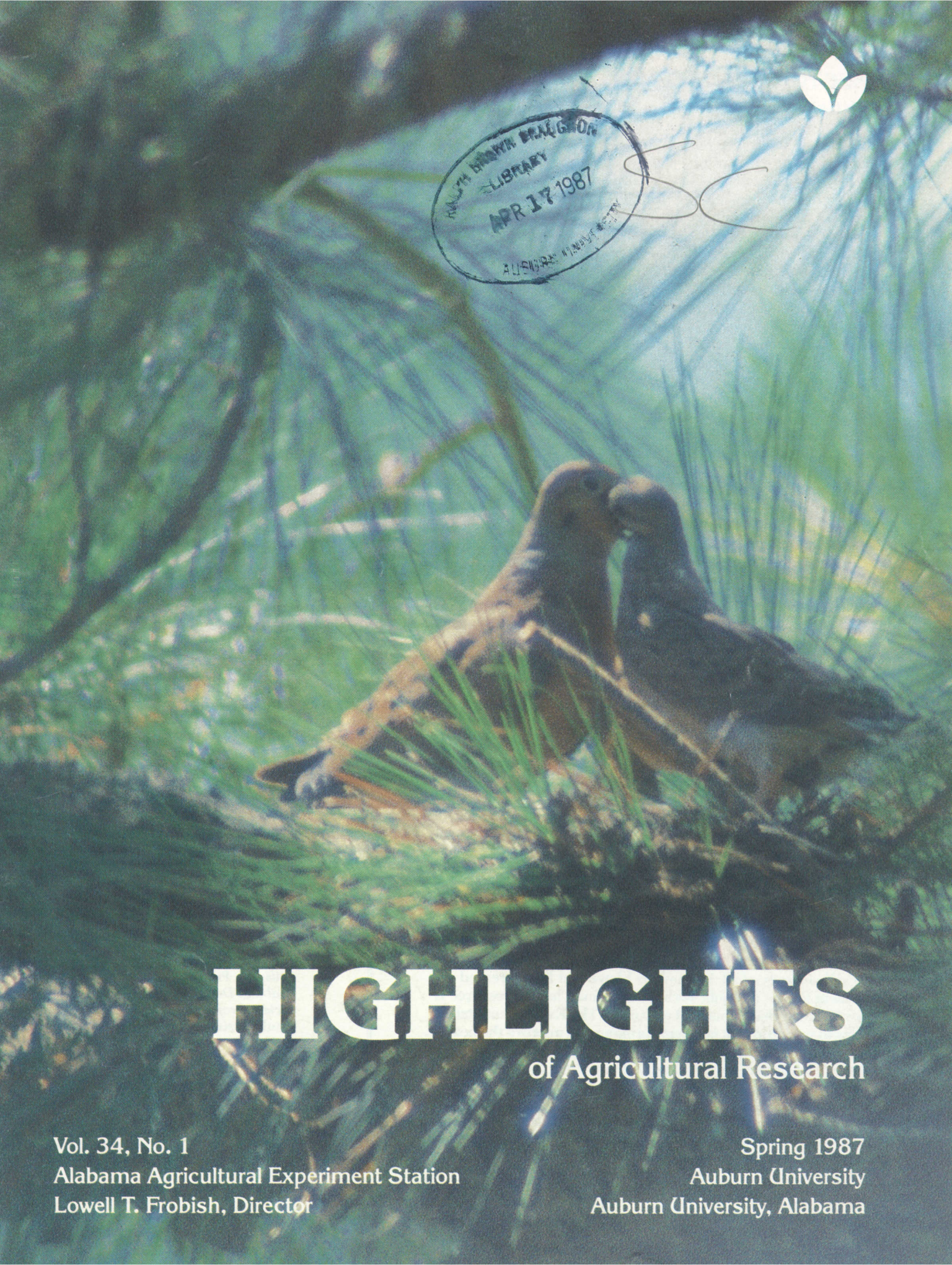




# HIGHLIGHTS

## of Agricultural Research

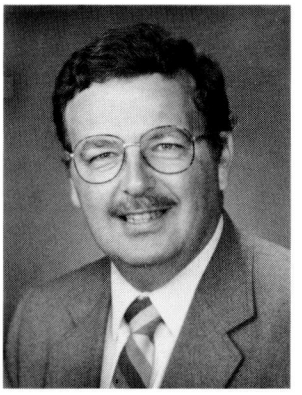
Vol. 34, No. 1
Alabama Agricultural Experiment Station
Lowell T. Frobish, Director

Spring 1987
Auburn University
Auburn University, Alabama

## DIRECTOR'S COMMENTS

CHANGE IS ALWAYS with us and affects us in many different ways and forms. Often change allows us to review where we are and where we want to go. In October 1986, I experienced a change—a new job. Just the anticipation of the change caused a sense of excitement, a sense of a new beginning. It is with this new excitement and energy that I assume the responsibility as Director of the Alabama Agricultural Experiment Station.

Farmers and their farms are not alike. Farm operators differ in age, educational attainment, management skills, and whether they are full-time or part-time farmers. Their farms range from a few acres to thousands of acres in size, they may raise livestock or grow crops, and they may be specialized in one type of farm enterprise or be diversified. However, they share a common dedication to agriculture and a conviction that each individual farm is adding to the wealth and well-being of the Nation. Yet they are just as convinced that their relative position in the economy is declining. Change has been the order of business in agriculture and many farmers question the uncontrolled changes that have occurred.



**DR. LOWELL T. FROBISH**

The Alabama Agricultural Experiment Station must be involved in orchestrating change. The vast abundance of food and fiber in the United States is the result of investments in research and the resulting development and use of improved technology in the production, processing, and distribution of farm commodities. Progress that has been made during the past 50 years is phenomenal. And the progress required in the next 50 years will be even more phenomenal. Increased production is not the answer to farm problems, but increased efficiency of production is the key to success. A change in one part of the environment will cause changes in other parts. World agricultural problems are offsprings of natural, social, and economic conditions and are linked so closely that an upset in a locality may be felt on the other side of the globe. Our research programs must consider all effects of change.

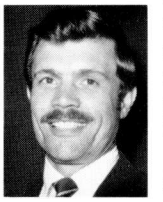
To meet the needs of the future, a team effort is needed. Team members are from all over the world, all occupations, large and small enterprises, and from the Agricultural Experiment Stations. Together we identify problems, set a course of action, perform our respective duties, and commence to orchestrate change.

It is said that Alabama has 10 percent of the Nation's natural resources. Since October, I have traveled throughout the State and have been introduced to many people. The enthusiasm, friendliness, and sincerity of all Alabamians I have met has increased my excitement for the new job. Perhaps Alabama's human resource is more important than its natural resources. The Experiment Station pledges to work through our many programs to improve the health and well-being of all people.

We, in agriculture, have come a long way. From the pioneer with ox and horse and wooden plow to where today the machine has taken over. In some ways, man has lost out. If we look again, however, we may see through the mist a better time ahead, where progress and people go hand in hand. The past was hard, the present is not easy, and the future is uncertain. One thing for sure, change will continue.

## *may we introduce*

Dr. Elvin Thomas, Associate Professor of Animal and Dairy Sciences, who has been a regular contributor to *Highlights* since joining the Auburn faculty in 1977. His research on beef cattle feeding systems has provided Alabama cattlemen with some money-making alternatives to shipping cattle out of state for finishing.



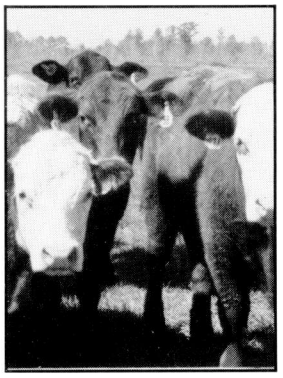
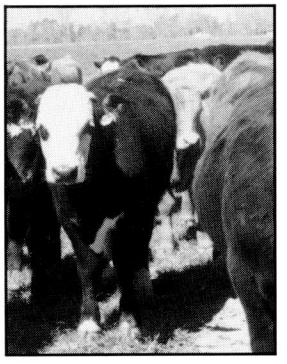
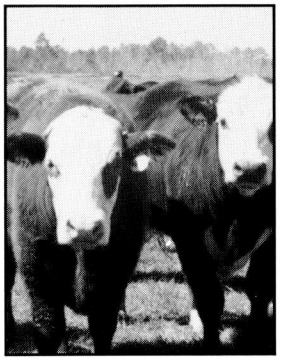
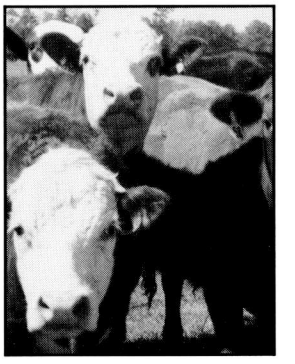
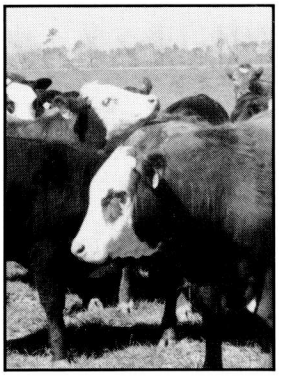
Thomas, who grew up on a farm in Iowa, is a staunch supporter of the efforts of Alabama cattlemen to grow their own feed and keep cattle in the State until slaughter. His recent research using grain sorghum, cottonseed, poultry byproducts, and wheat has provided cattlemen with some alternatives to higher priced corn to supplement beef cattle grazing. Additional research on high density rotational grazing should provide even more flexibility in beef cattle feeding programs.

The Auburn researcher earned a B.S. degree in agricultural education from Iowa State University. After teaching vocational agriculture in Iowa for 3 years, he returned to Iowa State to earn an M.S. degree and the Ph.D. in animal sciences. His story on intensive grazing systems for beef cattle appears on page 3 of this issue.

SPRING 1987 Vol. 34, No. 1
A quarterly report of research published by the Alabama Agricultural Experiment Station, Auburn University.



**ON THE COVER. Adult mourning dove feeds young during summer nesting. (See story, page 13.)**

# MOB GRAZING BOOSTS PASTURE BEEF YIELDS

E.E. THOMAS, R.A. DAWKINS, and D.R. PEDANE

MOB GRAZING isn't a term for unruly cattle on pasture. Instead, it refers to an intensive grazing system in which large numbers of cattle are rotated among small pasture areas for short periods of grazing.

This intensive controlled grazing requires more fencing and management effort than continuous grazing, but there are advantages. Pasture plants grow faster if allowed a rest period, so the system increases both quantity and quality of forage produced. Average daily gain per animal is usually less because animals are forced to eat entire plants instead of eating selected plant parts as they do under continuous grazing. However, total beef production per acre is higher under intensive grazing management as shown by first-year results of an Alabama Agricultural Experiment Station test.

A cool-season mixture of rye, ryegrass, wheat, crimson clover, and arrowleaf clover was used for the test to determine optimum stocking for both continuous and intensive grazing systems. Steers of Angus x Hereford breeding averaging 495 lb. each were placed on test pastures November 6, 1985, and removed April 29, 1986. This was 3 to 4 weeks earlier than normal to remove cattle from such pasture, but dry weather reduced the grazing season.

