advertising in some parts of the State. They listed absenteeism as another major problem within the work force. According to the managers, primary reasons for absenteeism are sick children and family members and drug and alcohol abuse. However, some workers work less than 40 hours a week to avoid losing government benefits such as housing and health care. For these people, the added income of working a full 40-hour week may not replace the government services they would lose should their income exceed a set level.

A number of plant managers indicated they had enough potential orders to expand production by as much as 100% if they could obtain additional workers. This suggests that it is imperative to more effectively meet the employment needs of the industry. It also indicates a need for education and training programs targeting the textile and apparel industry and management and public policy changes that will provide greater incentives for workers to be productive.

Warfield and Barry are Associate Professors of Consumer Affairs.

## TWO TICK SPECIES IDENTIFIED AS POTENTIAL LYME DISEASE VECTORS



Spirochete of *Borrelia burgdorferi*, the causative agent of Lyme disease.

**T**HE FIRST human case of Lyme disease in Alabama was reported in 1986. Since then more than 40 cases of this tick-borne disease have been documented in 24 Alabama counties. However, the identity of the tick species involved in transmitting the disease organism to humans in the Southeast remains uncertain. Based on Alabama Agricultural Experiment Station field studies conducted during the past 2 years, it is believed that more than one species of tick is involved.

The primary focus of these studies has been in Lee County where several human cases of Lyme disease have been documented, indicating local transmission. During 1988 and 1989, an extensive live trapping program for small mammals was conducted in an effort to recover ticks and to determine their respective hosts in the study area. The small mammals captured and studied include: cotton mice, golden mice, house mice, cotton rats, and southern short-tailed shrews. Ear biopsy samples were taken from rodents to determine if the animals were infected.

Ticks also were collected from white-tailed deer, dogs, cats, horses, and humans in the study area. Ticks were subsequently tested by direct and indirect fluorescent antibody assays for the presence of *Borrelia burgdorferi*, the bacterial organism

that causes Lyme disease.

The black-legged tick and the american dog tick were found parasitizing small animals at the test sites. All of the ticks were immature, either larvae or nymphs. Both species were recovered from cotton mice and golden mice, whereas only the black-legged tick was recovered from cotton rats. Larval ticks were more common than nymphs on these hosts. No ticks were found on the house mice or short-tailed shrews. Adults of the black-legged tick usually parasitize large mammals, the white-tailed deer being the preferred host. Adults of the american dog tick occur most commonly on dogs, but feed on a variety of medium-sized mammals.

*Borrelia*-like organisms were observed in 11 of the ticks assayed. Both nymphs and adults of the lone star tick collected from deer were found to be infected. Larvae of the black-legged tick



Both black-legged tick and american dog tick were recovered from cotton mice, such as this specimen from Lee County.

recovered from cotton mice and adult ticks recovered from deer were also positive. Ticks from other hosts were negative. No Lyme disease organisms were found in the cultured ear tissue from field-collected rodents.

Given the close relationship of the black-legged tick to the principal vector of Lyme disease in the Northern United States, it has been assumed that the black-legged tick is the major vector of Lyme disease in the Southeast. However, the detection of what appears to be Lyme disease-causing bacterial organisms in the lone star tick and black-legged tick indicates the potential role of both species as vectors of the Lyme disease agent in Alabama.

Unlike the black-legged tick, the lone star tick is commonly found attached to humans. It has been consistently recovered at sites of known cases of Lyme disease in Alabama and is the only tick that has been identified in association with confirmed cases of this disease in the State. Based on this information, there is reason to believe that, whereas the black-legged tick is important in transmitting the Lyme disease organism among wild animals, the lone star tick may be more important as a source of the infection for man.

Mullen is Professor and Luckhart is Graduate Student of Entomology.



## FOUR TICK SPECIES FOUND ON ALABAMA DEER



Examining deer for ticks at the Choccolocco Wildlife Management Area, Cleburne County.

were the species found on deer in the survey.

The black-legged tick was the most common and widespread species parasitizing deer. It was recovered from 54% of the deer examined and accounted for 57% of all the ticks collected. With the exception of two nymphal ticks, all black-legged ticks found on the deer were adults. The prevalence of this tick varied considerably from one location to another. Over 80% of the deer examined at the Bar-

bour County Wildlife Management Area were infested with this species, whereas none of the deer examined at the Choccolocco Wildlife Management Area in Cleburne County were infested. This difference may be due to habitat types and management practices which influence the availability of rodents and other small mammals serving as hosts for the immature stages of the tick.

The second most common species was the lone star tick. It parasitized 24% of the deer examined, but infestation rates as high as 80-90% were found at some locations. Over 70% of the ticks were adult males, with the remainder divided about evenly between nymphs and adult females. Collections of fewer females than males reflect the fact that females generally drop off the host after completing engorgement.

The winter tick was common on deer throughout the hunting season. Unlike the other three species, this is a one-host tick which undergoes all its developmental stages on a single host animal. It was found infesting 16% of the deer examined and represented 35% of the total ticks recovered. With the exception of two larvae, all of the specimens were

nymphs or adults.

The gulf coast tick was found on only five deer, representing fewer than 1% of the total deer examined. Each deer had just a single specimen, indicating that deer serve only as incidental hosts for this tick.

