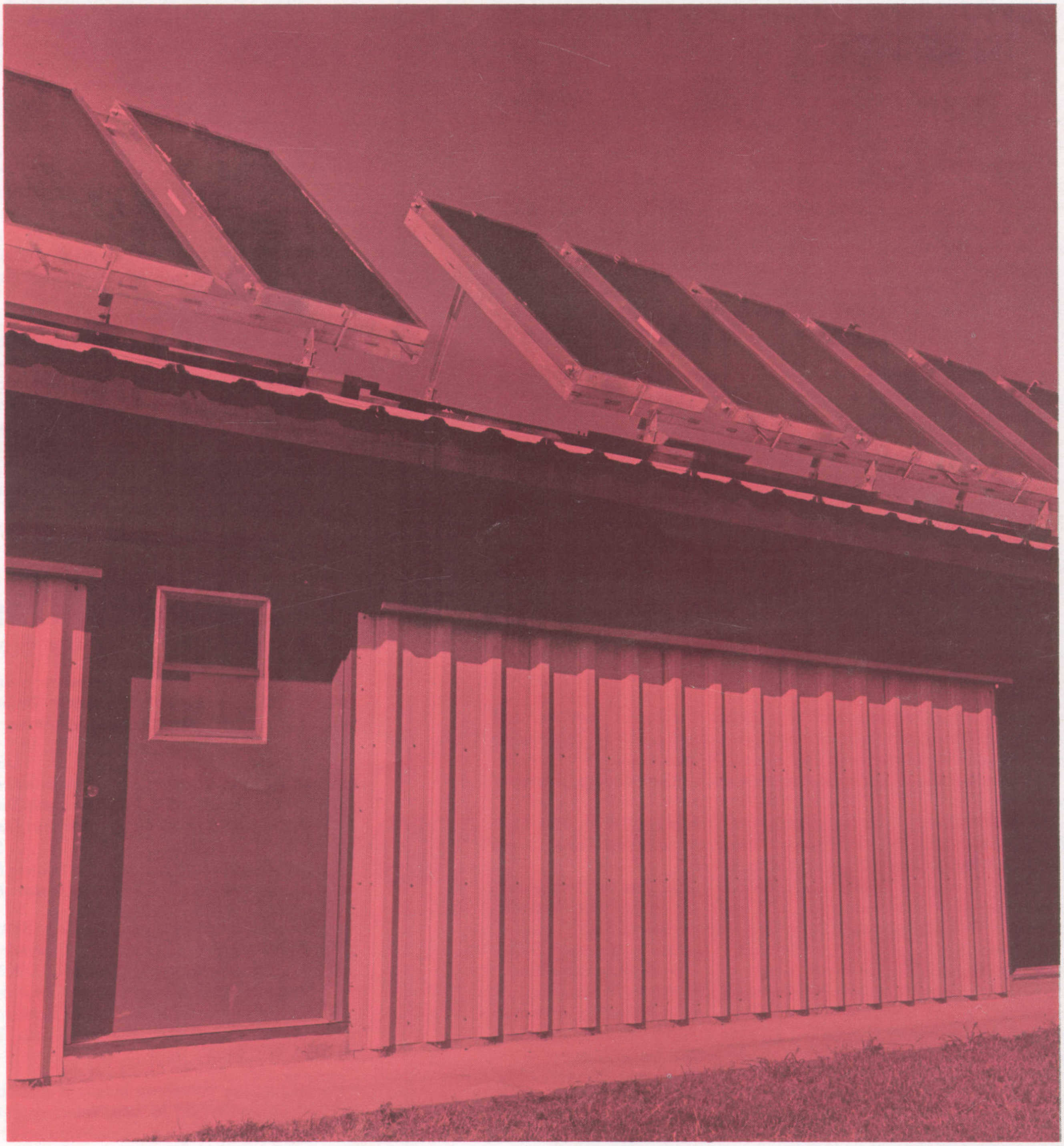
highlights

of agricultural research



Volume 24, No. 3

Fall 1977

Agricultural Experiment Station
R. Dennis Rouse, Director

Auburn University
Auburn, Alabama

Director's Comments

DIRECTOR'S COMMENTS in this issue will be devoted primarily to a progress report on the development of new research facilities resulting from the sale of bonds authorized by the Alabama Legislature in 1973. Funds have been made available as the bonds were sold by the State. The final allotment in July enabled us to proceed with all construction.

The first item funded was the purchase of 3,200 acres of land, officially named the E. V. Smith Research Center of the Agricultural Experiment Station, on which to relocate most of the Main Station field facilities. (See *Highlights,* Spring 1975, for description and location of land.)

R. Dennis Rouse

Since its purchase, the land has been used for production of feed and forage for livestock and foundation seed. This use of the land has provided information on field variability, weed infestations, and other factors basic to the design of field experiments.

An irrigation system was purchased from bond monies for use at the Wiregrass Substation. As those in southeast Alabama know, this is certainly a year when irrigation has made the difference between no production and excellent production. It is fortunate that this research system was available for the 1977 season.

Next, an office-auditorium was constructed at the Chilton Area Horticulture Substation which has served to up-grade the entire research and information delivery programs of this Station.

The Forest Products Laboratory was completed and dedicated in June. This facility will revitalize our research on use of wood fiber, especially from low grade trees and by-products of timber harvest.

The Poultry Science Center, a new eight-building complex on the Auburn campus, will go a long way toward providing the facilities needed for a research program to support Alabama's important broiler and egg industry. Research is in progress in these buildings and installation of an automated feed mill has just been completed.

A beef cattle nutrition research facility at the Black Belt Substation, with its associated feed mill and feed conveying system, is well along toward completion, and a full research program should be under way this fall.

Development of facilities at the E. V. Smith Research Center is proceeding as follows:

The beef cattle breeding unit was occupied this past summer, and buildings and fencing are essentially completed on this unit which occupies about 700 acres in the northwest corner of the Research Center.

Two dwelling houses and a headquarters shop-office building have been completed.

The dairy unit should be completed during the fall and cows from both Main Station dairies moved by January. This unit is visible on the north side of I-85, halfway between Auburn and Montgomery.

A contract was let in July for construction of the facilities for the beef cattle nutrition unit, the fruit, nut, and vegetable crops unit, and the field crops unit. Field research in these units is already under way.

The Basic Animal Physiology Laboratory located at the new Swine Production Research Facility on the Auburn campus is nearing completion.

In addition to these facilities being acquired under the 1973 Bond Issue, a modern bull testing facility with the capability for determining individual feed efficiency is nearing completion. Funding is being provided jointly by the Experiment Station and the Alabama Cattlemen's Association.

The 1976 Legislature provided funds for a Seed Technology Center on the Auburn campus and a foundation peanut seed facility at Headland. Bids for the Seed Technology Center were received in July, and the foundation seed facility should soon be ready for bidding.

Finally, the 1977 Legislature appropriated funds to the Alabama Department of Agriculture and Industries to fund the renovation and modernization of the Livestock Judging Arena.

may we introduce . . .

Dr. Paul K. Turnquist, head of the Department of Agricultural Engineering. He took over the leadership role in the Department following the August 1976 retirement of Prof. Fred Kummer, who had held the position since 1948.

Born in Lindsborg, Kansas, Dr. Turnquist earned a B.S. degree in ag engineering at Kansas State University. He also holds M.S. and Ph.D. degrees from Oklahoma State University.

Prior to coming to Auburn, he was a Professor and acting Department Head in the Department of Agricultural Engineering at South Dakota State University. Dr. Turnquist has previously been an instructor and assistant professor at Oklahoma State University and a research engineer for the Caterpillar Tractor Company.

Dr. Turnquist is a member of Sigma Tau, Sigma Xi, and Alpha Epsilon honoraries. He received the Outstanding Young Faculty Award in 1970 from the North Midwest Section of the American Society for Engineering Education and was the first recipient of the A.W. Farrall Young Educator Award from the American Society of Ag Engineers. In addition he has been a General Foods Fellow and a registered engineer since 1962.

HIGHLIGHTS of Agricultural Research

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ON THE COVER. Solar collectors capture energy from the sun to heat baby chicks in the Auburn research facility.

Solar Heating of Poultry Houses

R. N. BREWER, Department of Poultry Science
J. L. KOON and C. A. FLOOD, Department of Agricultural Engineering

Heat is delivered to the chick rooms by fin tube convectors (arrow) or by concrete slab brooders.

SOLAR ENERGY is viewed by many energy experts as one solution to the dwindling supply of fossil fuels in the United States and the world. Although it is a renewable source of energy and is universally available, it is also diffuse and difficult to collect in large quantities.

Current research at Auburn University Agricultural Experiment Station is aimed at adapting solar energy to poultry production programs and finding ways to make it an acceptable form of heat energy. The solar facility being used consists of 36 flat plate solar collectors having a combined area of about 700 sq. ft. These collectors are plumbed into three separate systems for research purposes. Each system has a 1,000-gal. insulated water storage tank for the solar heated water, an 80-gal. electric auxiliary water heater, and necessary pumps and controls to deliver hot water to the poultry production units.

Each of the six production units is 20 ft. x 36 ft., insulated in all walls and ceilings, and is ventilated separately from the other units. Heat is delivered to the rooms by fin tube convectors or concrete slab brooders. Electric and LP gas energy used to heat, light, and ventilate each unit is metered and recorded. This arrangement allows for an analysis of total energy required to operate the production unit and will be used in determining economic parameters of the system.