The intensive grazing treatment used 10-acre pastures divided into four 2.5-acre areas. Stocking rates compared were 1.6, 2.0, 2.4, and 2.8 head per acre (16, 20, 24, and 28 head, respectively, per 10-acre pasture). Continuous grazing pastures had stocking rates of 0.8, 1.2, 1.6, and 2.0 steers per acre for comparison.

Mob grazing management consisted of allowing the steers within each treatment to graze as a group until forage was eaten down to an average height of 4-5 in. The group was then moved to one of the remaining three pasture areas, based on forage availability rather than on a strict rotation sequence. During periods of insufficient grazing, the cattle were confined to one of their four pastures where big bales of Coastal bermudagrass hay were placed in retaining rings for animals to feed free choice. No grain was fed.

Data in the table illustrate the contrasting results from the two grazing systems. Continuous grazing resulted in high daily gains at low stocking rates, up to 2.36 lb. per day. In contrast, intensive controlled grazing supported high stocking rates with lower per animal daily gains but considerably higher beef production per acre.

Highest per acre beef gain in the test was 617 lb. from stocking of 2.8 steers per acre on intensive controlled grazing. Top production under continuous grazing was 478 lb. per acre from stocking rates of 2.0 steers per acre. At the higher stocking rates, daily gain per animal showed little difference between systems.

Hay feeding was required more days under intensive management, and hay feeding days increased with increasing stocking rate. However, total amount of hay fed showed little difference except at the lowest stocking rate on continuous grazing. Almost no hay was required on the 0.8 steer per acre stocking on continuous grazing, but this treatment produced only 326 lb. of beef per acre.

Economic calculations of these first-year data show that net returns under continuous grazing were maximized at stocking rate of 1.2 head per acre. These returns were similar to those achieved under intensive grazing management. Effect of dry weather conditions on these results must be considered, however. Under normal conditions, grazing would continue into May, 3-4 weeks longer. This would boost production considerably, especially under heavy stocking on intensive grazing, and widen the advantage of mob grazing over continuous grazing.

Thomas is Associate Professor, Dawkins is Superintendent, and Pedane is Herd Supervisor of Animal and Dairy Sciences.

EFFECT OF GRAZING SYSTEM AND STOCKING RATE ON BEEF PRODUCTION, 174-DAY TRIAL[1]

| Production measure | Result, by stocking rate and grazing system | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Continuous grazing | | | | Intensive controlled grazing | | | |
| | 0.8 | 1.2 | 1.6 | 2.0 | 1.6 | 2.0 | 2.4 | 2.8 |
| Av. daily gain, lb. | 2.36 | 1.93 | 1.54 | 1.39 | 1.68 | 1.27 | 1.31 | 1.27 |
| Total beef/acre, lb. | 326 | 400 | 426 | 478 | 466 | 440 | 545 | 617 |
| Grazing days, no. | 170 | 158 | 143 | 138 | 106 | 82 | 75 | 69 |
| Hay feeding days, no. | 3 | 15 | 30 | 35 | 67 | 91 | 98 | 104 |
| Hay fed/steer, lb. | 233 | 959 | 1,635 | 2,162 | 1,175 | 1,800 | 1,583 | 1,671 |

[1]The grazing trial began November 6, 1985, and ended April 29, 1986; terminated because of extremely dry soil conditions.

# Producing freshwater shrimp in ponds may be option on Alabama farms

D.B. ROUSE

PRAWNS ... river shrimp ... freshwater shrimp ...

Whatever name is used, this large freshwater crustacean has the potential for a pond crop in Alabama. Research at the Alabama Agricultural Experiment Station shows annual yield of 500-1,000 lb. per acre of pond is possible from *Macrobrachium rosenbergii*, a species imported from Asia.

Freshwater shrimp have several traits that make them desirable for pond culture.

1. They grow fast, from newly hatched young to a jumbo shrimp (15 per pound) in 4-5 months.

2. They are hardy, withstanding handling and poor water quality resulting from intensive management.

3. They are relatively free of disease problems and can be easily reproduced.

4. They can be grown in freshwater ponds, whereas marine shrimp require production in more expensive coastal ponds.

Although these shrimp are reared in freshwater, their newly hatched young (larvae) must be grown in brackish water with a salt content of 12 to 15 parts per thousand (seawater has about 34 parts per thousand). After 3-4 weeks of development, the larvae metamorphoses to a freshwater stage (postlarvae) and can be transferred directly to freshwater ponds for final growout. Larval rearing is carried out in hatcheries where water with the desired salinity can be maintained. Hatcheries generally recirculate water through a filter so the saltwater can be cleaned and reused.

Culturing freshwater shrimp in temperate climates, such as in Alabama, requires a new set of management conditions. Freshwater shrimp grow relatively fast when water temperatures are in the range of 80° to 90°F. However, growth falls off sharply below 70°F, and below 60°F stress and mortality result. In Alabama the growing season is from May to October.

Attempts to intensify production in Auburn research identified new problems. The general practice of increasing stocking and feeding rates that works with other aquatic animals cannot be used with prawns, since their growth is density dependent. Large males in a population inhibit the growth of small males when grown at densities above 15,000-20,000 per acre. In the tropics, large males are harvested periodically, allowing the smaller males to resume growth. In a 4- to 5-month growing period, this management practice is not possible. The result, as illustrated in the table, is that as stocking density is increased, average size decreases, even when feeding and water quality are adequate.

PRODUCTION OF FRESHWATER PRAWNS WITH DIFFERENT MANAGEMENT STRATEGIES

| Stocking size and rate | Yield/acre | | Harvest weight |
|---|---|---|---|
| | Prawns | Fish | |
| | *Lb.* | *Lb.* | *Grams* |
| Prawn (postlarvae) | | | |
| 36,500/acre ..... | 950 | — | 18 |
| 16,000/acre ..... | 600 | — | 30 |
| Prawn (nursed juveniles) | | | |
| 14,000/acre ..... | 1,000 | — | 41 |
| Prawn (postlarvae) | | | |
| 14,000/acre + fish | 500 | 800-2,000 | 25-30 |

In an attempt to increase yields and average size in prawn ponds, an indoor nursery phase is being tried. The hatchery phase begins in March, followed by a 4- to 6-week nursery period in indoor tanks before water temperatures reach adequate levels outdoors. Using this system, a 1-gram juvenile prawn can be stocked in a rearing pond in May rather than the 0.05-gram postlarval prawn that is typically stocked from the hatchery. By using warm water to produce juvenile prawns, a crop can be produced by October.

Another possible method of freshwater shrimp production is to include them with fish in polyculture. One requirement for polyculture is that the component species should not impair growth and survival of the other species through competition for food or space. Since prawns spend most of their time on the pond bottom, fish which occupy the upper regions of the pond are good polyculture candidates.

Various combinations of freshwater prawns and channel catfish, tilapia, and chinese carp are being evaluated in Experiment Station ponds. Early results indicate that all three groups of fish have good potential. There was no reduction in survival or total yield of shrimp when cultured with any one of the three fish. Shrimp production averaged 500 lb. per acre with an average size of 20-30 grams (25 per pound). Fish production ranged from 800 to 2,000 lb. per acre depending on the fish species used. The highest shrimp production occurred in combinations with chinese carps, 15% better than with other fish or under shrimp monoculture. This result indicates a possible synergistic effect between the filter feeding carp and bottom dwelling shrimp.

Results in a shrimp and fish polyculture study indicate that feeding is needed only for the fish. When only the fish were fed, shrimp production was still 500 lb. per acre.

Early economic analyses indicate that profitability is marginal because the growing season is too short. Other experiments suggest that production can be increased with different culture techniques, which may eventually lead to its economic feasibility in Alabama.

Rouse is Assistant Professor of Fisheries and Allied Aquacultures.

# LYME DISEASE

## a new tick-related problem in Alabama

G.R. MULLEN, L.J. HRIBAR, and C.S. MURPHREE

THE FIRST human case of Lyme disease in Alabama was recently documented at the Alabama Agricultural Experiment Station. The causative agent of the disease is a spirochete which is transmitted to man by the bite of infected ticks. A Lee County woman was positively identified as having the disease after being bitten by ticks on a family camping trip to the Choccolocca Wildlife Management Area in northeastern Alabama. Her teenage son was also bitten by ticks on the trip but did not contract the disease.

Lyme disease is a relatively new tick-borne disease first recognized in Connecticut in 1975. Since that time, the number of cases has risen dramatically in the United States with the highest prevalence in the New England and Mid-Atlantic states. In 1984, nearly 1,500 human cases were reported in 20 states, including 40 cases in North Carolina, Georgia, Florida, Tennessee, Arkansas, and Texas.

The causative agent of Lyme disease is *Borrelia burgdorferi* which infects small wild rodents and white-tailed deer. Certain ticks which feed on these hosts pick up the spirochete and then transmit it to humans upon attachment and subsequent feeding. About a week later, a characteristic skin lesion usually begins to develop as an expanding circular rash with a relatively clear center. If treated early enough, the spirochete is effectively killed by broad-spectrum antibiotics such as tetracycline and penicillin. If not treated, however, the agent typically invades the joints and spinal fluid, later causing acute arthritis and various neurologic and cardiac disorders. These medical complications may not develop for months, or even one or more years, after the initial exposure to infected ticks.

Only two ticks have been found to be efficient vectors of Lyme disease in the United States: *Ixodes dammini* in the Eastern States, and *I. pacificus* in the Western States. Neither is known to occur in Alabama and adjacent states. It is thus apparent that one or more other tick species are responsible for natural transmission of the disease agent in the Gulf Coast region. Unfortunately, the ticks involved in the Alabama case were discarded before any identification could be made.

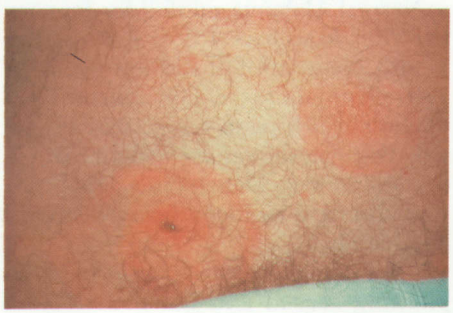
To determine what species were present at the exposure site, a follow-up survey of ticks was conducted in that immediate area. This was done in cooperation with personnel from the School of Public Health at the University of Alabama at Birmingham (UAB) and the Choccolocca Wildlife Management Area. Ticks were collected in June 1986 using flannel drag cloths to sample areas along camping trails and an associated recreational area in which the family had camped. The sampling method entailed pulling a large piece of light-colored flannel along the ground and over vegetation. Ticks, mistaking the disturbance and moving fabric for a potential animal host, readily grasp and cling to the flannel cloth. Live ticks collected in this way were removed with forceps and transferred to small holding containers for subsequent identification and examination for spirochetal infections.

A total of 148 specimens of two tick species, including both nymphs and adults, was thus obtained at the Choccolocca site. The majority (88%) were the lone star tick (*Amblyomma americanum*). The remainder were the American dog tick (*Dermacentor variabilis*). None of these specimens was found to be infected with the Lyme disease agent based on dissections and a fluorescent antibody test specific for this tick-borne parasite.