White-tailed deer serve as important hosts for three of the four ticks recovered in this study. However, the distribution and abundance of these ticks on deer during the hunting season are greatly influenced by the availability of smaller animals which serve as hosts for the immature stages of the ticks during the warmer months of the year.

Ticks usually cause little harm to deer; however, heavy infestations can cause anemia, weight loss, skin irritation and abscesses, thickening of the skin, hair loss, and even blindness when ticks are numerous about the eyes. Ticks are seldom directly involved in the transmission of disease agents that are harmful to deer. Even in the case of Lyme disease, deer do not suffer ill effects after being fed upon by infected ticks. Instead, deer appear to serve primarily as hosts for the adults of certain ticks which, particularly as immatures, transmit the Lyme disease organism among other wild animals and to man.

Mullen is Professor, Luckhart is Graduate Student, and Durden is Research Associate of Entomology.



This female black-legged tick was found on white-tailed deer in Butler county.

**L**IKE MOST wild animals, white-tailed deer have their share of ectoparasites, including ticks. In recent years, deer-infesting ticks have drawn particular attention because of their role in transmission of the bacterial agent which causes Lyme disease in humans. To better understand the potential role of deer ticks in the spread of this disease in Alabama, a survey of ticks on white-tailed deer in the State was conducted as part of an Alabama Agricultural Experiment Station project.

Ticks were collected primarily from hunter-killed deer during the 1988-89 and 1989-90 hunting seasons in Barbour, Bullock, Butler, Chambers, Clay, Cleburne, Coosa, Hale, Lee, Macon, Tallapoosa, and Wilcox counties. Most of the ticks were recovered from deer at State-operated check stations with the cooperation of personnel from the Alabama Department of Conservation and Natural Resources.

A total of 3,650 ticks was removed and identified from 539 deer, represented by nearly equal numbers of does and bucks. Lone star tick, gulf coast tick, winter tick, and black-legged tick

# IMPROVED NUTRITION MAY NOT SUBSTITUTE FOR REGULAR DEWORMING OF STEERS



**F**ORAGE CONSUMPTION and weight gain of steers grazing bermudagrass can be increased by regular deworming, regardless of nutritional level. This was shown in a 140-day Alabama Agricultural Experiment Station grazing experiment at the Wiregrass Substation, Headland.

The grazing study was conducted in 1989 to compare the effect of parasite control management on animals fed diets high or low in nutritional value. The study used 400-lb. steers grazing Coastal bermudagrass at various stocking rates (2, 4, or 6 steers per acre with no supplemental feed and 4, 8, 12, 16, or 20 steers per acre with supplemental feed of 50/50 broiler litter/grain).

Parasite control was achieved by injecting Ivermectin® every 56 days. This is a more frequent treatment than usually recommended because the study focused on minimizing parasitism rather than achieving the most economic parasite control method. Supplemented animals received the litter/grain ration daily. Animals were weighed every 28 days. Feed consumption was determined weekly and pastures were continuously grazed. Pasture height and the amount

of time animals spent grazing were estimated monthly.

Average daily gain (ADG) was affected by stocking rate, feed supplementation, and parasite control. As stocking rate increased, ADG decreased regardless of parasite control or supplementation. Supplementation improved ADG, maintaining gain at greater than 1.1 lb. per day even at the highest stocking rate, compared to a maximum of 1.16 lb. per day in the nonsupplemented group at the lowest stocking rate, see table. Parasite control increased ADG regardless of nutritional level or stocking rate. This result contradicts the common perception that parasitism causes greater losses when animals are on a low plane of nutrition and at high stocking rates.

When averaged for all stocking rates, parasite control resulted in a 0.45-lb. increase in ADG. This translated to a gain advantage of 63 lb. for animals treated for parasites over the 140-day period. However, this advantage was not easy to detect visually.

Infection level of parasites, measured by number of eggs per gram of feces, increased as stocking rate increased, and

was affected by deworming but not by nutritional level. Dewormed steers had average egg counts ranging from none at 2 steers per acre to 139 per gram at 20 steers per acre. Corresponding egg counts for nontreated animals ranged from 386 to 550 per gram.

Supplement intake increased from 8.34 to 9.14 lb. per day as stocking rate increased from 4 to 20 steers per acre, but did not differ between dewormed and nondewormed animals. As stocking rate increased, pasture height (and thus available forage) decreased, causing animals at high stocking rates to rely more on the supplement to meet their nutritional requirements, as shown in the table.

In contrast to supplement intake, which was not affected by parasitism, dewormed animals spent more time grazing than those which were not dewormed. This resulted in shorter pasture (increased forage consumption) for the dewormed animals when compared to parasitized animals, especially at the higher stocking rates.

The difference in ADG between animals that were or were not dewormed is due, at least in part, to the reduced grazing time and an associated reduction in forage intake. This suppression of forage intake or appetite for forages is associated with the increased level of parasitism. The reason supplement intake was not suppressed by increased parasitism remains obscure.

Results indicate that regular deworming increases ADG and forage consumption when compared to no parasite control, regardless of nutritional level and stocking rate. Litter/grain supplementation increased average daily gain and the carrying capacity of bermudagrass. Most importantly, this study suggests that an elevated plane of nutrition does not eliminate the need for deworming.