A weather monitoring station is in use at the research site to monitor meterological parameters affecting the operation of the solar facility. The amount and intensity of sunshine falling on the collectors is monitored daily, along with ambient temperature, wind direction, wind speed, and dewpoint. Since the frequency and amount of cloudy periods directly affect the amount of solar energy collected, this information is necessary in determining correct design features of the solar system.

Commercial poultry requires a significant amount of heat energy to sustain life and to perform efficiently. At the present time this energy is being supplied mainly by fossil fuels. Liquified petroleum (LP) gas furnishes approximately four-fifths of the total, followed by natural gas, fuel oil, coal, and electricity. A nationwide survey of poultry producers, done before beginning the solar study, found that approximately 40 gal. of LP gas are used per 1,000 broilers brooded. Commercial layers, turkeys, and ducks use considerably more.

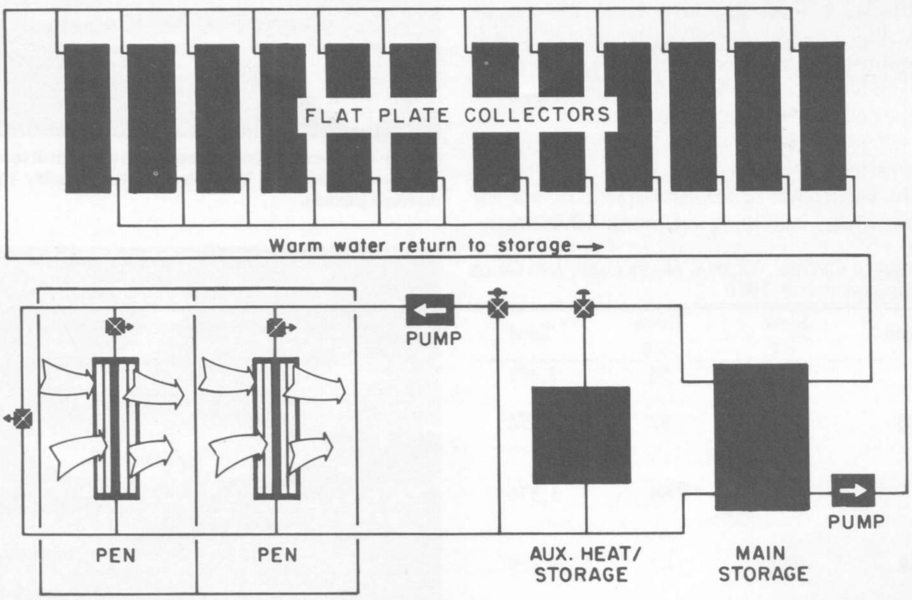
Heat energy is delivered to the poultry house by space heaters, central hot water, and hot air systems. The amount required depends on house construction, time of year, age of birds, and management of the total system. New forms of heat energy, such as solar, must be compatible with these delivery systems to be readily accepted by producers.

Existing poultry houses, therefore, would need some modification to allow use of new forms of energy. Paramount to this program would be improvement in environmental control in Alabama poultry houses. Sufficient ceiling insulation (R-11) to control heat loss is most important. Also required is mechanically controlled air exchange during cold months. Among the effective fuel saving management practices needed during brooding, the most promising is partial house brooding. This involves partitioning off approximately one-fourth to one-third of the house to be used as a brooding chamber for the first 3 weeks. When this chamber is well insulated and mechanically ventilated it can reduce fuel needs by 30-40% over conventional brooding. Solar heat adapts well to this system of brooding.

Design and construction of new poultry houses must consider fuel requirement as a major factor. Houses located approximately east-west and having a 2-ft. overhang and insulated ceiling will be much more efficient at handling both summer and winter thermal problems. When this type of building contains approximately R-11 of ceiling insulation and R-6 in sidewalls and ends, birds can be kept comfortable with comparatively low fuel costs.

Preliminary data from Auburn's solar research facilities and those from several other stations indicate that solar energy can be effectively adapted to poultry houses. Major barriers seem to be price of solar systems and availability of equipment which has been properly tested. In addition, more time must be spent testing various systems of delivering the heat to the brooding area. Hot water or a combination of hot water and warm air seem to be most acceptable.

The Auburn work is primarily concerned with determining the most economically feasible method of getting the stored energy to the brooding area. Fin tube convectors, concrete slab brooders, and heated ventilation air show promise.



Design of the solar poultry house at Auburn is illustrated by this drawing.

POND CULTURE OF CATFISH, TILAPIA, AND SILVER CARP

DAVE DUNSETH and NEAL SMITHERMAN, Dept. of Fisheries and Allied Aquacultures

POND CULTURE OF CATFISH in the U.S. is presently the only important commercial method of producing fish for human consumption. Economical yields of catfish reaching 2,000-3,000 lb. per acre can be obtained by feeding them a high protein feed at 2-3% of their body weight per day.

Feeding of pelleted rations to catfish in ponds usually results in dense "blooms" of phytoplankton. Catfish are bottom feeders and don't directly consume phytoplankton. Excessive phytoplankton often leads to oxygen depletions and fish kills; therefore, control of these algae is a major concern of catfish farmers.

Researchers at Auburn University, during 1971-1975, tested the following fishes for culture with catfish: hybrid buffalofish, mirror carp, silver carp, bighead carp, grass carp, male and female tilapias with reproduction, all-male tilapias with no reproduction, and combinations of these fishes. Combinations of all-male tilapias or silver carp with catfish indicated potential for increasing total production of fish without a decrease in catfish production.

The objective of polyculture research in 1976 was to determine the separate and combined effects of greater productions of all-male tilapias and silver carp on the yield of catfish.

Treatments, fish species, stocking rates, mean net productions for each species, and total net productions are presented in the table. Grass carp at a low stocking rate were used to ensure control of aquatic weeds. All treatments received equal inputs of feed and fertilizer.

Catfish production was slightly lower in the presence of tilapia, since large tilapia competed with catfish for the pelleted ration. However, 4.5 lb. of tilapia were produced for every 1.0 lb. reduction of catfish production. Based on a subsequent market study, farm prices of tilapia and catfish were 40¢ and 50¢, respectively. For every dollar lost in catfish production, $3.60 in tilapia value resulted.

Catfish production was slightly higher in the presence of silver carp, which did not compete with catfish for the pelleted ration. Total net production increased from 2,371 lb. per acre with catfish alone to 4,118 lb. per acre in a combination of catfish, tilapia, and silver carp without a decrease in the production of catfish. This increase in fish production was obtained with fewer problems of critically low oxygen concentrations.

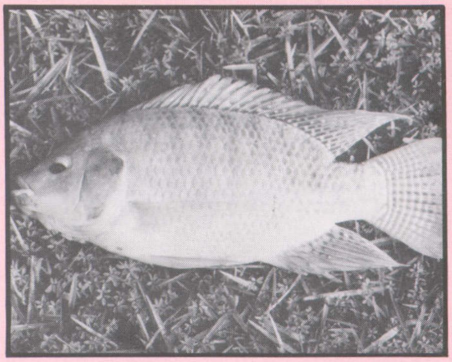
Phytoplankton density was lower in polyculture treatments than in the monoculture treatment. Species of buoyant blue-green phytoplankton, such as *Microcystis,* which produce surface scums and are associated with off-flavor in catfish, were scarce in treatments containing silver carp and dominant in treatments not containing silver carp.

A market study showed that consumer acceptance and demand was excellent for tilapia and fair for silver carp. Average retail prices for fish sold in local supermarkets were as follows: catfish, $1.89 per lb.; tilapia, $1.29 per lb.; silver carp, 89¢ per lb. Estimated farm prices were as follows: catfish, 50¢ per lb.; tilapia, 40¢ per lb.; silver carp, 20¢ per lb. Using a partial budgeting technique, it was estimated that net income from catfish ponds could be increased $171-$385 per acre using the polyculture combinations tested.

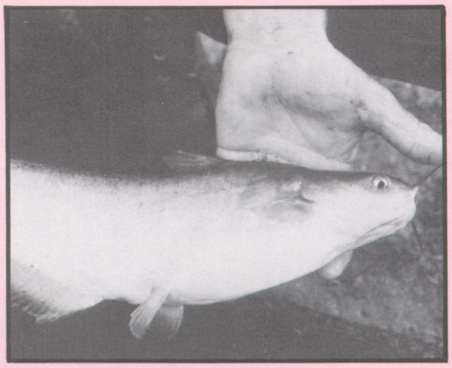
Polyculture was an effective method for increasing fish production in ponds, for reducing the occurrence of oxygen depletions, and for potentially increasing income for fish farmers.

MEAN NET PRODUCTION POUNDS PER ACRE PER TREATMENT OF CATFISH, TILAPIA, SILVER CARP, AND GRASS CARP IN THE POLYCULTURE EXPERIMENT IN 1976

Treatment	Fish per acre	Catfish	Tilapia	Silver carp	Grass carp	Total
1	3,000 catfish 20 grass carp	2,318			53	2,371
2	3,000 catfish 800 tilapia 20 grass carp	2,151	768		57	2,976
3	3,000 catfish 1,000 silver carp 20 grass carp	2,429		883	64	3,376
4	3,000 catfish 800 tilapia 1,000 silver carp 20 grass carp	2,335	738	979	67	4,118



Hybrid tilapia are all male and grow to 1 lb. average on wasted feed in catfish ponds.



Channel catfish is the basic species in the Auburn polyculture system.

Silver carp consume excess phytoplankton (green algae) and improve water quality in catfish ponds.

Bighead carp feed on zooplankton and provide extra production in catfish ponds.