Although no evidence is yet available to incriminate either of the above ticks as vectors of Lyme disease in Alabama, *B. burgdorferi* has been recovered from field-collected specimens of both the lone star tick and the American dog tick in other states. Perhaps of greater importance, however, is the black-legged tick (*Ixodes scapularis*), the most common tick infesting white-tailed deer in Alabama. This species is closely related to *I. dammini*. Like *I. dammini*, the larvae and nymphs of this tick parasitize small mammals, whereas the adults are found primarily on wild deer. In laboratory tests at UAB, black-legged ticks collected in Alabama were recently shown to be capable of being infected by the Lyme disease agent and transmitting it to hamsters.

Field work will continue during the coming year in an effort to determine the species of ticks serving as natural vectors of Lyme disease in Alabama. This will include the collection and examination of ticks from areas of suspected Lyme disease cases and from deer harvested in the State. In the meantime, it is important that physicians and the public be aware of this particular tick-borne disease so that any suspected cases are promptly reported and appropriate treatment measures can be taken.

Mullen is Associate Professor and Hribar and Murphree are Doctoral Students of Entomology.



***I. dammini*** **(top), the most common vector of Lyme disease in the Eastern United States, is similar to black-legged ticks which are commonly found on white-tailed deer in the Southeast. Circular skin lesions (bottom) are distinct early symptoms of Lyme disease.**

# Alabama's 1986 Drought May Have Long Lasting Effects

J.H. YEAGER

LAST YEAR'S drought was long lasting and in some respects the most devastating of any in the past 25 years. It occurred at a time when many farmers already faced financial problems and uncertainties. As a result, the economic consequences may be more long lasting than from previous droughts. On many farms, major adjustments will have to be made to overcome effects of the 1986 drought.

Most farm crops require substantial quantities of water continuously during the growing season for normal growth and development. This did not happen in 1986, as shown by data from 10 Alabama locations given in table 1. Alabama began the year with rather serious deficits in rainfall at 5 of the 10 locations. Largest deficit was 14.1 in. at Marion Junction, while Fairhope began with 9.0 in. above normal.

Normal Alabama rainfall for January through March is 4.5 to 6.0 in. per month. This rainfall did not occur in 1986. The January deficit ranged from 0.8 in. at Fairhope to 4.9 in. at Winfield; only Brewton showed an amount that exceeded normal. Deficits in rainfall continued at most locations during February and March.

April rainfall is critical because of the planting season and the necessity of moisture for satisfactory germination of seeds. However, in 1986 all 10 locations reported rainfall deficits in April, generally in the range of 4 to 5 in. Some rainfall was received in May, but generally it was inadequate to meet crop needs. This meant poor stands and replanting in some cases.

During the growing season (June, July, and August) below normal rainfall continued. It was not until November that all 10 locations reported any substantial rainfall amounts. This was too late to improve crops, and in some cases interfered with harvesting and caused further losses.

TABLE 1. DIFFERENCE IN ACTUAL AND NORMAL RAINFALL, TEN ALABAMA LOCATIONS, 1985 AND 1986 BY MONTHS

| Month | Rainfall in relation to average | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Auburn | Belle Mina | Brewton | Camden | Cross-ville | Fair-hope | Head-land | Marion Junction | Thorsby | Win-field |
| | *In.* | *In.* | *In.* | *In.* | *In.* | *In.* | *In.* | *In.* | *In.* | *In.* |
| 1985 total... | -11.1 | -6.0 | 0.2 | -13.6 | 7.8 | 9.0 | - 3.6 | -14.1 | - 8.3 | - 4.5 |
| **1986** | | | | | | | | | | |
| Jan. ..... | - 2.9 | -4.2 | 3.9 | - 2.3 | - 3.5 | - .8 | - 1.0 | - 3.5 | - 3.6 | - 4.9 |
| Feb..... | - .7 | -1.0 | -1.5 | - .1 | - 2.2 | - .1 | - .4 | - 1.4 | - 2.9 | - 1.8 |
| Mar..... | .8 | -3.8 | 1.3 | - 1.8 | - 4.7 | -2.6 | - 1.6 | - 4.7 | - 5.2 | - 1.5 |
| Apr..... | - 4.7 | -4.1 | -4.6 | - 4.3 | - 4.4 | -1.6 | - 4.2 | - 5.2 | - 5.8 | - 4.9 |
| May ..... | - 3.2 | .2 | - .9 | 2.6 | .2 | .4 | .4 | 1.6 | 1.6 | 4.2 |
| June..... | - .2 | 2.6 | -1.6 | - 2.4 | - 1.5 | - .4 | - 1.9 | - 3.4 | - 2.5 | - .5 |
| July ..... | - 1.7 | - .8 | 2.3 | - .9 | - 1.3 | -3.5 | - 1.2 | .4 | - 1.4 | - 1.9 |
| Aug..... | - .3 | 2.8 | -1.9 | - .1 | 2.3 | -1.0 | .1 | - .5 | - .1 | .8 |
| Sept. ..... | .4 | 1.0 | -1.9 | - 1.2 | - 3.0 | -4.1 | - 2.1 | 1.6 | - 1.8 | - 1.7 |
| Oct. ..... | 3.3 | 1.2 | 1.1 | - .8 | 2.8 | 2.8 | .5 | .8 | .8 | 1.6 |
| Nov..... | 9.1 | 5.7 | 5.4 | 7.7 | 2.7 | 2.3 | .0 | 9.4 | 10.6 | 2.1 |
| Dec..... | - 2.9 | - .6 | -1.9 | - 2.1 | - 2.6 | - .5 | - .4 | - 1.7 | - 2.0 | - 1.5 |
| Total..... | - 3.0 | -1.0 | - .3 | - 5.7 | -15.2 | -9.1 | -11.0 | - 6.6 | -12.3 | -10.0 |

TABLE 2. COMPARISON OF ACREAGE HARVESTED AND YIELD OF MAJOR FIELD CROPS IN ALABAMA, 1981, 1981-85 AVERAGE, AND 1986

| Crop | Comparison among years | | |
|---|---|---|---|
| | 1981 | 1981-85 average | 1986 |
| **Cotton** | | | |
| Acres harvested ... | 372,000 | 302,000 | 313,000 |
| Yield/acre, lb. .... | 545 | 645 | 506 |
| **Corn** | | | |
| Acres harvested ... | 530,000 | 417,000 | 270,000 |
| Yield/acre, bu. ... | 55 | 64 | 57 |
| **Soybeans** | | | |
| Acres harvested ... | 2,020,000 | 1,584,000 | 630,000 |
| Yield/acre, bu. ... | 23 | 23 | 23 |
| **Peanuts** | | | |
| Acres harvested ... | 222,000 | 200,000 | 219,000 |
| Yield/acre, lb. .... | 2,715 | 2,820 | 2,260 |

All 10 locations ended 1986 with a rainfall deficit for the year. For 6 of the 10 locations, the deficit was greater than at the beginning of the year.

Alabama rainfall in 1986 was inadequate for almost all crops. Losses resulted from poor stands, replanting costs, lowered yields, abandonment in some cases, and reduced quality for some crops. This reduced production and lowered farm income are being adversely felt by many agribusinesses and other firms.

The Alabama acreage harvested has trended downward since 1981, resulting in reduced total production of major crops. The decline has been substantial for soybeans, table 2. Not all of the decline in crop acreage can be attributed to drought, of course, but much of the lowered production in 1986 was a direct result of the drought. Cotton and peanuts showed a slight increase in acreage harvested in 1986 compared to the 5-year average, but total production was low because of drought-reduced yields.

The 1986 peanut yield of 2,260 lb. per acre was only 80% of the 5-year average, and quality was also reduced. Corn yield was reported at 57 bu. per acre for 1986, 7 bu. below the 5-year normal. Cotton averaged 506 lb. of lint per acre, only 78% of the 5-year normal yield, and drought damaged quality. Hay production in the State was reduced substantially.

Weed problems in most crops in 1986 were more serious than usual because of inadequate moisture to activate herbicides used. In some cases, additional costs were incurred in weed control.

Short-term consequences of the 1986 drought are clear. Farmers who were already in serious financial difficulties may be unable to continue farming, and others will begin the 1987 crop year in a much riskier situation. The same can be said of agribusinesses that depend on business from farmers to survive.

The long-term implications are harder to see, but they may be even more serious to agriculture in general. Much depends on the kind of cropping seasons that 1987 and following years bring, as well as impact of farm legislation and general economic conditions. Another bad year (or more) could deal a crippling blow to Alabama agriculture.

Yeager is Professor and Head of Agricultural Economics and Rural Sociology.

# Microcomputer-based model improves soybean pest management

D.A. HERBERT, P.A. BACKMAN, T.P. MACK, R. RODRIGUEZ-KABANA, and M. SCHWARTZ

SOYBEAN ACREAGE increased in the United States by 65% from 1971 to 1983, with much of this expansion in the Southeast. This shift in acreage from traditional Midwestern locales has been accompanied by overall increases in the cost of soybean production, in part due to more severe pest problems in the Southeast. To worsen matters, average per acre yields in the Southeast have decreased steadily during the past decade. This has further reduced profit margins and pushed soybean production to the brink of economic unfeasibility.

Many states have aided soybean farmers by implementing integrated pest management (IPM) systems that maximize control efforts and minimize costs. In the spring of 1985, a 3-year effort was begun at the Alabama Agricultural Experiment Station to develop an IPM system for Alabama soybeans. This system draws from data bases accumulated over years of research by scientists at Auburn. It utilizes soybean plant growth data; population data on the major insect, nematode, and plant disease pests found in each soybean growing region of the State; real-time and 30-year average weather data; crop loss (due to pest damage) data; and pesticide efficacy data. All of this information has been integrated into a single computer model, illustrated by flow chart, which is contained on a single floppy disk.

Once the model is perfected, disk copies will be available to any grower, consultant, or extension person and can be used on IBM compatible personal computers. The model predicts potential yield and crop value based on the cultivar selected, location, and planting date. As the season progresses, crop yields are affected by interactions with pests and weather phenomena, which vary among locales. The impact by pests is managed or manipulated by selected control tactics (i.e., pesticide applications, crop rotation, etc.), and the costs of those management practices are compared to the predicted increased value of the crop.

The model can troubleshoot each specific pest management decision prior to its use. For instance, a grower facing a problem with defoliation by a soybean looper infestation can input the cultivar planted, planting date, location (county), general crop condition, current market value of his soybeans, and the average number of looper larvae per foot of row. This input will prompt the display of an insecticide list from which he can choose. Any choice will begin a model simulation that predicts the potential yield loss due to the damage level predicted for soybean looper. Predicted damage is reduced based on the efficacy of the particular pesticide the grower has chosen. Material and application costs are then weighed against the potential amount of yield maintained (protected) and its market value. The net gain or loss achieved by any decision is displayed so that the model user can determine whether his pest management choice would be a valuable one.

The model can be used prior to the season to aid in cultivar selection and during the season as pest problems develop and crop conditions change. To date, the model includes pest/crop damage scenarios for soybean looper, corn earworm, green cloverworm, velvetbean caterpillar, bean leaf beetle, green stink bug, stem anthracnose, brown spot, frogeye, cyst nematode, and root-knot nematodes. Experiments are underway to gain the necessary information to include three cornered alfalfa hopper, lesser cornstalk borer, and stem canker in the model.