Kee is Research Associate and Bransby is Associate Professor of Agronomy and Soils; Snyder is Scientist of USDA Animal Parasite Research Laboratory; Gamble is Assistant Superintendent of the Wiregrass Substation.

EFFECT OF DEWORMING, STOCKING RATE, AND SUPPLEMENTATION ON AVERAGE DAILY GAIN AND PASTURE HEIGHT

Item	Result, by supplementation treatment and stocking rate									
	No supplementation			Litter/grain supplementation						
	2	4	6	4	8	12	16	20		
<b>Average daily gain</b>										
Dewormed steers, lb.	1.16	0.68	0.20	2.37	2.17	1.97	1.77	1.77	1.58	1.58
No deworming, lb. . .	.71	.23	-.25	1.92	1.72	1.53	1.33	1.33	1.13	1.13
<b>Pasture height</b>										
Dewormed steers, in.	4.75	4.11	3.48	4.71	4.09	3.44	2.79	2.79	2.14	2.14
No deworming, in. . .	4.84	4.30	3.76	4.93	4.47	4.01	3.55	3.55	3.09	3.09

# REDUCING DIETARY FIBER HELPS MAINTAIN MILK PRODUCTION DURING HOT WEATHER

**H**OT WEATHER during June, July, and August represents a major problem for Alabama dairymen. Cows respond to hot weather by eating less, which reduces the heat generated in metabolism and milk synthesis and helps them keep cool. However, the amount of nutrients required for milk synthesis is the same in hot weather as in cooler weather. Therefore, the final result of reduced feed intake is lower milk production.

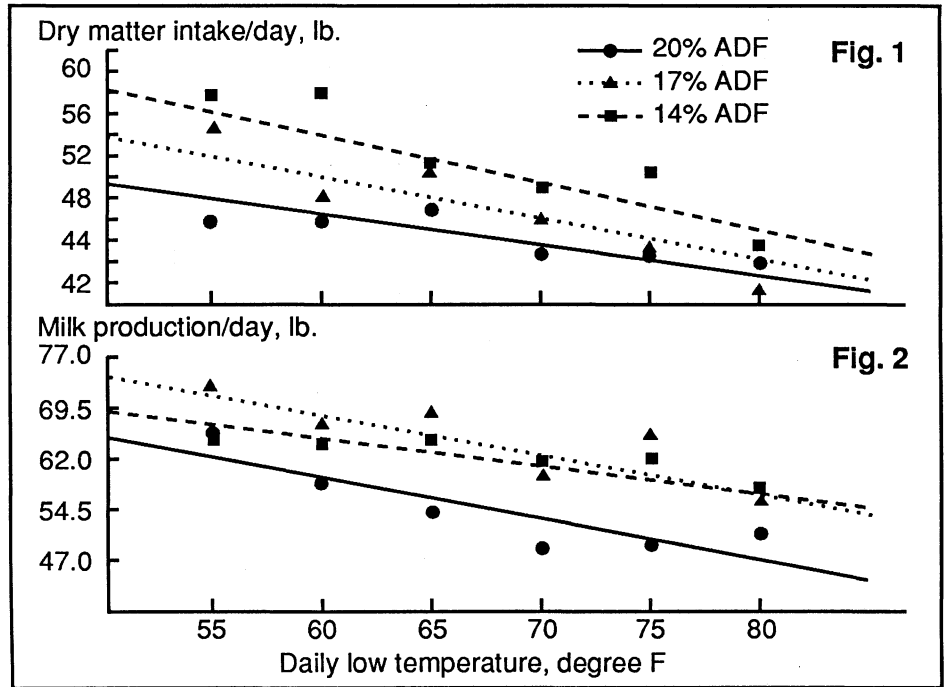
A typical method used by dairymen to overcome milk losses from reduced feed intake is to 'beef up' the nutrient content of the summer diet to boost dry matter intake. They do this by increasing the energy and protein density and reducing the fiber content. As a result, cows get more nutrients from a given amount of feed consumed.

Knowing just how far to go in fiber reduction to increase nutrient intake has been the problem since few guidelines are available. Thus, an Alabama Agricultural Experiment Station study on this subject was done at the E. V. Smith Research Center, Shorter.

Twenty-seven Holstein cows averaging 121 days in milk were used in the test. Test diets contained 20, 17, and 14% acid-detergent fiber. Feeding of the three test diets began 2 weeks before the onset of hot weather<sup>1</sup> during a cool period (Period 1). The onset of hot weather was the start of Period 2. The 17 and 14% fiber diets provided excess energy to compensate for the expected reduction in total feed intake during the hot weather of Period 2. All cows were fed the 20% fiber diet up to the start of Period 1.

Milk production declined in all cows with the onset of hot weather, as indicated by differences between Period 1 and Period 2 recorded in the table. However, the decline was less in cows

<sup>1</sup>The onset of hot weather is considered to be the first day that the maximum temperature exceeds 87°F or the minimum temperature is above 66°F.



Effect of daily low temperature on dry matter intake per day and milk production per day of Holstein cows.

fed the 14% fiber diet. Unexpectedly, dry matter intake increased in cows fed the 20% fiber diet, and declined in those fed the 17 and 14% fiber diets. As illustrated by figure 1, cows fed lower fiber diets were more sensitive to environmental temperature than those fed higher fiber diets. This was probably due to the greater energy eaten by cows fed the low fiber diets, which increased internal heat load more for a given level of feed intake.