DON'T LEAVE SOYBEAN PROFITS IN THE FIELD

ELMO RENOLL and DONALD SMITH, Department of Agricultural Engineering

MANY SOYBEAN FARMERS in Alabama are leaving too many beans in the field during harvest. Some farmers have reported losses as high as 40% with average losses reported to be about 15%.

A conscientious combine operator, using a properly adjusted machine and working under good field conditions, should be able to hold bean losses to 4 or 5%. The table shows acceptable bean losses in bushels per acre when combining beans yielding 35 to 40 bu. per acre. A loss of four seeds per sq. ft. equals 1 bu. per acre.

As indicated, field losses occur for several reasons. Some beans are lost before harvest starts. If beans are harvested at the correct maturity and moisture content this pre-harvest loss is usually small. The remaining harvest losses can be attributed to the machine.

Machine Losses

Machine losses take place at the gathering unit and during the threshing, separating, and cleaning operation within the combine. The table indicates that the single largest source of machine loss is the gathering unit of the combine.

ACCEPTABLE LOSSES WHEN COMBINING SOYBEANS (Yielding 35-40 Bu/acre)

Item	Acceptable loss range
	Bu/acre
Machine losses (Header)	1.1 - 1.4
Shatter loss	0.4 - 0.5
Loose stalk loss	0.2 - 0.25
Lodged stalk loss	0.2 - 0.25
Stubble loss	0.3 - 0.4
Machine losses (cylinder and separation)	0.1 - 0.15
Pre-harvest loss	0.1 - 0.2
Total crop loss	1.3 - 1.75

Losses at the gathering unit are caused by the following: (1) lodged stalks not going into the machine; (2) beans left on stubble under the cutter bar; (3) stalks cut but not getting into the machine; and (4) beans shattered from the plant during the cutting operation. The reduction of these losses is a great challenge.

Bean Moisture

Bean moisture content has considerable influence on pre-harvest and shatter loss. Beans should have a moisture content of 13% or more for good harvest. Shatter and pre-harvest losses increase as moisture content falls below 13%.

Stubble and shatter losses can be reduced by operating the cutter bar close to the ground. The cutter bar should, if possible, be operated below the lowest bean pods.

Combine Speed

Proper speed of the reel in relation to the combine ground speed will help reduce stalk and shatter losses. Many combine operators prefer to operate the reel speed slightly faster than the combine ground speed. Some operator's manuals suggest up to 25% faster. If the reel speed is too fast it tends to beat the stalks and knock off beans ahead of the cutter bar. This fast reel speed also tends to carry cut whole stalks over the reel top and drop them in front of the cutter bar in the uncut stalks. If the reel speed is too slow it will not effectively aid in getting cut stalks into the machine.

Reel Position

Reel position is also important in reducing cutter bar losses. The center of the reel should be run ahead of the cutter bar. Many operators run 6-10 in. ahead. The lowest bar should run deep enough into the crop to gain control of the plant before it is cut. A pick-up reel will reduce cutter bar losses in lodged beans, and many operators also use them in ideal harvest conditions.

Weeds also tend to increase harvest losses. Weeds increase losses at the cutter bat, cause threshing problems, and generally reduce the efficiency of the entire combining operation. In weedy fields it is generally agreed that ground speed should be reduced to allow the machine time to thresh and clean the beans from the extra volume going into the machine.

FIG. 1. Many soybean growers use a special pick-up reel on the combine to help reduce harvest losses.

FIG. 2. Good combine operators frequently check for seed loss. Each four seeds per square foot represents 1 bu. loss.

VIGOROUS TREES MAY "PITCHOUT" ATTACKING SOUTHERN PINE BEETLES

L. L. HYCHE
Department of Zoology-Entomology

"—VIGOROUS PINES may often 'pitch-out' attacking bark beetles." This, or a similar reference to tree vigor and resin production, is regularly heard from entomologists discussing the occurrence and decline of southern pine beetle, *Dendroctonus frontalis,* infestations. Although regularly referred to, the importance of resin production as a factor in tree resistance against bark beetles may oftentimes be underestimated, particularly during beetle-epidemic periods. During the most recent southern pine beetle outbreak in Alabama (1972-1975), researchers at the Auburn University Agricultural Experiment Station had the opportunity to observe and document "pitchout" and its impact on a beetle population. The following is a case history.

In the spring of 1974, research observations were begun on a small but active and expanding southern pine beetle infestation in Lee County. The infestation was in an artificially established loblolly plantation approximately 12 years old. Trees were 30 to 35 ft. tall and 5 to 7 in. in diameter at breast height. Tree growth had been good in early years but had slowed somewhat during the last 2 or 3 years, apparently because of high stand density. The infestation had its beginning in five or six trees on the edge of a fire-damaged area of the plantation. By late August and early September, it had spread to involve 40 to 45 trees. At this time activity slowed and spreading of the infestation ceased, as beetles entered the overwintering phase. Overwintering beetles were concentrated primarily in three trees. These trees were kept under observation through the winter and into the spring of 1975.

FIG. 1. Resin pitchtubes revealing points of beetle attack. Note some pitchtubes much larger than normally caused by Southern pine beetle, indicating heavy resin flow.

At the latitude of Lee County, crowns of all trees harboring an overwintering brood of southern pine beetle normally turn red by the end of winter or very early spring. Emergence of new beetles from overwintering trees usually occurs from about mid-March to mid-April, and new attacks of uninfested trees are well under way by the end of April. In the infestation under study, crowns of overwintering trees were green and trees were still alive on May 5, 1975. Inspection of bark revealed no evidence of beetle emergence or renewed beetle activity in the stand. On May 5, the overwintering trees were felled for examination. The entire boles of two of the trees were peeled in an attempt to determine the reason for failure of beetles to renew activity.

Examination of felled trees revealed evidence of heavy initial attack in late summer and early fall of 1974, Figure 1. Attacks were distributed along tree boles from just above ground level upwards to approximately 20 ft. Attack density was greatest in lower and mid-bole, ranging up to 70 attacks per sq. ft. of bark. Normally, such intensity of attack, if successful, is more than sufficient to cause tree mortality.

In peeling of tree boles, over 1,600 initial attacks were exposed. In some cases, attacking beetles appeared to have abandoned attack holes on reaching the inner bark; however, in about 90% of the attacks, some gallery construction occurred. Examination of these galleries revealed them to be filled with hardened resin, Figure 2, and in no case was there evidence of egg laying or brood development. In many instances, the original attacking adults were found dead in resin-filled galleries, Figure 3.

This southern pine beetle infestation ceased completely. All evidence points to "pitchout", or tree resistance in the form of abundant resin flow, as being the primary factor responsible.

FIG. 2. Resin-filled Southern pine beetle adult galleries.

FIG. 3. Closeup of resin-filled gallery showing entrapped dead adult beetle.

PSEUDORABIES IN SWINE

HAROLD A. KJAR, School of Veterinary Medicine

ALTHOUGH it is not at all related to rabies, pseudorabies is an infectious disease which is affecting swine production in many states. Also known as Aujesky's disease, mad itch, and infectious bulbar paralysis, the virus can be contracted by most domestic and wild animals, resulting in intense itching, self-mutilation, convulsions, and death. Man is not affected by pseudorabies, a herpes virus disease.

Cattle do contract severe cases of the virus, but swine are considered the natural hosts and chief reservoir of pseudorabies. Healthy swine can carry the antibodies in their sera, but this is not true of sera from healthy cattle.

The continued increase in the severity and numbers of pseudorabies may be caused by the rearing of more pigs in large confinement units or by the cessation of hog cholera vaccination which carried antibodies against the virus. The increase is expected to continue, and until effective control measures are issued, pseudorabies will continue to be of economic importance to pork producers.

Transmission

New swine in the herd may prompt the outbreak, possibly through nose-to-nose contact. Since cattle are highly susceptible to the virus and usually die from it, they should not be fed in a lot with swine. Wild animals, such as raccoons, that travel along ditches can also transmit pseudorabies.

Clinical Symptoms

Most older swine can contract mild infections, but pregnant sows are more susceptible and show a loss of appetite, fever, coughing, and possible vomiting. Half of the sows abort their pigs, and the others will carry to term and then deliver mummified, stillborn, or weak pigs along with healthy pigs. These new pigs soon show scours, depression, vomiting, incoordination, spasms, paddling, coma, and death (nearly 100% mortality).

When at least 3 weeks old, the pig has less severe symptoms and the mortality rate decreases. Adult swine also show symptoms but an even lower mortality.

Diagnosis

Diagnosis is based on the clinical signs previously described along with possible postmortem lesions and laboratory confirmation. Small greyish-white necrotic foci in the liver, spleen, and heart, along with necrotic tonsillitis or pharangitis is sometimes found. Histopath sections often show a diffuse nonsuppurative meningoencephalomyelitis. Virus isolation from fresh tonsils, brain, spleen, or lungs from pigs acutely ill is the most positive form of diagnosis. The fluorescent antibody test (FA) can also be done on these tissues but is not 100% reliable. Rabbit inoculation is also a reliable test employed by many laboratories to detect the virus.

A serum test (serum neutralization) is the most common and practical herd test. A positive titer does not necessarily mean the pig is spreading the virus but does indicate he has come in contact with it. Positive titers will occur about 10 days after the pig was infected and will persist for almost 2 years.

Control

A recent meeting of representatives from the USDA, Livestock Conservation Institute (LCI), state regulatory officials, National Pork Producers Council, research personnel, and other groups decided to establish a control instead of an eradication program. Many questions concerning the disease need to be answered before eradication can be attempted. These requirements include sampling thousands of herds, studying economic impact, increasing vaccine research, and enforcing regulations of stock movement.