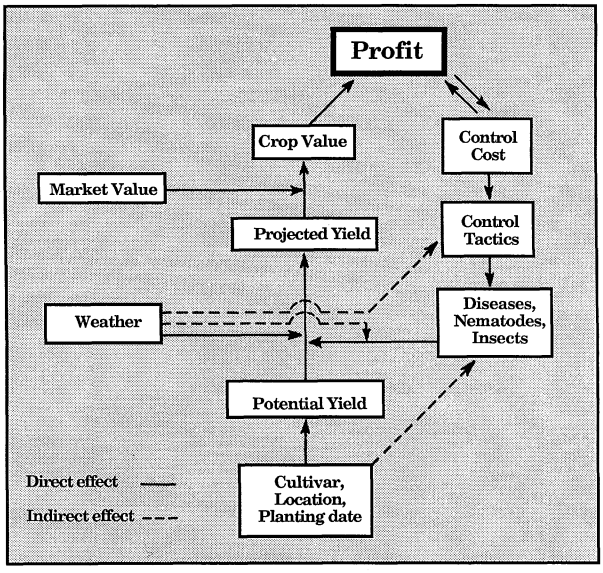
During 1986, 17 field experiments were established in six of the major soybean growing regions of Alabama to test the validity of the IPM model. Each experiment was designed to compare results (net profit) of pest management decisions made by the model to results of 'local practice' decisions (i.e., those typical of growers in the area of each test field). Pest management decisions began with the preseason selection of cultivars based on their degree of nematode susceptibility and the level of nematode infestation in each test field. Decisions concerning plant disease epidemics and insect infestations were made as they developed throughout the season. Model and local practice decisions were compared on 20 fungicide, 13 nematicide, and 4 insecticide applications during the season. Net profit (yield value-cost) was calculated for each specific pest management program.

The model decision was cost favorable 61% of the time on fungicides, 61% on nematicides, and 76% on insecticides. Damage by nematodes was most consistently managed by model selected cultivars vs. recommendations that relied on protective nematicide treatments. Yields were increased with almost every recommended fungicide application. However, due to low 1986 crop prices, yield increases did not always offset control costs. Although several insect infestations occurred, no insecticide treatments were recommended by the model. In most cases that decision was correct since pest populations did not reach economic injury levels.

The 1986 season was abnormally dry throughout most of Alabama, and research plots as well as grower fields suffered. Overall, however, the model proved to be a profitable aid in the pest management process. Several improvements were suggested by the 1986 data and will be incorporated and tested in the coming growing season.

Herbert is a Post Doctoral Fellow of Plant Pathology, Backman is Professor of Plant Pathology, Mack is Associate Professor of Entomology, Rodriguez-Kabana is Professor of Plant Pathology, and Schwartz is a Research Assistant of Plant Pathology.

**Flow chart of soybean pest management model.**



# Tomato Spotted Wilt Found in Alabama Peanut Fields

A.K. HAGAN, J.R. WEEKS, R.T. GUDAUSKAS, and W.S. GAZAWAY

A VIRUS DISEASE of peanuts, tomato spotted wilt, was found in Alabama in 1986 for the first time. This potentially serious disease has been present in Texas peanuts since 1971, but did not become a serious problem there until 1985.

Typical symptoms of tomato spotted wilt were found on peanuts in Henry County in June 1986. The virus that causes the disease (tomato spotted wilt virus) was identified, confirming the presence of the disease. By midsummer, symptoms were seen in almost all peanut fields across the Wiregrass and also in peanut samples from Butler, Elmore, and Marion counties.

Since the distribution and prevalence of the disease in Alabama's peanut crop were unknown, an Alabama Agricultural Experiment Station survey was conducted to provide this information. Fields were selected at random in the nine major peanut producing counties and the survey was done during August 31-September 23, 1986.

Plants in four to six fields per county were examined for symptoms that ranged from ring spotting and mottling of individual leaflets (shown in photo) to severe stunting of limbs or whole plants. In each field, symptomatic plants were counted in five randomly selected areas consisting of 100 ft. of adjacent rows for a total of 1,000 row-ft. per field. Stand density was approximated by counting the number of plants in 1 row-ft. in each area.

**Ring spotting and mottling of individual peanut leaflets are typical of tomato spotted wilt.**

Symptoms of tomato spotted wilt were seen in most fields visited in every major peanut producing county, as noted in the table. About 80% of survey fields in Barbour and Covington Counties had symptoms, while all fields checked in Bullock, Coffee, Crenshaw, Dale, Geneva, Henry, and Pike counties did.

Disease prevalence within fields across the nine-county area was low. Highest single field incidence (3.1% of plants) and average across all fields (approximately 1%) occurred in Covington County. Average for the other counties ranged from 0.1% infection in Henry County to 0.74% in Dale County.

Symptoms were usually seen in peanut plants that had not been under moisture stress during May and June. Fields under irrigation had the highest number of diseased plants, as well as more severe symptoms, such as stunting, seed coat mottling, and reduced pod set. In fields with the highest disease incidence, infected plants often occurred in "hot spots" that extended 5 ft. or farther down a row. Such spots probably developed as thrips nymphs carrying the virus moved from diseased to adjacent healthy plants.

As some apparently virus-infected plants reached maturity, a rapid decline of plant vigor was seen. This was characterized by a general yellowing or chlorosis of foliage, collapse of limbs, and finally plant death, particularly in fields with the highest level of tomato spotted wilt. Faint ring spotting or mottling was sometimes noted on leaves of rapidly declining peanut plants. Similar symptoms called "sudden death syndrome" have also been seen on Florunner peanuts in Texas. Whether the tomato spotted wilt virus or another pathogen is responsible for "sudden death syndrome" is not known.

OCCURRENCE OF TOMATO SPOTTED WILT IN PEANUTS, ALABAMA, 1986

| County | Fields with symptoms[1] | Percentage of diseased plants | |
|---|---|---|---|
| | | Range | Mean[2] |
| Barbour | 5/6 | 0-1.25 | 0.47 |
| Bullock | 5/5 | .07- .71 | .35 |
| Coffee | 5/5 | .09-1.00 | .54 |
| Covington | 4/5 | 0-3.11 | .98 |
| Crenshaw | 4/4 | .21-1.28 | .56 |
| Dale | 6/6 | .12-1.73 | .74 |
| Geneva | 5/5 | .08- .72 | .25 |
| Henry | 7/7 | .04- .18 | .10 |
| Houston | 5/6 | 0- .47 | .15 |
| Pike | 5/5 | .15- .48 | .27 |
| Total or average | 51/54 | 0-3.11 | .49 |

[1]No. fields showing symptoms/total fields surveyed.
[2]All fields surveyed.

Few infected plants were found in dryland peanuts under severe drought stress much of the summer. Chlorotic rings or mottling on a single leaflet or leaf were often the only symptoms seen; severe stunting was rarely recorded. Infected plants were usually isolated and widely scattered across a field. Some fields appeared to be completely free of the disease.

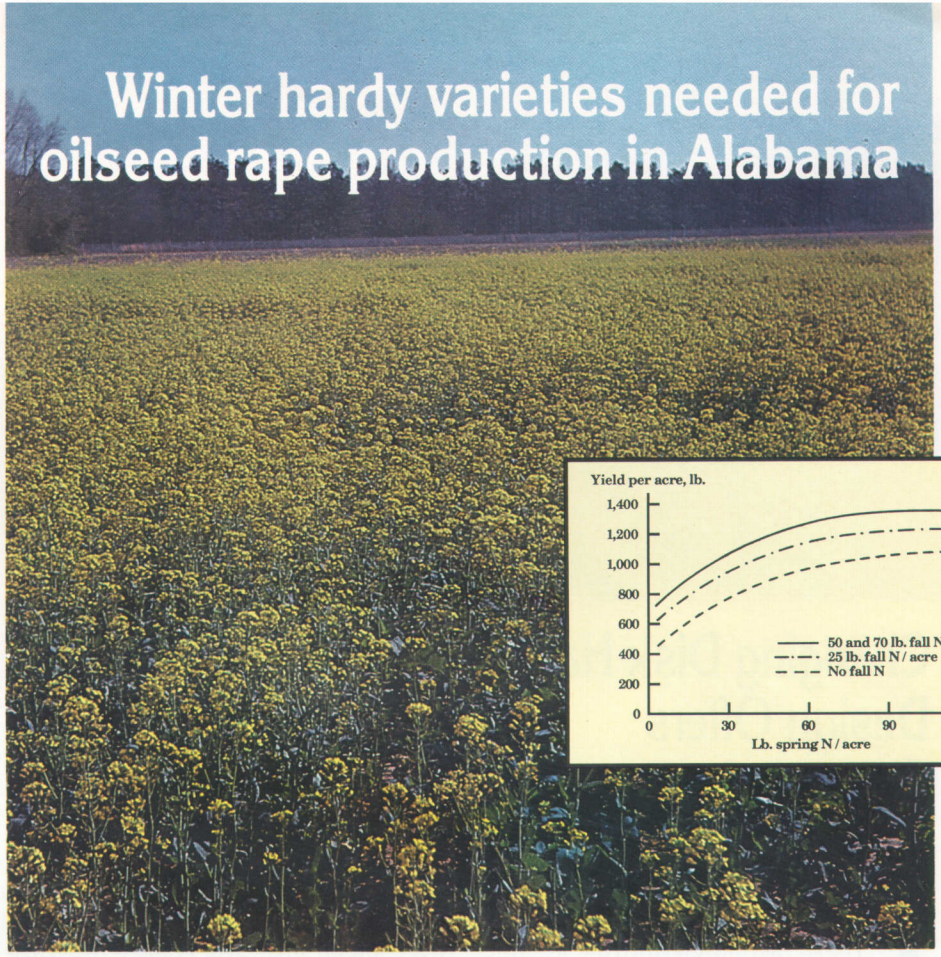
Five thrips species are the only known vectors of tomato spotted wilt virus. Western flower thrips is considered the most efficient vector, though the common tobacco thrips will also transmit the virus.

In the two fields sampled, only the tobacco thrips was collected. It is also the most common thrips species found on peanuts in the Southeast. Since initial virus infection probably occurred in June and July, another species such as the western flower thrips may also have been present.

Results of the Auburn survey show that tomato spotted wilt was widely distributed on Alabama's 1986 peanut crop. However, percentage of infected plants was low in all but a few scattered fields. Importance of this disease to Alabama peanut producers could dramatically increase if the virus becomes established in the area's numerous weeds and the thrips vectors are plentiful in the spring.

Hagan is Extension Plant Pathologist, Weeks is Extension Entomologist, Gudauskas is Professor of Plant Pathology, and Gazaway is Extension Plant Pathologist.

# Winter hardy varieties needed for oilseed rape production in Alabama




J.W. ODOM, J.F. PEDERSEN, D.L. THURLOW, and C.C. MITCHELL

OILSEED RAPE has been grown for centuries in Europe and Asia. Now there is interest in growing this crop in the United States, especially for double-cropping with soybeans in the South. Opportunities for this use are obvious in results of Alabama Agricultural Experiment Station research, but only if suitable winter hardy varieties become available and markets are developed.