The production graph, figure 2, shows that dietary fiber had to be decreased to 14% before daily milk production was made less sensitive to environmental temperature. Daily low temperature (average 71°F) had more of an effect on milk production than daily high

temperature (average 94.5°F) in this study. Milk fat depression, a common problem indicating deficient dietary fiber, was not evident with the low fiber diets.

The results of this study indicate that reducing fiber helps maintain milk production during periods of hot weather, but it also makes feed dry matter intake more sensitive to changes in environmental temperature.

Cummins is Associate Professor of Animal and Dairy Sciences.

Measure	Result, by dietary fiber content		
	20%	17%	14%
Change in milk/day, lb.	-8.6	-9.9	-5.7
Change in dry matter intake/day, lb.	+1.3	-1.5	-3.7
Milk fat (Period 2), pct.	3.4	3.1	3.3

## RESPONSE TO GROWTH IMPLANT DEPENDS ON TYPE OF CATTLE

**B**EEF CATTLE producers can typically increase profits by increasing their animals' growth rates. Growth implants, which contain naturally occurring hormones, can boost growth rates, but the degree of response often is affected by the animal's biological type. Research has found that slower growing, smaller cattle tend to respond more favorably to implants than faster growing cattle.

To learn more about this tendency, a 2-year Alabama Agricultural Experiment Station study was begun in 1989 at the Black Belt Substation, Marion Junction, to determine the response of various breeds and biological types of cattle to growth implants. An earlier study at the Lower Coastal Plain Substation in Camden had identified early and late maturing Angus and Charolais cattle. Steers and heifers from this herd were brought to the Black Belt Substation and treated with a commercial growth implant (Synovex®) during the preweaning and postweaning growth periods. Calves were weaned at 229 days of age and immediately placed in a confinement feedlot. Performance information was collected through a year of age.

Implanting nursing calves resulted in increased gains of 0.11 lb. per day and 25 lb. at weaning. If producers receive 85¢ per pound for weaned calves, the preweaning implant would, on the average, have increased returns by about \$19 per head. Postweaning implants increased feedlot gain 0.28 lb. per day and increased yearling weight, height, and ribeye area by 36 lb., 0.5 in., and 0.4 in., respectively. Calves implanted both pre- and postweaning gained 0.33 lb. per day more during the postweaning period and weighed 61 lb. more at a year of age than those never implanted. If producers receive 75¢ per pound for their yearling cattle, pre- and postweaning implanting would increase returns by \$42 per head.



Fast maturing  
Charolais cattle  
used in test at  
Black Belt  
Substation

Charolais cattle were heavier and taller at weaning than the Angus and had larger ribeye areas, as indicated by ultrasound imaging. The Charolais also gained faster in the feedlot, were heavier and taller, and had larger ribeye areas than Angus at a year of age. Cattle in the late maturing line gained faster preweaning and were heavier and taller at weaning than cattle in the early maturing line. However, at a year of age, the late maturing cattle gained slower and were taller than early maturing cattle.

The different breeds and lines of cattle responded differently in some traits to the growth implant. During the preweaning period, the faster gaining, late maturing calves gained only 0.03 lb. per day more due to the implant, but the slower growing, early maturing calves gained an additional 0.17 lb. per day due to implant. These differences in gain correspond to 9 and 41 lb. increases in weaning weight due to preweaning implant for late and early maturing calves, respectively. The preweaning implant was more effective on slower growing

than faster growing calves.

A similar effect was found between breeds and postweaning implant in yearling weight. The faster growing Charolais cattle weighed 12 lb. more at a year of age due to the postweaning implant, but the slower growing Angus cattle weighed 59 lb. more. Also, response to postweaning implanting in postweaning gain was altered by preweaning implanting. Calves not implanted prior to weaning gained an additional 0.15 lb. per day due to postweaning implant, but calves implanted prior to weaning gained an additional 0.41 lb. per day due to postweaning implant.

This study indicates implanting cattle both pre- and postweaning with Synovex increases rate of gain, weight, and ribeye area. Response is even more evident when cattle are genetically slower growing.

Hough and Mulvaney are Assistant Professors of Animal and Dairy Sciences; Holliman is Superintendent of the Black Belt Substation; Little is Superintendent of the Lower Coastal Plain Substation.

AVERAGES OF TRAITS, ACCORDING TO LINE, BREED, AND IMPLANTING

Item	Result, by line		Result, by breed		Result, by implant			
	Late	Early	Charolais	Angus	Preweaning		Postweaning	
					Implanted	Not implanted	Implanted	Not implanted
<b>Weaning</b>								
ADG., lb. . . . .	1.69	1.56	1.65	1.60	1.68	1.57		
Weight, lb. . . . .	473	432	465	440	465	440		
Height, in. . . . .	43.9	41.4	43.7	41.6	42.6	42.7		
Ribeye area, in. . . . .	5.5	5.8	5.9	5.4	6.0	5.4		
<b>Yearling</b>								
ADG., lb. . . . .	2.73	2.95	3.13	2.55	2.86	2.82	2.98	2.70
Weight, lb. . . . .	855	837	903	789	858	833	864	828
Height, in. . . . .	48.1	45.8	48.6	45.2	46.8	47.1	47.2	46.7
Ribeye area, in. . . . .	10.3	10.7	11.1	9.9	10.5	10.5	10.7	10.3