Norden Laboratories in Lincoln, Nebraska, was granted a license to produce a modified live virus vaccine for pseudorabies. But, state regulatory officials must authorize vaccine usage. Since vaccinated animals have antibodies identical to those of infected animals, it may be necessary to restrict the movement of vaccinates.

Vaccinating breeding stock prior to breeding twice a year is recommended. Pigs are to be immunized when 3 to 8 weeks old if they are nursing immune sows and after 3 days of age if the sows have not been vaccinated.

At this time, hyperimmune serum cannot be put into widespread use due to expense and ineffectiveness. Only a 30% reduction in mortality can be expected in herd outbreaks.

Discussion

The APHIS (Animal and Plant Health Inspection Service), USDA, has recently written a proposal for pseudorabies regulations. The proposal covers definitions, a notice of the disease's existence, general restrictions, interstate movement of exposed and nonexposed livestock, other movements, and cleaning and disinfection.

Many states are writing their own regulations, but until more information is available, several measures can be taken to protect herds.

1. Properly dispose of dead pigs (burning or burying) so dogs, cats, and scavenging animals cannot feed upon them.
2. Buy breeding stock that have been tested and isolate them for 30 days. Retest them before mixing with your herd.
3. If you raise breeding stock, do not buy feeder pigs.
4. Get feeder pigs from a farm that has not had an outbreak.
5. Keep visitors out of hog lots or provide them with clean clothing.
6. Keep stray dogs, cats, and wildlife off your premises.
7. Have your local veterinarian or county agent keep you abreast of the incidence of pseudorabies in your area.
8. Keep swine and cattle separate.
9. When show stock are brought home, isolate and test them in 30 days as you would newly purchased animals.

Summary

Most authorities agree that now is not the time to eradicate pseudorabies. The disease must first be brought under control by testing, isolation, quarantining, and vaccination. After thoroughly studying all aspects of the disease, it is hoped that eradication will be practical enough to carry out. An increase in research funds is now being provided for this study.

Swine producers are encouraged to call their veterinarian if symptoms of the disease occur. If an outbreak appears, other swine producers should be notified.

Effect of chemical frost on establishment of ladino clover in tall fescue sod is illustrated by this comparison at the Piedmont Substation. Both plots were seeded with clover.

CHEMICAL FROST Aids Ladino Establishment in Tall Fescue Sod

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Dept. of Agronomy and Soils
W. A. GRIFFEY and H. E. BURGESS, Piedmont Substation
L. A. SMITH and H. W. GRIMES, Black Belt Substation
J. T. EASON and M. E. RUF, Sand Mountain Substation

GROWING LADINO CLOVER with tall fescue pastures gives dual advantages of supplying nitrogen for the grass and improving quality of forage produced. Unfortunately, most of Alabama's million plus acres of tall fescue contain no clover. Therefore, adding clover to existing fescue sod would be expected to boost beef cattle weaning weights and beef production per acre.

Seeding ladino into tall fescue has had limited success because strong competition by the grass makes it difficult to establish clover in the sod. Now there is evidence that use of a "chemical frost" (chemical growth suppressant) may make possible successful introduction of clover into fescue sod. Applying the chemical in narrow strips reduced grass competition and aided establishment of the small clover seedlings in Auburn University Agricultural Experiment Station experiments.

Two chemical frost materials were tried at the Piedmont and Black Belt substations. Roundup® and Paraquat ®[1] were sprayed in 5-in. bands 9 in. apart at a rate of ½ lb. per sprayed acre with a Zip Seeder during September. Regal ladino was planted at 3 lb. per acre either in rows 9 in. apart or broadcast on the Kentucky 31 fescue sod. Grass and clover forage was harvested when available throughout the year. No nitrogen fertilizer was applied. Diazinon®[2] insecticide was applied to control striped field crickets.

Paraquat gave rapid top kill of the tall fescue sod. The kill was slower from Roundup, but longer lasting than from Paraquat. At the Black Belt Substation, dallisgrass in the tall fescue sod was unaffected by Paraquat but killed by Roundup.

Both Paraquat and Roundup improved clover establishment and subsequent production, Table 1. At the Piedmont Substation, clover production was better when seeded in rows than in broadcast planting. At the Black Belt Substation, broadcast seeding was similar to row seeding. Early spring growth of clover was generally best with a combination of chemical frost and row seeding. This was true at both locations.

Clover production the second spring was best when chemical frost had been used in planting, Table 2. Where clover seed were broadcast without application of a chemical there was little clover the second year.

Results were similar at the Sand Mountain Substation, except date of seeding seemed to be critical. September seedings have been successful, while late October and November plantings resulted in winter kill of clover seedlings. March seeding resulted in poor clover stands, and April seeding was a complete failure. Small clover seedlings from late spring plantings failed to survive summer heat and drought.

Subsequent trials at all three locations have established the necessity of cricket control. Without application of Diazinon insecticide, clover seedlings were destroyed by crickets.

Results of the Alabama tests indicate that use of chemical frost (Paraquat or Roundup) will aid in establishing ladino clover in tall fescue sod. Paraquat is labeled for use on pastures, but **Roundup is not yet cleared for this use.**

Row seeding proved to be the most dependable planting method to assure clover stands. Machines available for row seeding of clover include the Zip Seeder, Power Till, and Pasture Pleaser, and several others are currently being developed.

Early autumn seeding appears to give best results in Alabama. Application of Diazinon insecticide for control of crickets is essential for success.

TABLE 1. FORAGE YIELD IN 1976 OF TALL FESCUE SOD OVERSEEDED IN SEPTEMBER 1975 WITH LADINO CLOVER, USING GROWTH SUPPRESSANT CHEMICALS, TWO CENTRAL ALABAMA LOCATIONS

Sod treatment	Clover seeding method	Yield per acre, dry forage			
		Piedmont Substation		Black Belt Substation	
		Grass	Clover	Grass	Clover
		Lb.	*Lb.*	*Lb.*	*Lb.*
Roundup	Rows	3,260	3,560	2,840	1,450
Roundup	Broadcast	4,970	1,500	2,210	1,930
Paraquat	Rows	3,600	2,640	2,190	1,650
Paraquat	Broadcast	4,030	2,000	2,250	1,720
None	Rows	5,030	1,420	2,980	570
None	Broadcast	5,770	260	3,100	660
None	None	4,110	0	3,140	90

TABLE 2. FORAGE YIELD BY APRIL 1977 OF TALL FESCUE SOD OVERSEEDED IN SEPTEMBER 1975 WITH LADINO CLOVER, USING GROWTH SUPPRESSANT CHEMICALS, PIEDMONT SUBSTATION

Sod treatment	Clover seeding method	Yield per acre, dry forage	
		Grass	Clover
		Lb.	*Lb.*
Roundup	Rows	200	1,110
Roundup	Broadcast	390	720
Paraquat	Rows	360	920
Paraquat	Broadcast	260	980
None	Rows	520	580
None	Broadcast	720	290
None	None	440	0

[1]Roundup (common name, glyphosate) is a product of Monsanto Chemical Co., and Paraquat is a product of Chevron Chemical Co.
[2]Diazinon is a product of Ciba-Geigy Corporation

BABY PIGS NEED SUPPLEMENTAL IRON

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PIGS BORN UNDER CONFINEMENT conditions are unique among farm animals in that they have a definite need for supplemental iron within a few days of birth. This need is explained by several factors, such as those listed below:

1. Pigs are born with a low body storage of iron.
2. Sow's milk is low in iron.
3. Pigs are isolated from soil, which is their natural source of iron.
4. Pigs do not consume enough solid feed to meet their iron needs.
5. Pigs grow rapidly (size triples in 3 weeks) thus depleting the body of its iron reserve.

Because of the conditions described, iron in some form is critical to the well being and health of the baby pig. This supplemental iron is needed until the pig is old enough to consume enough solid food to meet its dietary iron needs.

Iron is an essential mineral component of hemoglobin, muscle myoglobin, and several enzymes which are indispensable for oxygen transportation and cellular respiration. The most obvious deficiency condition is anemia, accompanied by a general unthrifty appearance. Thus, the hemoglobin content of the blood is a good measure of the iron nutritional status of the baby pig.

This report of selected data from several Auburn University Agricultural Experiment Station tests compares some of the iron compounds most frequently used in preventing "baby pig anemia." The control group of pigs received no additional iron, whereas the iron-dextran group received 100 mg of iron as an injection at the sixth day of age.

Hemoglobin levels decreased rapidly, dropping to 70% of that at birth in the first 6 days of life in both groups. By the 14th day, hemoglobin levels in the control group had dropped to only 44% of the original level and they were also significantly lower than the iron treated group throughout the study, as shown by the following data:

Treatment	*Hemoglobin level (gram pct.) by age*					
	At birth	*6 days*	*14 days*	*21 days*	*35 days*	*56 days*
Control	11.7	8.1	5.1	5.8	4.9	5.3
Iron-dextran	12.3	8.7	10.1	11.6	9.1	8.0

Differences in weight became evident at 21 days of age, as shown by data in the table. Pigs that did not receive iron gained at only 70% of the rate of the iron-injected group (28.2 vs. 40.2 lb. at 56 days).

Two injectable iron compounds, iron-dextran and iron-peptone plus vitamin B_{12}, were compared with an oral iron compound, ferric oxide, in experiment 1. Ferric oxide is common iron rust. One hundred mg of iron-dextran or iron-peptone were injected the sixth day of age. Ferric oxide was given by mouth at a dosage of 200 mg of iron at the same age. (This rate used because other data showed that 100 mg was inadequate.) Although pig weights were similar throughout experiment 2, pigs that received iron-dextran were somewhat heavier at every weigh period.