Modern rape varieties are of two types: edible oil and industrial oil. The edible oil is a direct competitor with soybean oil and other vegetable oils used in foods. Oil from industrial rapeseed is used to manufacture plastics and is blended with mineral oils to produce special lubricants. The United States is an importer of industrial oilseed rape.

The Experiment Station tests evaluated rape as a substitute for wheat for double-cropping with soybeans, and as a single crop. Rape can often be harvested in late May in Alabama, which should allow timely planting of soybeans. Tests conducted at the E. V. Smith Research Center, Shorter, and Plant Breeding Unit, Tallasssee, included variety trials, fertility trials, and date of planting comparisons.

Yields from single-crop production at Tallassee ranged from zero for some varieties to 2,500 lb. for the top yielder, table 1. This compares with yields of about 1,100 lb. per acre reported in Canada and 1,800-3,100 lb. in Europe.

Yields were lower when rapeseed was double-cropped with soybeans, table 2. Although yields some years compared favorably with those reported from Canada, winter kill was a problem in about half the years at Shorter. This resulted when hard freezes followed long warm periods. The varieties of rape in the test were not as winter hardy as wheat.

Nitrogen requirements for rapeseed production are high. Results from the E. V. Smith Research Center tests suggest that rape following soybeans needs at least 50 lb. per acre of N in the fall, followed by at least 90 lb. in the spring. As noted in the graph, spring-applied N will not substitute for fall-applied N.

Late planting, lack of nitrogen, grazing, or any other factor that delays fall growth will reduce rapeseed yield. Fall planting is a problem when double-cropping with soybean. Even if a short-season soybean variety is used, lack of soil moisture usually delays planting rape until late October or early November. Such late planting may reduce stand survival.

In summarizing this research, it can be stated that large scale production of rapeseed in Alabama awaits two advances:

1. Development of winter hardy varieties that produce high quality oil.

2. Establishment of markets to handle the rape produced. Production without prior marketing contracts almost guarantees failure since there are no alternative uses for the crop.

**Response of oilseed rape to fall and spring N applications is illustrated in the graph.**

TABLE 1. YIELD OF SELECTED OILSEED RAPE VARIETIES, SINGLE-CROPPED AT THE PLANT BREEDING UNIT, WINTER 1981-82

| Variety | Yield/acre | Harvest date |
|---|---|---|
| | *Lb.* | |
| Quinta | 2,500 | June 7 |
| Herkules | 2,400 | May 26 |
| Primor | 2,300 | May 26 |
| WW843 | 2,300 | June 7 |
| Gorzanski | 2,200 | May 26 |
| SV031 | 2,100 | May 26 |
| Sipal | 2,100 | May 26 |
| Jet Neuf | 2,100 | June 7 |
| Norde | 2,000 | June 7 |
| Dwarf Essex | 2,000 | May 18 |
| Brink | 1,900 | May 26 |
| Rapora | 1,900 | May 26 |
| ORB | 1,800 | May 18 |
| WW696 | 1,800 | June 7 |
| Wendlers | 1,800 | June 7 |
| WW928 | 1,800 | May 26 |
| WW692 | 1,600 | May 26 |
| Emil | 1,300 | June 7 |
| Mary | 1,200 | May 18 |
| WW889 | 1,200 | June 7 |
| Nora | 1,200 | May 18 |
| Wesbell | 1,000 | May 18 |
| Gulliver | 1,000 | May 18 |
| Willi | 900 | May 18 |
| Christa | 800 | May 18 |
| Tilde | 800 | May 18 |
| Line | 800 | May 18 |
| Wesroona | 600 | May 18 |
| Winfred | 0 | — |
| Argus | 0 | — |

TABLE 2. YIELD OF RAPESEED AND SOYBEANS DOUBLE-CROPPED AT THE E.V. SMITH RESEARCH CENTER

| Season | Rapeseed yield/acre | Soybean yield/acre |
|---|---|---|
| | *Lb.* | *Lb.* |
| Fall 1979-fall 1980 | 1,200 | 600 |
| Fall 1980-fall 1981 | 1,300 | 1,500 |
| Fall 1981-fall 1982 | winter killed | 2,100 |
| Fall 1982-fall 1983 | 1,100 | 1,800 |
| Fall 1983-fall 1984 | winter killed | 1,400 |
| Fall 1984-summer 1985 | winter killed | — |

Odom is Associate Professor, Pedersen is Assistant Professor, Thurlow is Associate Professor, and Mitchell is Assistant Professor of Agronomy and Soils.

# Changing Disk Harrow Design Offers Chances for Energy Savings

C.E. JOHNSON, R.L. SCHAFER, and M.L. CHAPMAN

PREPARING LAND with a disk harrow expends a lot of energy, but there are opportunities for improvement. Research at the Alabama Agricultural Experiment Station found that changing design of disks can reduce the force required to pull a disk harrow through the soil. The bottom line was energy savings, and this was achieved without affecting the quality of land preparation.

The research was designed to measure the effect of disk gang design and operational characteristics such as disk shape, disk angle, and disk spacing on soil forces that act on disk gangs. Disk shape, angle, and spacing may affect both draft (force required to pull the disk) and vertical force (weight) needed to maintain tillage depth. Reducing the draft would provide a savings in fuel, while reducing the vertical force required could reduce the weight and cost of a disk harrow and cut down on soil compaction.

Tests in cooperation with the USDA-ARS National Soil Dynamics Laboratory were conducted with 24-in.-diameter disks of two standard shapes, one flatter than the other. Each disk shape was tested at two angles: (1) a conventional angle that results in a convex pressure area and back pressure on the back side of the disk, and (2) an angle which allowed clearance on the back of the disk and no convex pressure area, figure 1. Design trends have been toward flatter, spherical disks or conical disks which give less convex pressure area for the same disk angle. One to five disks were tested on a gang, figure 2.

In the first series of tests, a constant disk spacing of 9.8 in. was used. An operating depth of 5.8 in. was standard for the tests, which were done in Decatur clay loam and Norfolk sandy loam soils.

Force trends observed for soil type and disk angle were similar for disk gangs and single disks. Disk gang forces were related to the number of disks in the gang. This linear relationship is illustrated by the example shown in figure 3. Interactions occurred in disk gang forces that made the estimation of gang forces from single disk data inaccurate, as shown by data in the table. The draft of a disk gang with five disks is not equal to five times the draft of a single disk.

In all cases, more draft and vertical force were required when operating at the back pressure angle than when operating with clearance. This is illustrated by the example plotted in figure 3. These results indicate that a minimum of two disks on a gang is needed to study soil forces.

A second series of tests used single and double disks with disk spacing ranging from 7.9 to 13.8 in. Soil forces were found to be a linear function of spacing over this useful range.

Results from the two series were combined to develop a mathematical relationship for the soil forces in terms of the number of disks and disk spacing. These data established that interactions in disk gang forces depended on disk spacing for a given disk shape, disk angle, and soil, all of which affect draft requirements.

The lesson learned from this research is that the draft of disk harrows can be reduced without affecting tillage performance. Reducing draft causes a direct decrease in tillage energy use, thereby lowering the cost of production. This energy saving can be brought about by changing disk harrow design to provide wider blade spacing and by operating the harrow gangs at greater angles than normal to provide clearance on the back sides of the blades.

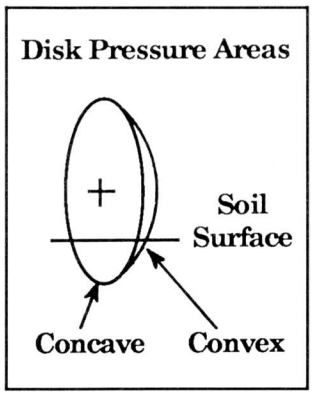
Results from this research point to the possibility of developing a field adjustable disk harrow that will allow farmers opportunities for highly efficient tillage operations.

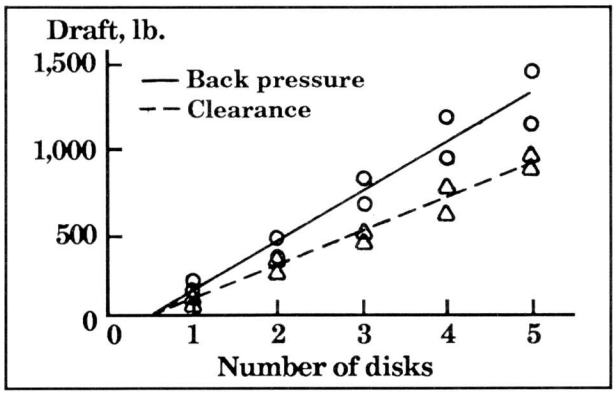
Johnson is Professor of Agricultural Engineering; Schafer is Agricultural Engineer, USDA-ARS; and Chapman is a Former Graduate Student of Agricultural Engineering.

DRAFT MEASUREMENT BY DISK SHAPE, DISK ANGLE, AND SOIL TYPE

| Disk shape and angle and soil type | Draft for single disk | Draft/ additional disk |
|---|---|---|
| | *Lb.* | *Lb.* |
| CONCAVE DISK | | |
| **Back pressure angle** | | |
| Norfolk sandy loam ..... | 249 | 396 |
| Decatur clay loam ..... | 214 | 341 |
| **Clearance angle** | | |
| Norfolk sandy loam ..... | 126 | 268 |
| Decatur clay loam ..... | 107 | 252 |
| FLATTER DISK | | |
| **Back pressure angle** | | |
| Norfolk sandy loam ..... | 241 | 335 |
| Decatur clay loam ..... | 167 | 286 |
| **Clearance angle** | | |
| Norfolk sandy loam ..... | 165 | 232 |
| Decatur clay loam ..... | 106 | 207 |

**FIG. 1. (left). Disks were tested at two angles, to result in concave and convex pressure areas. FIG. 2 (title photo). One to five disks were tested on a gang. FIG. 3 (right). Draft of disk gang (flatter disk) in Decatur clay loam.**



# Initial Impact of the DAIRY TERMINATION PROGRAM

L.E. WILSON

IN THE EARLY 1980s national milk production began to increase faster than commercial use. This led to a growing volume of surplus dairy products purchased by the government in its price support programs, table 1. At this same time, milk production in Alabama and the Southeast was fairly well-balanced with commercial demand. The increasing government cost for purchasing dairy surpluses resulted in legislative attempts to bring milk production more in line with domestic demand. In the South, where surpluses were not a problem, government supply-reducing programs have occasionally created serious regional shortages.

Legislative programs have included price support cuts, deductions from producer marketing receipts to finance dairy programs, a voluntary diversion plan in 1984 and 1985 in which dairy farmers were paid to reduce milk production, and a marketing assessment to finance dairy product and promotion programs. In spite of these efforts, excess milk production remains a problem. Almost 10% of the milk produced in 1985 was purchased by the USDA, at a cost of over $2 million.