# EXTRA NITROGEN IN PINE NURSERY BOOSTS FOREST WOOD GROWTH

IMPROVING the growth potential of pine plantations in Alabama is a major goal of research in the Alabama Agricultural Experiment Station. Thus far, a large amount of effort has been devoted to practices which can improve seedling survival. However, significant improvements in tree growth can also be made by subtle manipulations that affect seedling diameter in the nursery. A small increase in the initial diameter of the plants can have a surprisingly large effect on subsequent growth. Not only do the seedlings that start out ahead remain ahead, but the absolute difference in tree volume increases as the trees grow. By increasing the mean root collar diameter of seedlings only 1 mm (millimeter), yields can be increased from 1.5 to 4.5 cords per acre.

The Auburn University Southern Forest Nursery Management Cooperative installed studies throughout the South to determine the combined growth response due to seedling nutrition and seedling morphology. Seedling

morphology was altered by growing seedlings in the nursery at various spacings. Seedling nutrition was varied by applying different levels of nitrogen fertilizer (a rate to minimize production of culls and a substantially higher rate). Samples of seedlings were measured for seedling size, nutrient status, and levels of photosynthesis. Other seedlings were outplanted in the field to measure growth rate.

Regardless of treatment, as seedling root collar diameter increased, the total quantity of foliage increased, figure 1. This increased foliage mass allows greater light interception and greater photosynthesis and carbohydrate production to occur. As a result, foliage weight was directly related to height growth during the first season after planting.

Applying extra nitrogen fertilizer in the nursery also resulted in increased growth in the field, even when comparing seedlings with the same needle mass, figure 2. Thus, seedling nutrition appears to benefit growth in ways other



FIG. 3. First-year height of a seedling from the high nitrogen fertilization regime, approximately 6.5 mm in root collar diameter, and planted on a site receiving herbaceous weed control. The measurement standard is 3.2 ft.

than simply increasing seedling size. This results from an increase in the rates of photosynthesis of plants with the same amount of needles.

When provided with herbaceous weed control, large diameter seedlings can show a dramatic increase in first-year growth in the field, figure 3. Subsequent observations indicate that the early effects of improved nitrogen nutrition on growth will continue to affect yields as the plantation develops.

Blake is Assistant Professor and South is Associate Professor of Forestry.

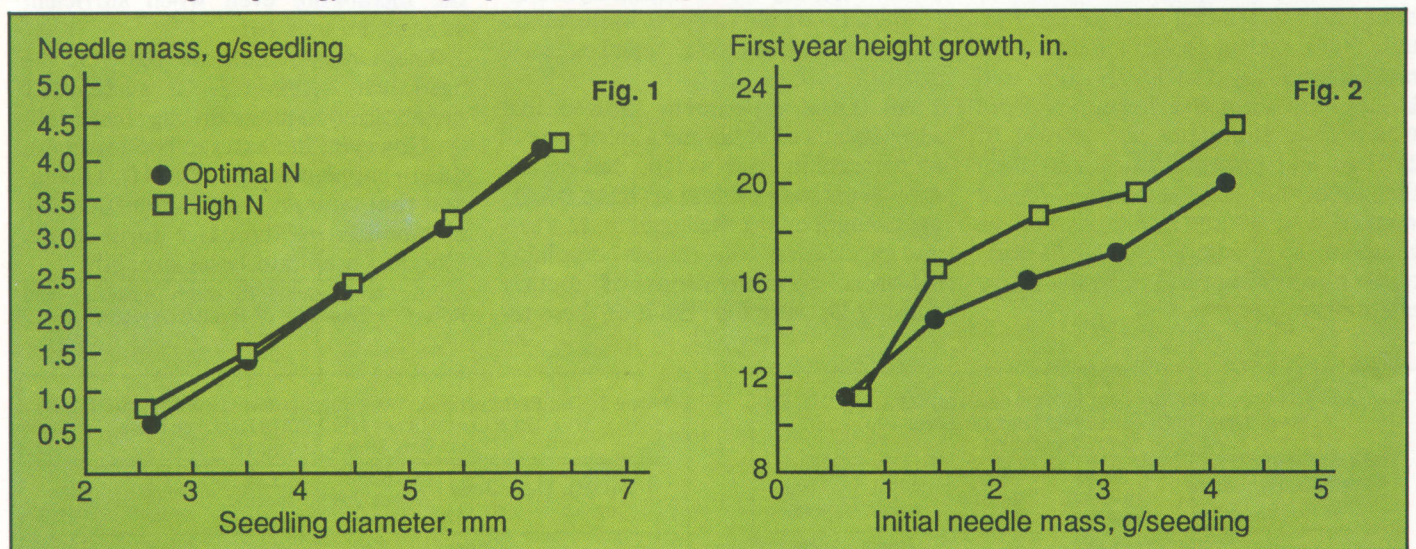
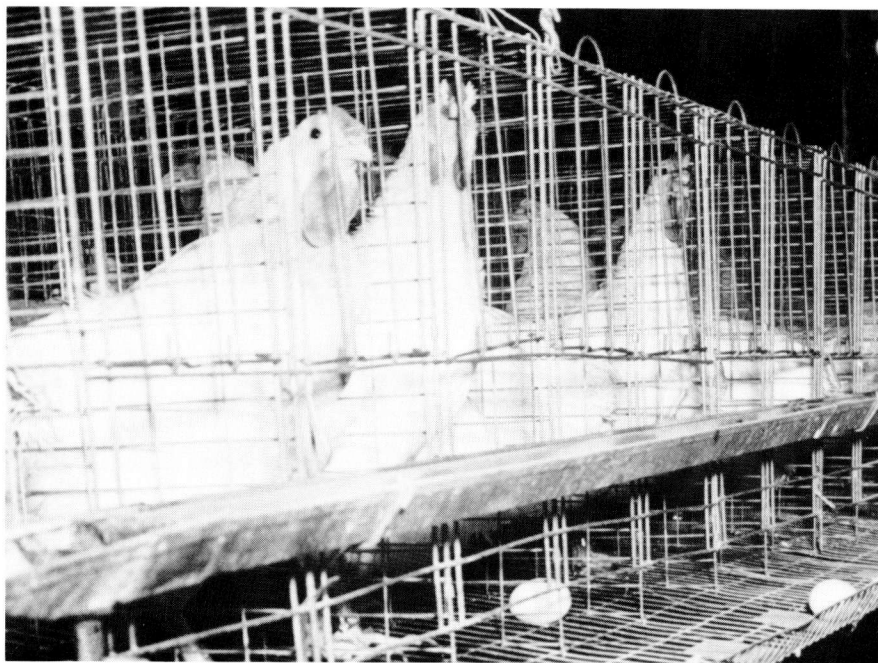