Experiment 3 compared the efficacy of two oral iron compounds, ferric oxide (200 mg of iron per dose) and ferric citrate (100 mg of iron per dose), with 100 mg of injectable iron-dextran. All pigs were treated at 4 days of age. Pigs that received injected iron were heavier than the two orally-treated groups at 56 days (41.7 vs. 38.0 and 37.4 lb.).

Iron injection boosted growth rate of pigs farrowed in confinement.

In experiment 4, efforts were made to increase the weight response of oral-iron treated pigs to that of pigs injected with iron. In this test the same levels of iron were given as in experiment 3. However, the oral iron was given at 4 days and again at 14 days of age. Rate of gain was essentially the same for pigs in all treatment groups, as shown by data in the table.

Based on the Auburn trials, it is concluded that iron supplementation is necessary for desirable performance of pigs farrowed in confinement. Either oral or injectable iron compounds are effective if given at the rates indicated by 3-4 days of age: however, in each experiment pigs that received injected iron were slightly heavier at 56 days of age than those that received oral iron.

EFFECT OF VARIOUS IRON COMPOUNDS AND METHODS OF ADMINISTRATION ON GROWTH OF BABY PIGS

Treatment	Weight at specified age					
	At birth	6 days	14 days	21 days	35 days	56 days
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Experiment 1						
Control	3.0	4.4	8.5	10.2	15.6	28.2
Iron	3.1	4.7	8.6	12.0	20.7	40.2
Experiment 2						
Iron-dextran	3.4	5.5	9.4	13.6	21.7	43.3
Iron-peptone plus vitamin B_{12}	3.3	5.0	8.8	12.5	20.8	41.3
Iron capsule (oral)	3.4	5.3	9.1	12.3	19.4	40.1
Experiment 3						
Iron-dextran	—	—	9.5	13.5	22.8	41.7
Ferric oxide (oral)	—	—	9.0	12.4	20.1	38.0
Ferric citrate (oral)	—	—	9.2	12.8	20.6	37.4
Experiment 4						
Iron-dextran	—	—	9.3	11.7	21.0	43.1
Ferric oxide (oral)	—	—	8.7	11.8	20.7	42.6
Ferric citrate (oral)	—	—	8.7	11.7	20.7	42.9

ERADICATION OF BRUCELLOSIS– a look to the future

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Contact between non-infected cows and aborted fetuses can result in spread of brucellosis.

BRUCELLOSIS IS THE TARGET of expanded research underway at Auburn University. Veterinary medical and agricultural researchers are seeking to provide information needed to eradicate this costly cattle disease in Alabama and the nation. The urgency of eradicating brucellosis is illustrated by USDA data showing that American livestock producers suffer annual losses in excess of $30 million because of the disease.

Since 1934 USDA has conducted a nationwide brucellosis eradication program. Unfortunately, within the past 4-5 years the incidence of brucellosis has increased nationwide, and particularly in the South. This has resulted in a resurgence in the number of human cases.

Brucellosis, caused by the bacterium *Brucella abortus,* is readily transmitted from infected to noninfected cattle. The disease may or may not cause abortion. However, the reduction in fertility and milk production is certain to cause a significant loss in income. The disease in humans is characterized by an insidious, and frequently misdiagnosed, illness with fever, fatigue, night sweats, and myalgia. It often progresses to serious complications manifested in any and all organs of the body, and may lead to long periods of invalidism.

Abortion is the most frequently noted and most obvious sign of bovine brucellosis, but most infected cattle abort only once. Farmers often believe that their herd is not infected because they have not observed abortions. It is not clear whether fetal death is due to an endotoxin or to placental necrosis and disruption of circulation to the fetus. Blood tests of some animals that become infected may remain negative until after abortion or calving, a situation that is not understood.

The brucellosis organism is found in large numbers in the vaginal discharge following calving. Calves born to infected dams have millions of brucella organisms in their stomachs and for some time after birth these bacteria are shed in the calf feces. Brucella organisms also leave the body of the cow in the milk. Although udder infection lasts for years, the numbers of organisms in the milk fluctuate widely from year to year.

The nature of problems from brucellosis is indicated by a comparison of conditions in clean and infected herds, as given below:

Condition	*Clean herd*	*Infected herd*
Retained placenta for completed pregnancy	6%	47%
Abortions per completed pregnancy	4%	44%
Calves per completed pregnancy	87.8%	25.6%
Number of cows bred	100	100
Number of services per pregnancy	1.7	2.4
Number of pregnancies	87	43
Number of completed pregnancies	64	38

Since the beginning of the eradication program, there has been a marked reduction in the prevalence of the disease in cattle—from approximately 11% of all cattle in 1935 to less than 1% at present. Greatest progress towards eradication has been in the North and West. Unfortunately, about 90% of the existing bovine brucellosis is in the Gulf and South Central States, an area undergoing the greatest expansion of the cattle industry.

New research at Auburn is aimed at lowering the incidence of brucellosis in Alabama and the Southeast. A new diagnostic test is being sought in a study by Drs. T. T. Kramer and Ian Swann, of the School of Veterinary Medicine, and Dr. Phillip Klesius, of the USDA Regional Parasite Laboratory. Results to date are encouraging. It is hoped that this test may aid in differentiating antibodies produced in the blood stream by vaccination from those produced upon infection by the field strain of the organism.

Animals are now being assembled to evaluate the role of calves born to brucellosis infected dams as a possible means of spread. In the past it was assumed that these calves could be retained for breeding stock and they would not transmit the disease. However, results of preliminary studies in France indicate that this assumption may be false. The study of this problem is a cooperative project between the Animal and Plant Health Inspection Service of the USDA and Auburn University (Agricultural Experiment Station and the School of Veterinary Medicine), funded primarily by USDA.

Another project on brucellosis now underway at Auburn is concerned with the study of wildlife and their importance as a possible means of spread of the disease. The Cooperative Wildlife Research Unit is cooperating with the School of Veterinary Medicine and Agricultural Experiment Station.

Although research is needed in such areas as diagnosis, prevention (vaccines), pathogenesis, and epidemiology, a big need is for Alabama producers to accept and follow key elements of the eradication program. These steps include:

1. Maintain closed herds if possible.
2. Raise own replacements.
3. Purchase animals only from brucellosis-free herds.
4. Isolate and retest new additions.
5. Confine calving to a 2- to 4-month period, rather than have year-round calving.
6. Practice sanitary and hygienic measures as an aid in preventing diseases.

If Alabama producers expect to maintain demand for their cattle throughout the United States, greater consideration needs to be given to maintaining brucellosis-free herds. Buyers from states where eradication progress has been made need assurance that Alabama cattle will not transmit brucellosis to their herds. Furthermore, consumers of Alabama livestock products have the right to demand that meat, milk, and milk products are free of brucella organisms.

The tests and procedures now being used are adequate to accomplish the goal of eradication of brucellosis; however, a major research effort is still needed to improve effectiveness of the program. This in turn would permit the accomplishment of the goal of eradication at an earlier date.

Energy Costs of Pumping Irrigation Water from Wells

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ALABAMA FARMERS have steadily been increasing acres irrigated to ensure high yields for several years. Now, with a drought in Alabama, the number of irrigation units used and acres irrigated could increase more rapidly.

A research project now in progress at the Alabama Agricultural Experiment Station has these objectives: (1) to collect data and implement an information retrieval system for evaluation of irrigation potential of Alabama cropland, and (2) to evaluate the irrigation potential, including physical and economical benefits and costs, of irrigating crops in Alabama.

This article will be concerned with only a small part of the objectives—that of energy costs for two typical irrigation systems by different power sources. No attempt is made to treat the fixed costs of the systems themselves, responses by different crops to irrigation, and many other aspects of a complicated subject. However, energy requirements alone are of increasing importance in this era of uncertainty concerning these subjects.

A recent survey conducted by the authors for the year 1975 found that 58.1% of the irrigated acres and 42.4% of the systems in Alabama were powered by diesel engines. LP gas provided power for 22.9% of the irrigated acres and 20.3% of the systems. Electricity furnished power for 14.6% of the irrigated acres and 21.6% of the systems. Gasoline and city or county systems accounted for only about 4.4% of the acres irrigated and will not be discussed here. The traveler, or cable tow system, accounted for 51.3% of the acres irrigated in the 1975 survey and the center pivot for 22.5%. These were the two most important systems for row crops.

Pumping cost is affected by: (1) height of lift, whether from a well, pond, lake, or river: (2) conveyance losses from the source to the application; (3) drive system requirements; (4) pump efficiency; (5) power plant efficiency in converting an energy source to use; (6) nozzle pressure requirements for different systems; (7) costs per unit of different energy sources; and others not mentioned.

TABLE 1. ESTIMATED PUMP ENERGY REQUIREMENTS (KILOWATT HOURS/ACRE-INCH WITH 65% PUMP EFFICIENCY) TO DELIVER 1 ACRE-INCH OF WATER, BY PRESSURE REQUIREMENTS OF 70 AND 120 POUNDS PER SQUARE INCH AND BY DIFFERENT PUMPING DEPTHS

Pumping depth (ft.)	Typical center pivot system 70 p.s.i.	Typical traveler system 120 p.s.i.
	(KWH per acre-inch)	
0	22	36
100	35	50
200	49	64
300	63	77
400	76	91
500	90	105

Simplified estimates of pump energy requirements are presented in Table 1 for two representative nozzle pressures, the center pivot system (70 p.s.i.) and the traveler system (120 p.s.i.). These are converted from horsepower requirements to a common denominator of kilowatt hours per acre-inch for different pumping depths. These requirements are generally independent of pumping rate but are dependent on outlet pressure and pumping depth. Persons using this table may estimate energy requirements for other nozzle pressures by interpolating or extrapolating from the 70 and 120 p.s.i. figures and for different depths.