TABLE 1. U.S. MILK MARKETINGS AND USDA NET REMOVALS, 1977-85

| Year | Milk marketings[1] | Net removals by USDA[2] | Removals as a percent of marketings |
|---|---|---|---|
| | *Bil. lb.* | *Bil. lb.* | *Pct.* |
| 1976..... | 117.2 | 1.2 | 1.1 |
| 1977..... | 119.8 | 6.1 | 5.1 |
| 1978..... | 118.8 | 2.7 | 2.3 |
| 1979..... | 120.9 | 2.1 | 1.8 |
| 1980..... | 126.2 | 8.8 | 7.0 |
| 1981..... | 130.7 | 12.9 | 9.8 |
| 1982..... | 133.5 | 14.3 | 10.7 |
| 1983..... | 137.7 | 16.8 | 12.2 |
| 1984..... | 132.5 | 8.6 | 6.5 |
| 1985..... | 141.2 | 13.2 | 9.3 |

Source: USDA, ERS.
[1]Milk production less amount fed to calves and consumed on farms.
[2]Milk equivalent basis.

TABLE 2. SUMMARY OF SUBMITTED AND ACCEPTED DAIRY TERMINATION CONTRACTS IN ALABAMA, 1986

| Item | Submitted | Accepted |
|---|---|---|
| Number of bids .... | 136 | 91 |
| Contract base, lb. .. | 174,031,905 | 114,035,487 |
| 1985 marketings, lb. | 192,990,104 | 128,267,688 |
| Estimated payment, dol. ..... | | 16,018,540 |
| Cows, no. ..... | 17,392 | 11,667 |
| Heifers, no. ..... | 5,365 | 3,435 |
| Calves, no. ..... | 5,454 | 3,389 |
| MDP participant, no.[1] ..... | 51 | 34 |
| Lowest bid, dol. ... | 5.00 | 5.00 |
| Highest bid, dol. ... | 199.00 | 22.50 |

Source: USDA, ASCS.
[1]Milk diversion program participants.

The most recent attempt by the government to get milk supply under control includes the Dairy Termination Program (commonly referred to as the buyout program or DTP) authorized by the Food Security Act of 1985. The DTP offered cash payments to dairy farmers who contracted with the USDA to get out of dairying and to stay out for 5 years. Producers who voluntarily contracted to get out of dairying were paid a contract price per hundredweight of milk based on a production history period and were required to either export or sell all female dairy cattle for slaughter. Further, the contracting dairy farmer could have no interest in milk production or female dairy cattle for the 5 years. Producers could bid to end milk production in any or all of three specified time periods: April-August 1986, September 1986-February 1987, and March-August 1987.

Almost 40,000 producers submitted bids, ranging from $3.40 to more than $1,000 per hundredweight. Nationally, 13,988 bids were accepted from farmers who had marketed 12.3 billion lb. of milk in 1985. This was 8.7% of total U.S. production. All bids up to $22.50 were accepted, with an average payment to producers of $15.80 per hundredweight of base marketings. Participating dairy farmers held 951,619 cows and 598,784 heifers and calves. All are to be slaughtered or exported. The average herd in the DTP reported 68 cows.

Participation in the DTP varied greatly among regions, ranging from less than 6% of milk marketings in the Northeast and Lake States to 17.2% in the Southeastern States. Research at the Alabama Agricultural Experiment Station evaluated participation in these programs by State dairymen. In Wisconsin, the leading dairy state where a large volume of Commodity Corporation Credit price support purchases are made, participating dairy farmers had only 3% of 1985 marketings, while in Alabama 24% of 1985 marketings were made by producers entering the termination program.

In Alabama in 1985, 538 million lb. of Grade A milk intended for fluid use were marketed from about 420 dairy farms in Alabama. A small volume of manufacturing grade milk was sold by a few dairy farmers. Bids were submitted by 136 dairy farmers and 91 were accepted, table 2. Of the bids accepted, about 85 were Grade A dairy farmers. Some of these farmers operated more than one production unit. A few were manufacturing milk producers. In 1985, these farmers marketed 128 million lb. of milk, almost one-fourth of the milk marketed in the State. Participation in Alabama was at the highest rate in the nation. The range in bids accepted was from $5.00 to $22.50 per hundredweight, an average of $12.51. Producers located in 37 counties are participants, with the highest rate of participation in Hale (9), Cullman (7), Limestone (7), and Madison (6).

The supply-demand balance for milk in Alabama and across the South has been tight in recent years during a time of national surplus. Both the Milk Diversion Program effective in 1984 and 1985 and the Termination Program have resulted in seasonal milk shortages in the region, requiring the importation of milk from other regions at high costs to Southern producer organizations and milk handlers. In spite of the high rate of participation by Alabama and other Southern dairy farmers in the DTP, there are no supply restrictions on non-participants. Early indications are that non-participants are expanding output and will diminish the intended impact of the program, especially in regions of low participation. The largest supply reducing impacts will likely be in areas where the reductions were least needed.

Wilson is Professor of Agricultural Economics.

# Fungi and insects team up to control cotton seedling disease

R. LARTEY, E.A. CURL, C.M. PETERSON, J.D. HARPER, and R.T. GUDAUSKAS

FUNGI AND INSECTS are usually thought of as enemies of crop plants. In most cases this is true. But research at the Alabama Agricultural Experiment Station has identified fungus-insect combinations that work as biological control agents for certain plant diseases.

Biocontrol agents have been sought all over the world for many years, with fungi getting the most attention. Among the most promising agents found in recent years were three saprophytic soil fungi for control of root diseases. (Scientific names of the three are *Trichoderma harzianum*, *Gliocladium virens*, and *Laetisaria arvalis*.)

Now there is a strong interest in minute soil-dwelling insects and their possible suppression of plant pathogens that attack roots, an area of study that has been neglected. Certain insects that feed on fungi to suppress plant pathogens and reduce severity of root diseases have been discovered in Alabama. This microarthropod group, called Collembola or springtails, has been found to have the potential for suppressing pathogens such as *Rhizoctonia solani*, the soil fungus which causes seedling diseases of cotton and other crops.

A survey of cotton fields in Alabama revealed that two species of these tiny (1-2 mm long) insects (*Proisotoma minuta* and *Onychiurus encarpatus*) are most prevalent in rhizosphere soil around cotton roots. They were found to rapidly destroy colonies of *Rhizoctonia* and several other major pathogenic fungi in laboratory tests. Populations of 450-900 insects per pound of soil (1,000-2,000 per kilogram) provided excellent control of *Rhizoctonia* disease of cotton seedlings in greenhouse experiments.

EFFECTS OF FUNGAL AND INSECT BIOLOGICAL CONTROL AGENTS ON *Rhizoctonia* DISEASE OF COTTON

| Treatment in sterilized soil | Seedling emergence | Root damage index[2] |
|---|---|---|
| | *Pct.* | |
| Untreated | 91.7 | 0.02 |
| RS | 54.2 | 3.78 |
| RS + PM | 87.5 | 2.35 |
| RS + TH | 70.9 | 2.26 |
| RS + TH + PM | 58.3 | .74 |
| RS + GV | 75.0 | .79 |
| RS + GV + PM | 91.7 | .10 |
| RS + LA | 54.2 | 1.80 |
| RS + LA + PM | 62.5 | 1.02 |

[1]RS = *Rhizoctonia solani;* PM = *Proisotoma minuta;* TH = *Trichoderma harzianum;* GV = *Gliocladium virens;* and LA = *Laetisaria arvalis.*
[2]Root damage index: 0 = no disease; 5 = dead plant.

It was further learned that these insects have food preferences, preferring certain kinds of fungi over others. This raised the interesting question as to whether they might be compatible with some of the well known fungal agents being used experimentally for biological control. The answer to this question was found in feeding preference tests in the laboratory.

The insects did feed on the three promising biocontrol fungal agents (*Trichoderma*, *Gliocladium*, and *Laetisaria*), but only when other fungal food sources were not present. When each of these fungi was offered to the insects along with the pathogen that causes root disease (*Rhizoctonia solani*), the Collembola fed on the pathogen, but did not harm the fungal biocontrol agents. This suggested that the insects and the fungal agents might work together for maximum suppression of *Rhizoctonia* and protection of roots from disease.

**Cotton roots grown in pathogen-infested soil in which a fungal biological control agent and Collembola are present are fully developed and healthy.**

The insect *Proisotoma minuta* and the three fungal agents were then tested alone and in insect-fungus combinations for control of *Rhizoctonia* disease in cotton. Each fungal agent was cultured on a special laboratory medium and finely chopped for use as inoculum. *Trichoderma harzianum* and *Gliocladium virens* were applied directly to pots of both sterilized and nonsterilized (natural) soil which had been infested with the pathogen *Rhizoctonia solani*. *Laetisaria arvalis* was applied as a seed dressing before planting. Immediately after planting cotton, *Proisotoma* was added at the rate of 450 insects per pound of soil. Fourteen days later the disease severity index for each pot was compared with untreated controls.

Results were similar in sterile and nonsterilized soil. The sterilized soil experiment serves as the example reported in the table. Each fungal agent, as well as the insects, when used alone against *Rhizoctonia*, increased the stand (percent emergence) of cotton seedlings or reduced the amount of root-disease injury. These control benefits were enhanced in treatments in which the insects and one of the beneficial fungal agents were introduced together into the same pots. For example, *Rhizoctonia* in soil without any control agent caused a root-disease injury rating of 3.78; the injury rating was reduced to 2.35 and 2.26, respectively, by use of the insects (*Proisotoma*) and fungal agent (*Trichoderma*) alone, but using both control agents together dropped injury to a rating of just 0.74.

The results suggest that the fungal-feeding insect *Proisotoma* is compatible with the three biocontrol fungi in soil where *Rhizoctonia*, a preferred food source, is available. Consequently, the combination of insects and fungal agents provides greater biological control than either insects or fungi alone. Continuing research should further explain the role of fungus-feeding Collembola in regulating rhizosphere fungi that affect health and vigor of crops.

Lartey is a Graduate Student and Curl and Gudauskas are Professors of Plant Pathology, Peterson is Professor of Botany and Microbiology, and Harper is Professor of Entomology.

# Reproduction in First-Year Mourning Doves

L.M. WHITE, R.E. MIRARCHI, and M.E. LISANO

THE MOURNING DOVE is a prolific game species valued highly by Alabama hunters. The great reproductive potential of mourning doves allows hunters to take liberal harvests annually. Better understanding of the factors involved in the prolific breeding of mourning doves will insure large numbers of these game birds will be available for future generations of Alabama hunters.

Alabama has climatic conditions that allow consistent breeding of mourning doves from February through September. Mourning doves lay two eggs per clutch, incubate them for 14 days, and feed and brood the squabs for an additional 15 days. Doves feed the young "crop milk" regurgitated from a visibly developed crop gland. With long nesting seasons and short nesting cycles, mourning doves may produce five or six broods per season in Alabama. Young raised early in the breeding season (first-year doves) may reproduce later that same year. Although breeding activity of first-year doves has been reported previously, little research has been conducted on their contribution to annual production. Thus, the Alabama Agricultural Experiment Station began studies in the early 1980's to gather information on reproductive activities of these young mourning doves in east-central Alabama.

First-year mourning doves, approximately 70-131 days old, were live-trapped from June to October. These birds were identified by buff-tipped covert feathers on their wings and later verified through lab analyses, figure 1. All doves were held overnight and sacrificed the following morning. Each carcass was examined for the presence or absence of crop gland activity, and reproductive organs were analyzed for development. Doves were placed in breeding categories based on crop gland and gonadal characteristics obtained from captive breeding birds.