FIG. 1. Average relationships between needle mass of weight and seedling diameter at outplanting for two nursery nitrogen regimes: a nitrogen fertilization rate adequate for seedling development (Optimal N) and a rate 50% greater than needed for best nursery growth (High N). FIG. 2. Average relationship among first-year growth after planting in the field, needle mass or weight, and previous nursery N regime.

# SUPPLEMENTAL VITAMIN D<sub>3</sub> METABOLITES IMPROVE BONE STRENGTH IN AGED POULTRY



**A**S HENS AGE, they typically exhibit a decline in egg shell quality and bone strength which limits the productive life of the bird. This may be caused by a reduction in the bird's ability to release calcium and phosphorous for use in bone and egg production. Dietary vitamin D<sub>3</sub> is known to be converted, or metabolized, by the bird's liver and kidney into an active hormonal form which then stimulates the release of calcium and phosphorus. It has been theorized that this tendency toward weakened bones and egg shells may be caused by a reduction in the bird's ability to convert vitamin D<sub>3</sub> into the active metabolite.

Based on this theory, experiments were conducted at the Alabama Agricultural Experiment Station to determine if dietary supplements of synthetic vitamin D<sub>3</sub> metabolites in the form of 1,25-dihydroxyvitamin D<sub>3</sub> [1,25(OH)<sub>2</sub>D<sub>3</sub>] or 1 alpha-hydroxyvitamin D<sub>3</sub> would improve bone breaking strength, bone weight, and egg shell quality.

An initial experiment showed that supplements of either metabolite caused an increase in bone weight, but no improvement was evident in bone breaking strength or egg shell quality. In a second experiment, four rations containing different concentrations of dietary vitamin D<sub>3</sub> were fed. Each of these ra-

tions was supplemented with one of three different concentrations of the 1,25(OH)<sub>2</sub> D<sub>3</sub> metabolite.

Results showed that these metabolite supplements improved bone weight and bone breaking strength, table 1. In addition, egg shell quality (measured by egg specific gravity, shell weight, percent shell, and egg breaking strength) was also improved by adding the metabolite. These results illustrate the activity of the metabolite when fed in minute amounts with no supplemental vitamin D<sub>3</sub>.

The metabolite was also supplemented in rations containing typical concentrations of dietary vitamin D<sub>3</sub>. When birds were fed a ration containing normal concentrations of vitamin D<sub>3</sub> (1,500 ICU D<sub>3</sub> per kg), adding 1,25(OH)<sub>2</sub> D<sub>3</sub> did not improve egg shell quality, table 2. Egg specific gravity was improved by feeding the metabolite; however, the observed decrease in egg weight would account in part for this improvement. Shell weight, percent shell, and egg breaking strength were not improved by feeding the metabolite. However, bone breaking strength and bone weight were increased by adding the metabolite even when sufficient vitamin D<sub>3</sub> was fed.

These results indicate that, in the aged hen, vitamin D<sub>3</sub> is sufficiently metabolized to maintain egg shell quality. However, increases in bone strength due to supplemental 1,25(OH)<sub>2</sub> D<sub>3</sub> suggest that vitamin D<sub>3</sub> is not sufficiently metabolized to its active form in the blood to maintain bone strength.

Frost is Graduate Research Associate and Roland is Professor of Poultry Science.