To estimate energy costs from pumping 1 acre-inch of water, the physical energy requirement for a particular farm situation must first be obtained from Table 1. This figure is then used to estimate energy costs from Table 2. Table 2 presents energy costs for pumping 1 acre-inch of water for the three energy sources or systems (electricity, diesel, and propane gas) and for different costs per unit of these three energy sources.

Users of this table may read the cost per acre-inch for their particular situation directly from Table 2 as the nearest figure, or interpolate and/or extrapolate as required to approximate their particular situation. For example, assume that a user has a pumping depth on his farm of 400 ft. and is figuring energy cost for a center pivot system. KWH needed per acre-inch will be 76 from Table 1. In Table 2 he can either read from the 80 KWH column (the nearest) or interpolate between the 60 and 80 KWH column in proportion that 76 is from 60 or 80. Assume that he is comparing the three power sources as a replacement to a present unit and he assumes that electricity will average about 6¢ per KWH over the future life of the unit, diesel fuel will average 60¢ per gallon, and propane will average 50¢ per gallon. Reading from the nearest KWH per acre-inch column (80), the energy cost for the three power sources will be $5.33 for electricity, $3.87 for diesel fuel, and $5.34 for propane. If he does the arithmetic of a proportion problem and interpolates between 60 and 80 KWH, the figures will be $5.06, $3.67, and $5.07, respectively (76.3/80 x each value).

This of course will not be the only cost of irrigation—only one of the items in the total picture, but, an important one. In evaluation of whether a total system is feasible for a particular farm situation, the user needs to know something of the costs of the irrigation system planned or used and the expected returns above the non-irrigated situation. Costs of the total situation will include, in addition to energy costs, labor and other variable costs, depreciation per year of the different facilities and items of equipment, interest on investment, and other detailed considerations.

TABLE 2. ENERGY COSTS FOR PUMPING 1 ACRE-INCH OF WATER, BY SOURCE OF POWER, PER UNIT ENERGY COSTS, AND TOTAL PUMP ENERGY REQUIREMENTS

Energy unit costs	Cost of pumping 1 acre-inch when pump energy requirements in KWH/acre-inch are:					
	20	40	60	80	100	120
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
$/KWH	electric power plant (90% power plant efficiency)					
.02	0.44	0.89	1.33	1.78	2.22	2.67
.04	0.89	1.78	2.67	3.56	4.44	5.33
.06	1.33	2.67	4.00	5.33	6.67	8.00
.08	1.78	3.56	5.33	7.11	8.89	10.00
.10	2.22	4.44	6.67	8.89	11.11	13.33
$/gallon	Diesel power plant (31% thermal efficiency with 25.8 KWH/gal.)					
.30	0.48	0.97	1.45	1.94	2.42	2.90
.40	.65	1.29	1.94	2.58	3.23	3.88
.50	0.81	1.61	2.42	3.22	4.03	4.84
.60	0.97	1.94	2.90	3.87	4.84	5.81
.70	1.13	2.26	3.39	4.52	5.65	6.78
.80	1.29	2.58	3.87	5.16	6.45	7.74
.90	1.45	2.90	4.36	5.81	7.26	8.71
1.00	1.61	3.22	4.84	6.45	8.06	9.67
$/gallon	propane power plant (29% thermal efficiency with 25.8 KWH/gal. best value)					
.20	0.53	1.07	1.60	2.14	2.67	3.20
.30	0.80	1.60	2.41	3.21	4.01	4.81
.40	1.07	2.14	3.21	4.28	5.35	6.42
.50	1.34	2.67	4.01	5.34	6.68	8.02
.60	1.60	3.21	4.81	6.42	8.02	9.62
.70	1.87	3.74	5.62	7.49	9.36	11.23
.80	2.14	4.28	6.41	8.55	10.69	12.83

Soil Moisture Response to Deep Tillage Controlled Traffic Cultural Practices

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TILLAGE AND TRAFFIC PRACTICES can significantly influence availability of soil water to cotton in sandy Coastal Plain soils. In fact, wrong tillage and traffic practices can result in low cotton yields in soils with abundant subsurface moisture, because compacted soils impede root penetration into lower soil profiles which contain crucial supplies of water.

Gypsum blocks have been used for 3 years to measure soil water as percent of field capacity in tillage and traffic research plots at the Agricultural Engineering Research Unit in Marvyn. These plots included six treatments: three levels of traffic (traffic restricted to permanent lanes, normal tricycle tractor traffic, and normal tricycle tractor plus sprayer traffic) imposed over two levels of tillage (conventional 6 to 8 in. deep and deep chiseling to 18 in.). Cotton was maturing and reproducing when moisture measurements were made. Rainfalls during the periods of data collection were 5.79, 9.84, and 11.97 in. in 1973, 1974, and 1975, respectively. However, 1975 was abnormally wet during the winter and spring preceding the test.

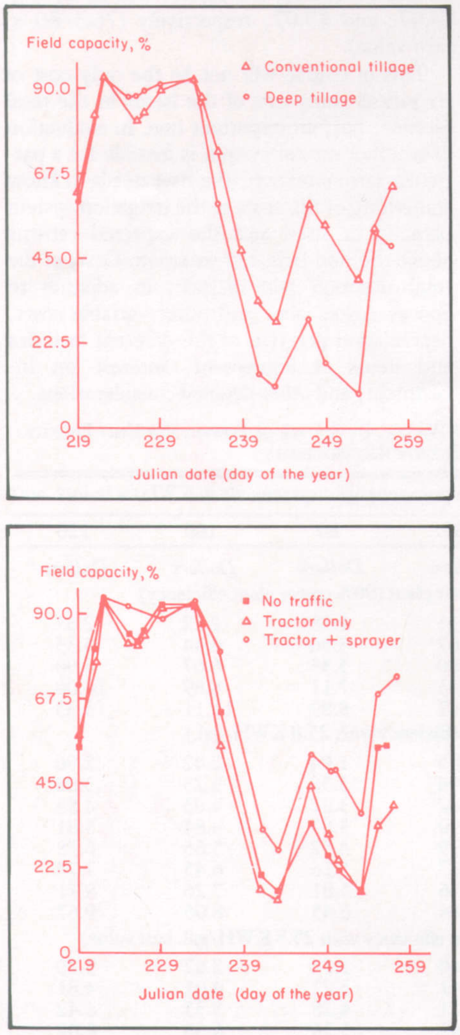

FIG. 1. 1973 soil water profiles measured by gypsum blocks at 8-in. depth for tillage and traffic main effects.

Soil moisture profiles for 1973, showing the responses to tillage and traffic main effects at 8 and 18 in. depths, are characteristic of responses during the test years, figures 1 and 2, respectively. Soil moisture was generally higher at the 18 in. depth than at the 8 in. depth and showed a slower response to rainfall and drought. Surface aeration and a larger volume of early root growth in the shallow soil extracted moisture more readily at 8 in. than at 18 in. On the other hand, recharge usually occurred more rapidly at 8 in. than at 18 in.

A higher percent field capacity of water was usually observed in conventional tillage than in deep tillage plots at both depths. Intuitively, this response may seem strange when one assumes that deep tillage can help conserve moisture. Such an assumption, however, does not consider the difference in size of plants growing in the field under the two tillage practices. Plants on deep tillage plots were consistently larger. Their root distributions were also much more prolific and extensive. Although deeply-tilled soil allowed plants access to larger regions of soil water, the moisture demands of larger plants resulted in lower measurable soil water. Plant water deficits were never of critical magnitudes, consequently deep tillage cotton consistently exhibited higher yields, Table 1. While larger deep tillage plants could get water from both measured soil depths, conventional tillage plants were unable to penetrate the hardpan of these soils. Much soil water went unused as suggested by the high values of percent field capacity in conventional tillage, Figure 2, even during a drought period from day 234 to 256. Tests indicate that soil water must be available to the plants to increase production.

Soil water variabilities were not as apparent under different traffic practices as tillage practices. Certain points of interest were, however, evident. Soil water tended to measure slightly highest at both 8 and 18 in. depths, with extensive tractor plus sprayer traffic. Observations of root distributions, however, revealed more extension and proliferation in soils receiving lower levels of traffic. Also, with the exception of the unusually wet 1975 season, yields were higher for lower traffic levels, Table 1.

Tillage and traffic practices can greatly influence the accessibility of soil water and the subsequent production of cotton grown in Coastal Plain sandy soils. Larger, more productive plants are grown where tillage is deep and vehicle traffic is restricted to permanent traffic lanes outside the root zone.