Of 79 juvenile males sampled, 20 (25.3%) were considered reproductively active, figure 2. Of these, 4 (5.1%) showed signs of successful nesting (i.e. raising young) based on crop gland activity. Paired testes weights of some male first-year doves contained spermatozoa and indicated sexual maturity (puberty) was reached as early as 80 days of age. Ninety-one females also were sampled. While 6 (6.6%) of the first-year females were considered reproductively active,

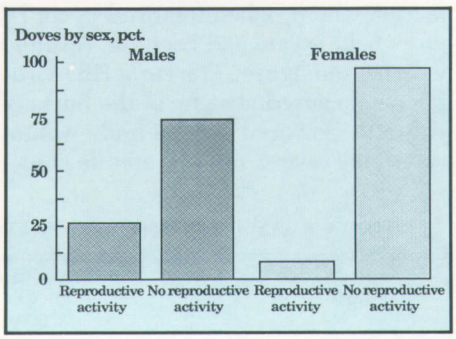



**FIG. 1. Buff-tipped wing feathers (top) are characteristic of first-year mourning doves. FIG. 2. Reproductive activity of male and female hatching-year mourning doves (bottom) in east-central Alabama in 1981-82.**

most (93.4%) were considered nonbreeders, figure 2. Some females reached puberty by 93 days of age.

More males (25.3%) than females (6.6%) reached puberty during the 2 collection years. The difference between sexes was probably based on energy needs. First-year males probably can best "afford" the costs of reproductive activity if there is any chance of breeding. Little energy is invested in testicular growth and maturation even if they do not nest successfully. However, reproduction by inexperienced first-year females requires large energy investments for egg production and oviduct development.

Reproductive potential of both sexes tended to increase with age, provided development occurred during the height of the breeding season. First-year birds collected near the end of the breeding season showed little indication of puberty attainment. Decreasing daylengths at the end of the breeding season probably were responsible for the reduced reproductive effort. Apparently, puberty is achievable at an early age, but this age must be reached while daylength is still sufficient (approximately 760 minutes) to stimulate a reproductive response.

Alabama mourning doves breed primarily from February to October, peak nesting occurs during May and June, and greatest nesting success occurs during June, July, and August. Hatching dates (backdated from collection dates) for first-year mourning doves considered reproductively active in the current study occurred from April 7 to June 2. Therefore, it is unlikely that doves hatched in Alabama after mid-June would reach puberty their first summer because physiological maturation would have to occur during decreasing day lengths.

The Auburn findings emphasize the importance of adult nesting success during the turbulent weather of the spring months in determining the proportion of first-year mourning doves that reach puberty. In any given year and area, this proportion should approximate nesting success rates of adult doves from February through mid-June. Some first-year doves hatched during that time will not attain puberty or breed because of other factors such as temperature, weather, food supply, behavioral traits, body weight, and natural selection pressures. However, with these data population biologists could develop reasonable estimates of the contribution first-year mourning doves make to yearly productivity.

White is a former Graduate Student and Mirarchi and Lisano are Associate Professors of Zoology and Wildlife Science.

# Experimental Production of the Swollen-Head Syndrome in Chickens

J.J. GIAMBRONE

THE SWOLLEN-HEAD syndrome (SHS) is a chronic upper respiratory disease of young broilers. Also known as thickhead or facial cellulitis, the condition is characterized by fluid under the skin causing facial swelling. Morbidity of infected birds ranges from 0 to 50% and mortality up to 20%, depending on management practices. Increased stocking density and poor air quality worsen the condition.

The disease has been associated in 4- to 6-week-old broilers with a severe reaction to infectious bronchitis (IB) virus and Newcastle disease (ND) vaccinations. High morbidity, low mortality, and low condemnation are usually associated with it. Typically, the disease fails to respond to antibiotic therapy or changing ND-IB vaccination programs. Often associated with SHS are an atrophied bursa of Fabricus and low antibody responses to ND-IB or infectious bursal disease (IBD) viruses in flocks that had been vaccinated one to three times against all three pathogens.

A study at the Alabama Agricultural Experiment Station was initiated to reproduce the SHS in specific pathogen free (SPF) broilers to provide methodology for further research on its control. Various combinations of IBD and IB viruses and disease organisms were used to reproduce SHS in the lab. Sixty-day-old SPF broilers were divided into six equal groups. Each group was housed in a separate isolation unit. Groups 1-3 received a virulent field IBD virus by eye and nose drop at 1 day of age. All groups received a virulent field IB virus isolate at 18 days by eye and nose drop. At 21 days of age, groups 1 and 4 received an 18-hour *E. coli* broth culture by eye and nose drop and tracheal instillation. Groups 2 and 5 received an 18-hour broth culture containing *S. faecalis* by the same route. Groups 3 and 6 received no bacteria. All challenge organisms were isolated from commercial broilers experiencing the SHS. Two weeks after receiving the bacteria, all birds were bled, killed, weighed, bursae weighed, and necropsied. Bursae were taken for histologic preparation and evaluated for microscopic lesions. Lesions were scored from 0 to 4 based on increasing severity (lymphoid cell necrosis). Serum samples were tested for antibody against IBD virus.

Of the birds given "varient" viruses, SHS occurred in 5 of 10 and 6 of 10 examined in groups 1 and 2, respectively, see table. Only groups 1 and 2 birds that received IBD virus at day 1 developed a subclinical immunodepressive IBD infection which, when followed by an IB virus field isolate and bacteria, resulted in SHS, see figure. The early IBD virus infection caused atrophy of the bursa of Fabricus (lowered bursae body weight ratio and severe microscopic lesions), decreased the immune response to IB virus, and rendered birds highly susceptible (increased SHS) to the combined effects of IB virus and bacteria.

Data from the Auburn study show the importance of an early subclinical immune depressive IBD infection in the development of SHS. Only groups 1 and 2 that received IBD virus later developed SHS after respiratory viral and bacterial infections. This is the first study showing the production of SHS using organisms isolated from commercial birds.

This study indicates SHS occurrence and severity may be reduced by increasing the magnitude and uniformity of antibody to IBD virus in breeder hens, and/or vaccinating all broiler chicks at day 1, and giving a booster in the field against IBD using combinations of live and killed vaccine viruses to prevent early subclinical immunodepressive IBD infections in progeny.

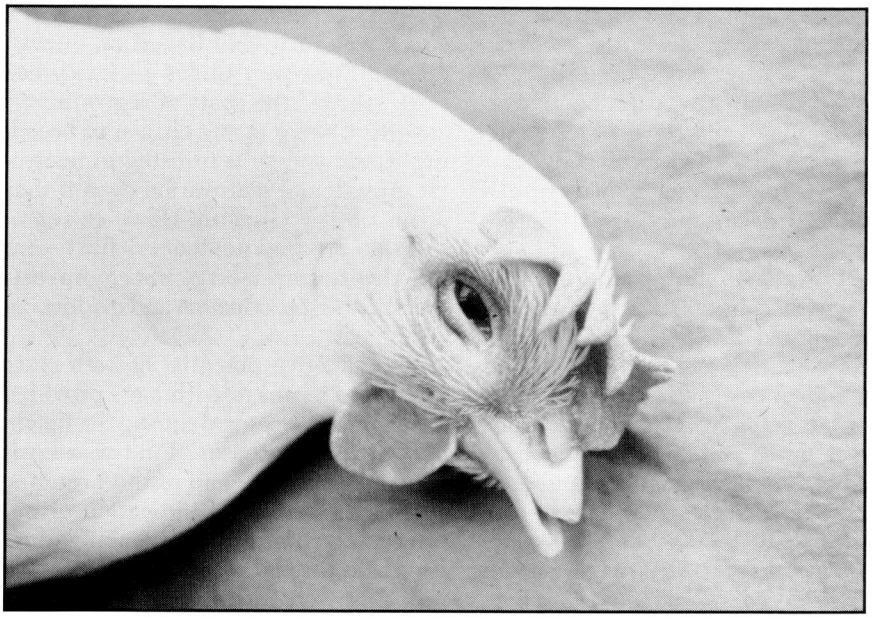
Giambrone is Associate Professor of Poultry Science.

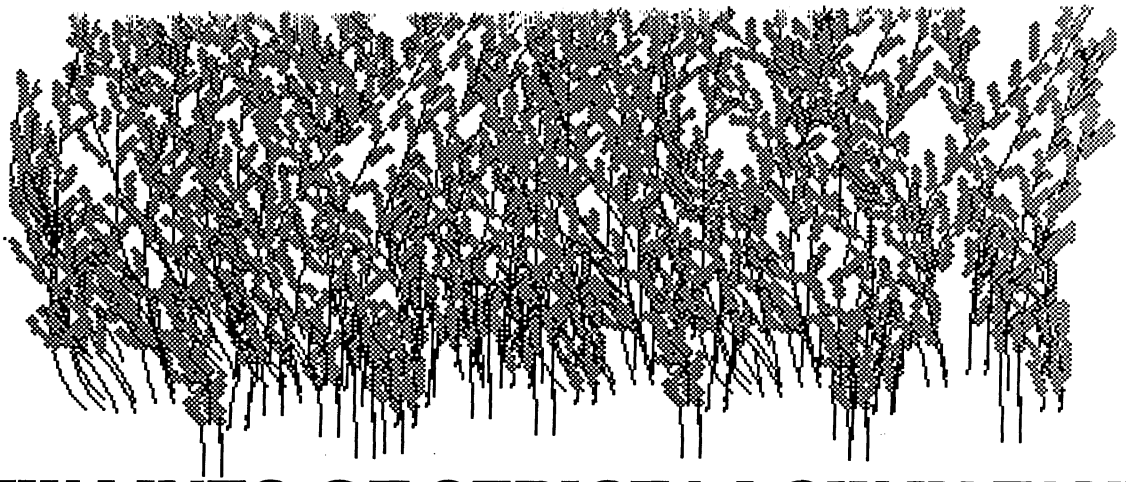
INCIDENCE OF SWOLLEN HEADS, BURSAL LESIONS, AND SEROLOGY RESULTS IN SPF BROILERS

| Groups[1] | Swollen heads[2] | Bursae wt./ body wt. x 1,000 | Mean microscopic bursal lesions | Mean antibody titers | |
|---|---|---|---|---|---|
| | | | | IBD-VN | IBV-VN |
| 1 | 5/10 | 1.03 | 3.5 | 32 | 6 |
| 2 | 6/10 | .85 | 3.8 | 28 | 2 |
| 3 | 0/10 | 1.10 | 3.2 | 42 | 4 |
| 4 | 0/10 | 3.86 | .5 | 0 | 38 |
| 5 | 0/10 | 3.91 | .5 | 0 | 16 |
| 6 | 0/10 | 4.35 | .0 | 0 | 24 |

[1]Birds in groups 1-3 received IBDV infection at 1 day. All groups received IBV infection at 18 days. Groups 1 and 4 received *E. coli* and groups 2 and 5 *S. feacalis* at 21 days of age.
[2]Number of birds with lesions over total number examined.