TABLE 1. THE EFFECTS OF DIETARY SUPPLEMENTATION OF 1,25(OH)<sub>2</sub> D<sub>3</sub> TO A VITAMIN D<sub>3</sub> DEFICIENT DIET ON BONE AND EGG SHELL STRENGTH

1,25(OH) <sub>2</sub> D <sub>3</sub> , ug/kg	Bone weight	Bone breaking strength	Egg specific gravity	Shell weight	Egg weight
	Grams	KgF		Grams	Grams
0.....	5.1	5.8	1.0732	5.05	63.9
0.5.....	6.0	7.6	1.0773	5.51	65.4
1.0.....	5.9	7.4	1.0782	5.52	64.8

TABLE 2. THE EFFECTS OF DIETARY SUPPLEMENTATION OF 1,25(OH)<sub>2</sub> D<sub>3</sub> TO A DIET CONTAINING 1,500 ICU D<sub>3</sub>/KG ON BONE AND EGG SHELL STRENGTH

1,25(OH) <sub>2</sub> D <sub>3</sub> , ug/kg	Bone weight	Bone breaking strength	Egg specific gravity	Shell weight	Egg weight
	Grams	KgF		Grams	Grams
0.....	6.2	7.3	1.0788	5.67	65.3
0.5.....	6.3	7.9	1.0796	5.71	65.1
1.0.....	6.6	8.1	1.0799	5.60	64.3

# FINNISH TREE HARVEST SYSTEM EFFICIENT IN ALABAMA FORESTS

**T**HE HIGH COST of cut-to-length Scandinavian timber harvesting equipment combined with the lack of spare parts and repair facilities has slowed the acceptance of these machines in Alabama. However, recent Alabama Agricultural Experiment Station tests indicate the advantages of a Finnish harvester and forwarder outweigh the disadvantages, if qualified operators are available.

Scandinavian companies currently market their equipment in the United States and provide support for their machines by forming partnerships with or buying U.S. equipment manufacturers and their parts-supply networks. Additional factors creating interest in these machine systems include an increasing lack of woods workers and a poor safety record of timber harvesting operations that utilize manual labor.

Although initial price is a barrier to some potential users, these machines should be compared with alternative harvesting systems on a cost per unit output. A study is being conducted by the AAES in conjunction with Ab Norcar Oy, a Finnish equipment manufacturer, and Rocky Creek Logging Company in Chapman, Alabama, to document the productivity and cost of a cut-to-length harvesting system.

Rocky Creek Logging Company has been operating a Norcar 600H harvester and 490 forwarder since October 1989. The 600H has a harvester head mounted on a 34-ft. outreach, telescoping boom. Thus, the operator can often harvest 8 to 10 trees from a single set-up location. The 490 forwarder has a grapple loader mounted on a 24-ft. outreach knuckled boom, and can transport a 16,500-lb. payload in its wood-carrying rack. The two operators ride in ergonomically designed cabs equipped with a heater, an air conditioner, a stereo radio, and a shock absorbing, swiveling "captain's" chair. Not only are the operators comfortable, but they are probably in the

safest timber harvesting environment available.

Data have been collected while the machines performed total (clear cut) and partial (second thinning) cuts in pine plantations. The figure shows the individual observations and predicted productivity for the 600H harvester on two study sites: (1) a clear cut of a 30-year-old plantation, and (2) a second thinning in a 21-year-old plantation. The volume per tree and the number of trees cut per acre had the most impact on machine productivity. The predicted productivity was based on a linear regression of cords per productive machine hour (PMH) versus tree diameter breast height (dbh).

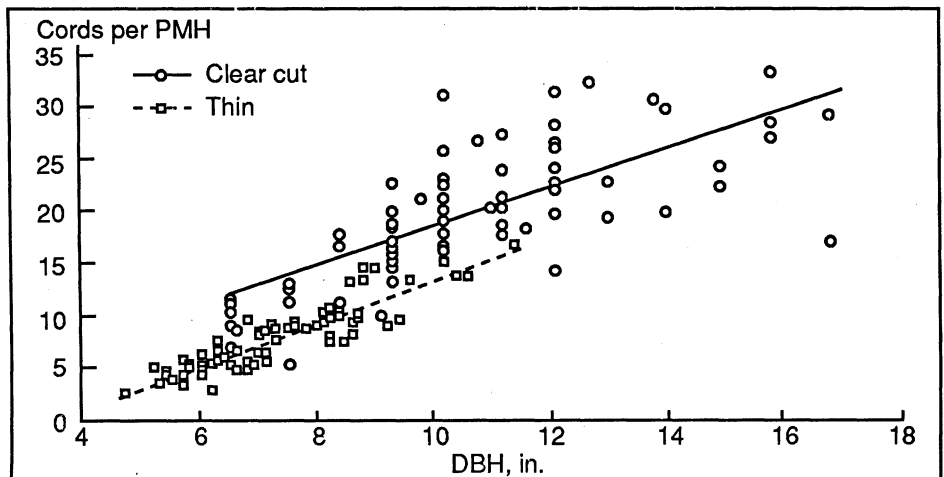
The 490 forwarder produced an average of 7.5 cords per PMH. It was slightly more productive in the clear cut versus thinning and when loading sawlogs versus pulpwood. Factors that affected its productivity included the forwarding distance, the number of grapple loads required to load the wood storage rack, the number of times the machine moved to pick up a load, and the distance moved between piles of wood.