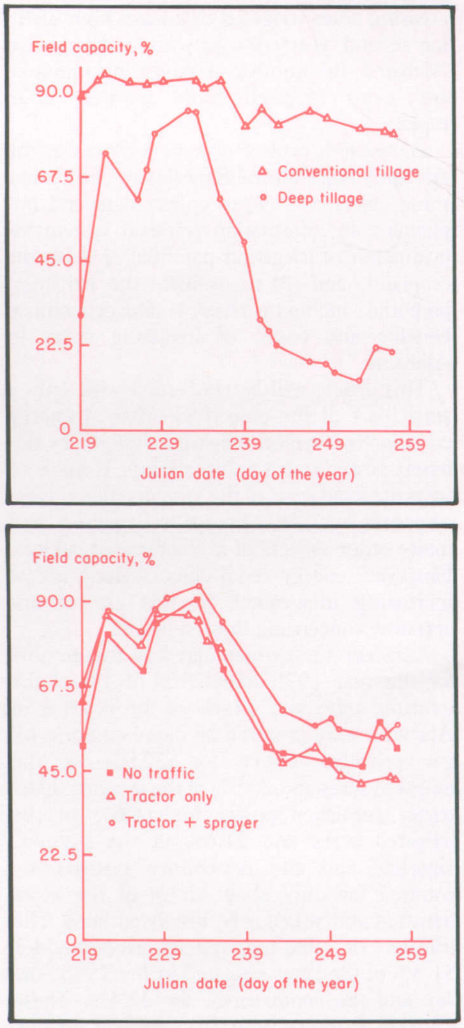

FIG. 2. 1973 soil water profiles measured by gypsum blocks at 18-in. depth for tillage and traffic main effects.

YIELDS OF SEED COTTON FOR TILLAGE AND TRAFFIC MAIN EFFECTS

Treatment	Year	Yield per acre
		Lb.
Conventional tillage.	1973	1,803
	1974	1,887
	1975	1,966
Deep tillage.	1973	2,399
	1974	2,699
	1975	2,263
Controlled traffic	1973	2,429
	1974	2,464
	1975	1,911
Tractor traffic only	1973	1,960
	1974	2,305
	1975	2,203
Tractor and sprayer traffic . .	1973	1,916
	1974	2,111
	1975	2,229

Scale Insect Pests of Alabama Shade Trees

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THE PRODUCTION of beautiful, uniform trees of desirable, lasting species will do more toward increasing property values and attracting buyers to a given section than any other single item of improvement. It is therefore important to protect shade and ornamental trees from attack by damaging insects.

Scale insects are among the most destructive agents of shade trees and ornamentals and at times may cause serious damage to forest growth. Injury results either from the withdrawal of sap or the production of galls while feeding. When scale insects occur in large numbers, the extensive withdrawal of plant juices causes discoloration and eventual drying of leaves or needles. This feeding may cause death of the tree or of heavily infested parts. Also, the feeding damage makes a tree more susceptible to winter injury and disease.

Scale insects do not resemble the usual form of insects. Most scale insects do not move about much after they begin to feed; so they often go undetected when trees are inspected to determine the cause of death or loss of vitality. The scale insects may appear as brownish, reddish, or grayish growths or small swellings on twigs or foliage. Pine needle scales appear as white spots on needles, and heavily infested branches may seem to be encrusted with scales.

Many scale insects excrete a sticky sweet fluid called honeydew, which may become so abundant that infected leaves glisten in the sunlight. Usually a black sooty mold fungus grows on the honeydew causing foliage and branches to look black. These two conditions are often the first symptoms of scale insect infestations.

Auburn University Agricultural Experiment Station entomologists have been conducting a survey of the scale insects of Alabama since 1973, with the intent of finding out which species occur in the State, the extent of their distribution, and which host plants are attacked. Current records indicate 157 species and 70 genera of scale insects in Alabama. Many of these scale insects attack both deciduous (leaf-shedding) and evergreen trees.

Many species of scale insects do not build up large enough populations to injure a tree, and some trees are able to withstand attacks without evident injury. However, some species of scale insects occurring in Alabama are very detrimental to shade and ornamental trees and may cause noticeable injury or even death of the tree in a few seasons. Such scale insects include the obscure scale, gloomy scale, tuliptree scale, white peach scale, and terrapin scale. Other species, such as European elm scale, pine needle scale, cottony maple scale, woolly pine scale, pine tortoise scale, and European fruit lecanium may occur in large numbers but generally do not kill the trees they attack. These may, however, make the tree unsightly and the large amount of honeydew they produce may attract other noxious insects such as bees, wasps, and ants.

Field tests indicate control of scale insect pests may be achieved by applying sprays of Carbaryl, Diazinon, or Malathion during periods of crawler emergence (when young are born), but close and constant inspection of the trees is necessary to determine when sprays are needed.

Research has shown that: scale insect pests of shade trees can best be controlled by spraying in the dormant season, that is, in winter before tree buds swell and burst open. Treatments immediately preceding bud break are most effective. Spraying should be done when the temperature is above 32°F and there is no likelihood of freezing for 24 hours. Best spraying time is a dry, mild, sunny morning. Dormant sprays should not be applied in late afternoon or repeated in the same year.

Use an emulsifiable concentrate of 60- or 70-second Superior-type oil spray, or for difficult scale insect pests, use a combination of oil plus Ethion. Oil sprays may cause plant injury to the following trees: Japanese maple, sugar maple, beech, birch, hickory, walnut, butternut, Douglas fir, and blue spruce. When spraying insecticides *Always Follow Label Directions Carefully.*

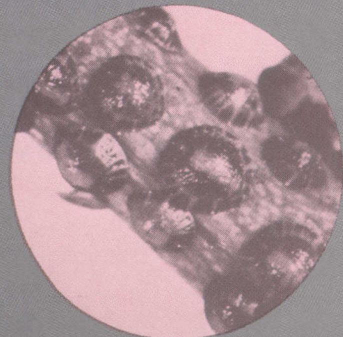

FIG. 1. Adult female terrapin scale insects occur on a wide variety of shade trees.

FIG. 2. Young woolly pine scale insects attack only pine trees.

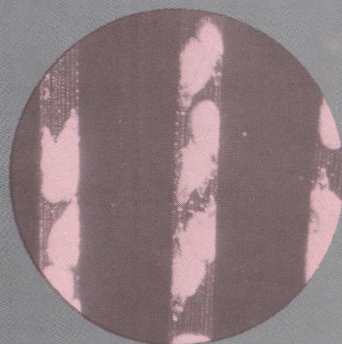

FIG. 3. Adult female pine needle scale insects feeding on needles of loblolly pine.

FIG. 4. A tuliptree or yellow poplar which shows typical damage caused by heavy infestation of tuliptree scale.

FIG. 5. Adult female European fruit lecanium scale insects look like small bumps or galls on the twigs of oak trees.

Overseeding Coastal Bermudagrass with Winter Annual Clovers and Grasses Boosts Beef Cow-Calf Performance

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COASTAL BERMUDAGRASS is dormant or unproductive in southern Alabama for 5 to 6 months of the year. Results of a 3-year grazing trial at the Wiregrass Substation show that overseeding the grass sod with winter annual grasses and clovers can extend the grazing season by 1 to 3 months and increase calf gain 40 to 75% per acre.

In this experiment, closely grazed Coastal bermudagrass sod was overseeded in October or November with a grain drill. The four treatments compared were: (1) rye, arrowleaf clover, and crimson clover; (2) arrowleaf clover and crimson clover; (3) ryegrass, and (4) not overseeded. Seeding rates per acre were 56 lb. Wrens Abruzzi rye, 8 lb. Yuchi arrowleaf clover, 10 lb. Autauga crimson clover, and 20 lb. Gulf ryegrass. Nitrogen at 50 lb. per acre was applied to non-overseeded Coastal bermuda in early April and July to total 100 lb. N annually. The treatment with ryegrass received 50 lb. N per acre in January, April, and July, to total 150 lb. annually. Rye-clover received 50 lb. N per acre in November and January to total 100 lb. annually. The overseeded clover treatment did not receive any N fertilizer.

Grade Hereford and Hereford-Charolais cows bred to crossbred Charolais bulls were used. Calves, born from November through December, remained with the cows until weaned in September. Pastures were stocked whenever grazing was available, but no supplements were fed to animals while on pasture. During late autumn and winter when no grazing was available, animals were removed from the paddocks and fed Coastal bermudagrass hay and a protein-mineral-vitamin supplement.

Pastures

Overseeding Coastal bermudagrass with the rye and clover mixture increased the grazing period about 3 months, with ryegrass nearly 2 months, and with arrowleaf-crimson clovers nearly a month. Overseeded rye-clover furnished a 9-month grazing season, with rye furnishing most of the forage until early April. Crimson clover was available early March through late April. Most of the arrowleaf clover production occurred during April, May, and June. Ryegrass grazing was available from early February until mid-May, followed by Coastal bermuda. Most of the grazing during the first 2 to 3 weeks on non-overseeded sod each year consisted of weeds. Coastal bermudagrass growth was delayed 4 to 6 weeks by overseeding, but the loss of bermudagrass was compensated for by growth of the overseeded winter annuals. Stocking rate varied from 0.6 to 0.7 cow-calf units per acre on rye-clover or ryegrass during January through March, to 1.1 units on Coastal bermudagrass in summer.

Animal Performance

Calf gain per acre was increased 75% when the Coastal bermuda sod was overseeded with rye and clover. Calf gains per acre were increased 45% with ryegrass and 40% with clovers overseeded on the grass sod.

Average calf daily gain on pasture for the season was increased 10% with ryegrass, 20% with rye-clover, and 25% with clovers, as compared to Coastal bermudagrass alone. The lower average daily gain on Coastal bermudagrass was mainly a result of poor performance in late summer. Calves on overseeded pastures maintained a higher rate of gain throughout the grazing season. Cow gain per acre was also increased by overseeding rye-clover or clovers on the grass sod, with the highest daily gain from sod overseeded with clovers.

Total cow and calf gains per acre were high on overseeded Coastal bermudagrass sod. Cow and calf gains per acre were 750 lb. for rye-clovers, 700 lb. for clovers, and 610 lb. for ryegrass, compared to 450 lb. for Coastal bermudagrass sod alone.