**Facial swelling typical of young broilers with swollen-head syndrome.**





# NEW LINES OF SERICEA LOW IN TANNIN

J.A. MOSJIDIS, E.D. DONNELLY, and C.S. HOVELAND

SERALA SERICEA has been a popular summer grazing legume for cattle in Alabama and the Southeast since its release in 1962. However, it is high in tannin, which reduces palatability, digestibility, and crude protein. In 1980, a low tannin sericea named AU Lotan was released at Auburn, but it yields only about 70 percent of Serala. Current research is underway at the Alabama Agricultural Experiment Station to develop a better low tannin variety, one with yield potential nearer Serala.

The best lines of low tannin sericeas were tested for yield and compared to Serala at three locations in Alabama over the past 3 years. Serala outyielded the other low tannin varieties in every individual cut and in total forage yield, table 1. Serala produced more forage than the low tannin sericeas after the plants came back from the dormant stage and after each cut. AU Lotan, the only low tannin sericea commercially available to growers, ranked fifth in the first and second cutting and fourth in the third one. Line 73-162-19, an unreleased low tannin sericea, had the second highest yield in the first cutting and ranked third after the next two cuttings. The total forage yield of 73-162-19 was about 80% of Serala, compared to 70% for AU Lotan.

AU Lotan ranked higher in yield tests at Auburn than at the other two test sites, which averaged only about 65% of Serala. This indicates that AU Lotan can perform better in some environments than others, while line 73-162-19 seems to have a more stable yield. In a test carried out at three locations in Georgia during 1983, line 73-162-19 yielded 79% and AU Lotan 67% relative to Serala, comparable to relative yields recorded in the Alabama tests.

Dry matter digestibility, measured by the in vitro method, was 28% higher in line 73-162-19 than in Serala. AU Lotan produced forage which was 22% more digestible than Serala. The tests indicate line 73-162-19 has a yield about 10% higher than AU Lotan, and its forage is 6% more digestible.

Line 73-162-19 is more tolerant to *Rhizoctonia* than most sericeas low in tannins. In some environments of southern Alabama, where humidity is particularly high, the plants may be attacked by this fungal disease late in summer. However, the plants will usually recover and be healthy the following season.

When the morphology of 73-162-19 and AU Lotan was compared to Serala in two environments, the three genotypes were found to have the same stem diameter. Genotype 73-162-19 tends to have longer stems, and each stem is heavier than Serala and AU Lotan. Serala ranked higher in weight of leaves per stem, leafiness (proportion of the total stem weight made up of leaves), and weight of leaves per stem length than either AU Lotan or 73-162-19. Stem weight per stem length was almost the same in the three genotypes. Thus, the genotypes low in tannins have their total yield made up of a slightly higher proportion of stems, table 2.

It is likely that line 73-162-19 will be released as a new low tannin cultivar of sericea because of its higher digestibility and total forage yield than AU Lotan. Also, it produces about the same digestible dry matter per acre as Serala.

Mosjidis is Assistant Professor and Donnelly is Professor Emeritus of Agronomy and Soils and Hoveland is Professor of Agronomy, University of Georgia.

TABLE 1. MEAN FORAGE YIELD/ACRE OF EACH CUTTING AND TOTAL FORAGE YIELD OF SERICEA LESPEDEZA LINES GROWN IN SEVERAL ENVIRONMENTS

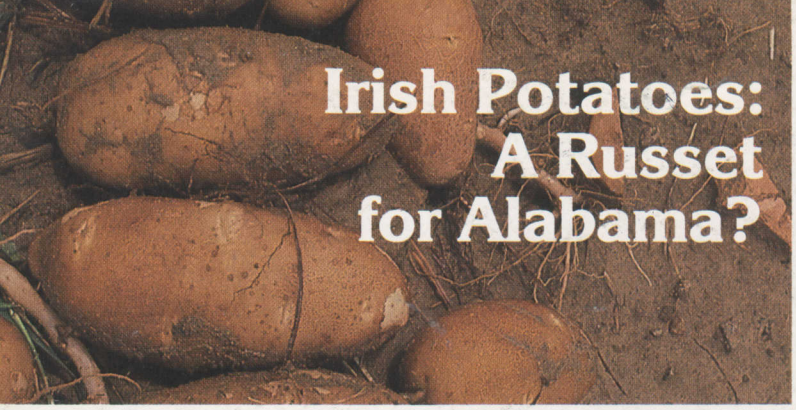
| Entry | Yield of cutting | | | Average total yield at three locations[1] | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | | |
| | *Lb.* | *Lb.* | *Lb.* | *Lb.* | *Lb.* |
| Serala | 3,043 | 3,275 | 2,804 | 8,731 | 100 |
| 73-162-19 | 2,430 | 2,750 | 2,172 | 7,049 | 81 |
| AU Lotan | 2,056 | 2,492 | 2,047 | 6,319 | 72 |

[1]The locations were Brewton, Auburn, and Winfield. The plants were harvested in 1983, 1984, and 1985.

TABLE 2. MEANS OF SEVERAL VEGETATIVE TRAITS OF SERICEA LESPEDEZA LINES[1]

| Entry | Stem diameter | Stem length | Stem wt. | Leaf wt. | Leafiness | Stem wt./ stem length | Leaves wt./ stem length |
|---|---|---|---|---|---|---|---|
| | *In.* | *In.* | *Oz.* | *Oz.* | *Pct.* | *Oz./in.* | *Oz./in.* |
| Serala | 0.05 | 16.0 | 7.0 | 11.8 | 62.2 | 0.44 | 0.73 |
| 73-162-19 | .05 | 16.2 | 7.2 | 11.3 | 61.1 | .44 | .70 |
| AU Lotan | .05 | 15.8 | 6.8 | 11.1 | 61.9 | .43 | .71 |

[1]The measurements are expressed on a single stem basis, with the exception of stem and leaf weight which are on a 1,000 stem basis.



# Irish Potatoes: A Russet for Alabama?

ND 534-4 russet irish potatoes.

D. SMITH, J.L. TURNER, E.L. CARDEN, and R.McDANIEL

A LONG-TIME need of Alabama potato growers is a russet type irish potato which produces profitable yields and has good baking quality. Recent testing at the Alabama Agricultural Experiment Station has identified some new varieties that may fill this need.

To be marketed as baking potatoes, irish potatoes should be uniform in size and shape, high in solids with a dry, mealy texture, and have uniformly white flesh. The flavor of potatoes, like most other foods, is usually descriptive only in subjective terms as a result of taste panel or flavor tests. A desirable potato would generally be somewhat bland of flavor, low in reducing sugars, and free of the musty and somewhat sour off-flavors sometimes found in irish potatoes.

The potatoes for baking tests were supplied from the 1986 potato variety trial at the Gulf Coast Substation in Fairhope, table 1. A description of growing conditions, marketable yields, total solids at harvest, and tuber type is given in table 1.

Laboratory baking and quality tests were conducted at Auburn. The potatoes were baked at 325°F in an oven designed for rapid and uniform baking. The baked tubers were allowed to cool to 100°F before testing by a trained, five-member sensory panel. Panelists rated the potatoes for flavor, texture, and flesh color using a 10-point, multiple-ranking scoring system, table 2. Included in the test for comparison purposes were Red La Soda (the dominant variety grown in Alabama) and Idaho-grown Burbank russets from two sources.

The top yielding varieties, ND 651-9, Red La Soda, and ND 860-2, were rated only fair in baking quality by the sensory evaluation panelists, table 2. Each of the varieties received relatively low flavor scores for non-characteristic baked flavors, which the panelists described as musty and slightly sour. Textures were described as watery and gummy.

Krantz and ND 534-4 were intermediate yielders and were judged to be good in flavor and texture. Krantz received only a fair color score because of its yellow flesh. Norgold and Centennial also had good baking quality but did not yield as well as other varieties in the test.

Processing and taste tests indicate several varieties of russet potatoes, including ND 534-4, Krantz, Norgold, and Centennial, have baking qualities comparable to Burbank russets and can be grown in Alabama. Field tests, however, indicate these varieties will not yield as well as Red La Soda.

Smith is Associate Professor and Turner is Research Associate of Horticulture and Carden is Superintendent and McDaniel Associate Superintendent of the Gulf Coast Substation.

TABLE 1. POTATO VARIETY TRIAL, FAIRHOPE, SPRING 1986[1]

| Variety | Marketable yield/acre | | | Standard at harvest | Type |
|---|---|---|---|---|---|
| | Size A[2] | Size B | Total yield | | |
| | *Cwt.* | *Cwt.* | *Cwt.* | *Pct.* | |
| ND 651-9[3] | 231 | 11 | 242 | 95 | Round-white |
| Red La Soda | 214 | 5 | 219 | 95 | Round-red |
| ND 860-2 | 161 | 13 | 174 | 94 | Round-white |
| Krantz | 162 | 4 | 166 | 88 | Round-white |
| ND 534-4 | 149 | 9 | 158 | 96 | Russet-long |
| Norking | 143 | 6 | 149 | 93 | Russet-long |
| Norgold | 137 | 13 | 149 | 95 | Russet-oval long |
| Centennial | 103 | 10 | 113 | 91 | Russet-round flat |

[1]Planted February 20 and harvested June 10; 111 growing days. Soil test: P = 44 (M); K = 160 (M); pH = 5.7.

[2]Size A = potatoes with 1 7/8 in. diameter and larger, Size B = potatoes with 1 ½ to 1 7/8 in. diameter.

[3]All varieties fertilized with 1,600 lb. per acre 10-10-10 fertilizer at planting with minor elements, no sidedress.

TABLE 2. QUALITY OF IRISH POTATOES FROM 1986 VARIETY TRIAL, FAIRHOPE

| Variety | Total solids | Sensory evaluation[1] | | | |
|---|---|---|---|---|---|
| | | Flavor | Texture | Flesh color | Composite quality |
| ND-651-4 | 21.06 | 5.7 | 6.7 | 6.0 | 6.1 |
| Red La Soda | 19.58 | 5.0 | 6.3 | 6.7 | 6.0 |
| ND 860-2 | 21.48 | 5.3 | 6.7 | 8.0 | 6.7 |
| Krantz | 20.21 | 8.5 | 7.3 | 6.0 | 7.3 |
| ND 534-4 | 21.96 | 7.7 | 8.0 | 8.7 | 8.1 |
| Norking | 22.54 | 5.7 | 6.7 | 7.5 | 6.6 |
| Norgold | 24.22 | 7.3 | 8.2 | 8.8 | 8.1 |
| Centennial | 21.27 | 7.7 | 8.0 | 7.0 | 7.5 |
| Burbank russet | 24.93 | 7.7 | 8.5 | 8.5 | 8.2 |

[1]Sensory evaluation was by a panel of 5 trained judges using a multiple-ranking test with a 10 point scale where scores of 9 or 10 would indicate an unusually good product, 7 or 8 a good product, 5 or 6 a fair product, and below 5 an unacceptable product.

ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN UNIVERSITY
AUBURN UNIVERSITY, ALABAMA 36849

*Lowell T. Frobish, Director*
PUBLICATION—Highlights of Agricultural Research 3/87
11M
Penalty for private use, $300

BULK RATE
POSTAGE & FEES PAID
USDA
PERMIT No. G269

Hatch Act Centennial
1887-1987