A cost analysis indicated that the 600H harvester costs about \$110 per PMH and the 490 forwarder costs about

\$50 per PMH. By dividing the machine costs by the productivity estimates shown in the figure, a cost per cord can be calculated for different types of stands and sizes of trees. For example, clear cutting 8-in. dbh trees would require one harvester and two forwarders at a cost of \$210 per PMH. A resultant productivity of 15 cords per PMH and a cost per cord of \$14 would be realized for this system configuration. This cost is competitive with conventional harvesting systems. It represents an ideally balanced system and does not include trucking, overhead, or profit.

Research results indicate that the Norcar system is economical, comfortable, and safe. However, the system has a high initial investment and operation of these machines requires a higher level of mechanical knowledge than needed by operators of most conventional harvesting systems. Thus, additional training will be required for U.S. operators who will use this machinery. It appears that advantages outweigh the disadvantages for these machines, and the number of these systems operating in the South will increase in the near future.

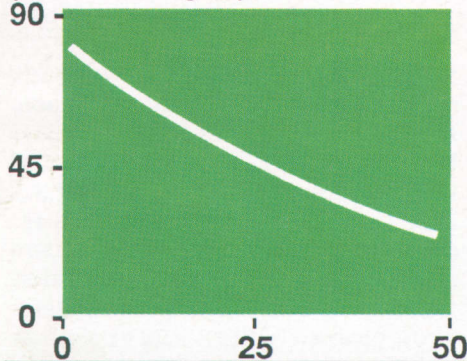
Tufts is Associate Professor and Brinker is Assistant Professor of Forestry.



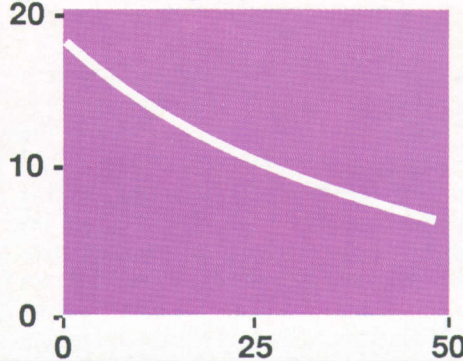
Productivity of 600H harvester in total or partial cuts in pine plantations.

# SIMPLE EFFECTIVE SYSTEM MEASURES FISH POPULATION

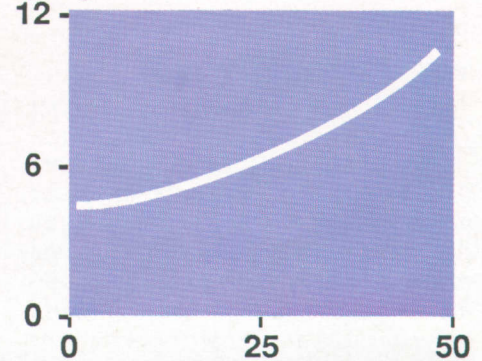
**Harvestable size**  
pct. total standing crop



**Largemouth bass,**  
pct. total standing crop



**Prey/predator ratio**  
by weight



**NUMBER OF INTERMEDIATES**  
per standard 50-ft. seine sample

**P**ROPER BALANCE in a farm pond is a condition where both bass and bluegill are able to grow and reproduce, thereby producing a sustained crop of harvestable size fish. How efficiently fish feed on each other is a key ingredient in maintaining populations in balance. While feeding efficiency is affected by a number of factors, the size distribution within bass-bluegill populations at any given time reflects how efficiently fish are feeding and summarizes the ongoing dynamics of growth, recruitment, and mortality.

Estimating the size distribution requires that the populations be sampled. Ongoing research at the Alabama Agricultural Experiment Station has developed some simple, yet effective methods of sampling bass-bluegill populations in farm ponds. Seining to determine the size structure of fish populations can give an accurate picture of fish population balance, and allow biologists and pond owners to make reliable management decisions.

Historically in the Southeast, farm pond fish populations have been sampled during the period May-September by seining. Using both a 50-ft. seine and 15-ft. seine, researchers can determine the relative number of intermediate-size bluegill (50-ft. seine) and the presence of bass and bluegill reproduction (15-ft. seine). Both seines are deployed in a manner that allows the results to be

roughly quantified, i.e., bracing one brail on the bank while the other person seines in an arc, returning to shore and pursuing the net to ensure that the lead line stays on the bottom.

No attempt is made to expand the catch on an area basis to the entire pond. Instead, the relative abundance of the intermediate-size bluegill and presence or absence of young of year are used as an index to determine how the adult populations are structured. In fact, few adult fish are usually caught. The graphs illustrate the relationship between seine samples and various population values determined by draining research ponds that have been repeatedly seined the previous summer. Note that while the seining results are variable, the relationship to the population values is evident.

As the average number of inter-

mediate-size bluegill increases in the seine sample, the percentage of the population's total standing crop (by weight) consisting of harvestable size fish declines, as does the percentage by weight of largemouth bass. Also, the weight ratio of prey to predator species in these populations increases as the number of intermediate-size bluegill increases in the seine sample. Based on these relationships, it appears that an average of 20 intermediate bluegills per standard seine sample would indicate populations in balance: harvestable-size fish would make up 60% of the population, largemouth bass would make up approximately 12% of total standing crop, and the prey-predator ratio by weight would be approximately 5:1.

Davies is Professor of Fisheries and Allied Aquacultures.

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