By overseeding the sod, nursed calves gained almost twice as much as similar calves on the same sward without overseeding. Calf gain per season was 520 lb. on sod overseeded with rye and clover, 410 lb. on ryegrass, and 410 lb. on clover, as compared to only 260 lb. on Coastal bermudagrass alone.

Although ryegrass extended the grazing season and increased gain per acre, it is apparent that applying the same amount of nitrogen to overseeded rye and clover provided more grazing over a longer season. Overseeding clovers alone on the sod, although furnishing a shorter grazing season, sharply increased calf daily gain and gain per acre at relatively low cost over that of Coastal bermudagrass alone. The value of clover in supplying nitrogen to the pasture and improving calf performance is apparent from these results.

PERFORMANCE OF BEEF COWS AND CALVES ON COASTAL BERMUDA PASTURES OVERSEEDED WITH WINTER ANNUALS AT WIREGRASS SUBSTATION, AVERAGE OF 3 YEARS (1974-76)

Species overseeded on Coastal bermuda sod	N/acre applied annually	Dates on pasture	Grazing days	Cows		Calves	
				Gain/acre	ADG	Gain/acre	ADG
	Lb.			*Lb.*	*Lb.*	*Lb.*	*Lb.*
Rye-arrowleaf and crimson clovers	100	Jan. 8-Oct. 5	268	240	0.90	510	1.91
Arrowleaf and crimson clovers	0	Mar. 11-Oct. 5	211	290	1.37	410	1.94
Ryegrass	150	Feb. 14-Oct. 5	240	190	.18	420	1.76
None	100	Apr. 6-Oct. 5	187	160	.49	290	1.57

Systemic Fungicide Protects Southern Pine Seedlings From Fusiform Rust

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FUSIFORM RUST, caused by the fungus *Cronartium fusiforme,* is the most destructive disease of loblolly and slash pines in the southeastern United States. Annual losses resulting from this disease have been estimated to exceed $28 million.

Like many other rust fungi, *C. fusiforme* requires two hosts to complete its life cycle. Aeciospores, yellow-orange masses of powder-like spores produced on galls of pine trees in early spring, only infect emerging leaves of red and black oaks. Although small, orange leaf spots (uredial stage) become evident on the underside of oak leaves following infection, damage to the oak host is negligible. Within a few weeks dark-colored, hair-like columns (telial stage) are formed from the leaf spot areas. These columns are made up of numerous small cells, each of which germinates to produce four basidiospores. Basidiospores only infect emerging new needles and meristematic tissue of pines; viable basidiospores usually are present from the last week of April through mid-June.

Loblolly and slash pine seeds are planted in nursery beds during April, thus seedling emergence coincides with basidiospore release. For many years the carbamate fungicide, Ferbam, has been used to control fusiform rust in nursery beds. Unfortunately, Ferbam is a contact fungicide that acts as a protectant, i.e., it does not move inside the plants (systemic), it has no therapeutic effects, and it must be present on the surface of the plant to prevent infection from occurring. In Alabama nurseries, Ferbam is applied two or three times a week and after rains from seedling emergence through late June; total number of applications ranges from 30 to 50 per year, resulting in considerable costs for labor, equipment, and fungicide.

An experiment was conducted to evaluate the experimental systemic fungicide, benodanil, as a possible alternative to Ferbam in controlling *C. fusiforme* in loblolly pine. Five replicate greenhouse flats, each containing 20 transplanted seedlings of a genetic family known to be susceptible to *C. fusiforme,* were used for each treatment. Treatments were: (1) Untreated control; (2) Ferbam control (2.27 lb. per acre active ingredient(ai) applied as a foliar spray 9, 7, and 2 days before inoculation with *C. fusiforme*); (3) benodanil soil treatment (17.8 lb. per acre (ai) applied pre-plant incorporated); (4) benodanil foliar spray (0.88 lb. per acre (ai) one application either 26, 13, or 2 days before inoculation with *C. fusiforme*); and (5) benodanil soil drench and foliar spray (combination of numbers 3 and 4).

FIG. Two seedlings shown at left are healthy and the two shown at right are galled (see arrows).

Seedlings were transported to the USDA Forest Service Rust Testing Center near Asheville, N.C., for inoculation with *C. fusiforme* 40 days after being transplanted. Each flat of seedlings was sprayed with 10 ml. of an aqueous suspension containing 35,000 basidiospores per ml. Following inoculation, seedlings were stored in a humidity chamber for 24 hours to enhance spore germination and penetration. Seedlings then were maintained for an additional 24 hours in a header-house before being removed to a greenhouse, where they remained for the duration of the study.

Sixteen weeks after inoculation, each seedling was examined for *C. fusiforme* galls (see photograph), and the data obtained were used to calculate the percentage of seedlings infected in the various treatments.

In the untreated controls, 42% of the seedlings were galled (see Table). In plots treated with a foliar spray 26 days before inoculation, 14% of the seedlings were galled. This indicates that benodanil applied as a foliar spray retained some activity against *C. fusiforme* for at least 26 days; however, the amount of protection provided was not at an acceptable level. All other treatments, including Ferbam, provided complete protection against *C. fusiforme.*

Data indicated that (1) benodanil, applied pre-plant incorporated at a rate of 17.8 lb. per acre (ai) provided complete protection for at least 40 days; (2) following pre-plant incorporation at the rate tested, subsequent foliar sprays with benodanil were unnecessary; and (3) foliar spray with benodanil at a rate of 0.88 lb. per acre (ai) provided complete protection for at least 13 days, but less than 26 days, thus benodanil on a 2-week spray program provides the same protection as Ferbam applied two or three times a week.

Benodanil is not available commercially and is not labeled for use with pine seedlings. Further studies with this and other systemic fungicides are currently underway.

INCIDENCE OF FUSIFORM RUST ON LOBLOLLY PINE SEEDLINGS TREATED WITH FUNGICIDES

Treatment	Rate pounds active ingredient per acre	Method of applications[a]	Seedlings with galls percent
Untreated control	—	—	42
Ferbam	2.27	FS (9, 7, & 2 days)[b]	0
Benodanil	17.80	PPI	0
Benodanil	0.88	FS (26 days)	14
Benodanil	0.88	FS (13 days)	0
Benodanil	0.88	FS (2 days)	0
Benodanil	17.8 + 0.88	PPI + FS (26 days)	0
Benodanil	17.8 + 0.88	PPI + FS (2 days)	0

[a]FS = Foliar Spray; PPI = Pre-Plant Incorporated
[b]Days before inoculation with *C. fusiforme.*

TALL FESCUE FOR TURF

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TALL FESCUE IS WIDELY GROWN in Alabama as a pasture grass. However, it also has some other uses, expecially in some areas of northern Alabama where it is popular as a turf grass for lawns and highway rights-of-way.

Tall fescue has several characteristics that make it well adapted to Alabama's northern region. It is more cold hardy and has a longer growing season than bermudagrass or other warm season turf species. In addition, tall fescue is more heat, drought, and disease tolerant than Kentucky bluegrass or the fine leaved fescues. It is also adapted to a wide range of soil conditions and is easily established from seed.

The major disadvantages of tall fescue for lawns are its coarse texture and bunch growth habit. These characteristics can be temporarily overcome by using heavy seeding rates at establishment. But as the stand matures, wide, coarse leaves and clumpy growth predominate. This occurs because only pasture type varieties, in particular 'Kentucky-31,' are available for turf use.

Variety evaluation tests were established at Auburn University Agricultural Experiment Station in the fall of 1972 to compare available tall fescue varieties for turf in Alabama. Evaluations were made by ratings taken periodically through 1975 on plots maintained as fine turf at the Auburn University Turfgrass Research Area.

None of the varieties proved superior to 'Kentucky-31' in color or general appearance, tables 1 and 2. 'Fortune' had significantly poorer color and appearance characteristics than all other varieties. Persistence of 'Fortune' was also inferior to the other varieties.

When it became evident that no superior varieties were available for turf use, a breeding program for a turf type tall fescue was initiated at Auburn in 1975. Selections are being made from forage breeding nurseries and evaluated under space plant and turf conditions. Promising plants will be utilized as parent material in the breeding program designed to produce a superior turf type tall fescue variety.

Characteristics being sought in the selection program are dark green color, good summer color retention, fine texture or narrow leaf, and a creeping-type growth habit. Nematode and disease resistance are also desirable to ensure long lived stands that do not become thin and clumpy.

A few plants with better overall turf quality have already been found. As additional superior plants are found it will be possible to develop a turf type variety. Perhaps in the future, homeowners in northern Alabama will have available a variety of tall fescue which combines the species' excellent adaptation with superior turf quality.

In addition to the Auburn turfgrass breeding program, selections of tall fescue from other plant breeders throughout the United States are also evaluated. These selections are being compared to Auburn material for turf characteristics and persistence under Alabama conditions.

TABLE 1. COLOR COMPARISONS OF TALL FESCUE VARIETIES MAINTAINED AS TURF

Variety	Color ratings[1]						
	1974		1975				Season
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	average
Kentucky-31	7.8	7.0	8.4	8.2	8.7	8.5	8.1
Goar	7.7	6.8	8.2	8.7	8.8	7.8	8.0
Fawn	7.8	6.3	8.5	8.3	8.7	7.7	7.9
Kenhy	7.0	6.7	7.8	7.8	8.3	8.3	7.7
Kenwell	8.0	7.3	8.5	8.8	8.7	8.5	8.3
Penngreen	7.8	6.5	8.3	8.3	8.2	7.5	7.8
Fortune	5.0	3.8	5.8	6.2	6.7	5.5	5.5

[1]Ratings 1-9, with 9 = darkest green color

TABLE 2. APPEARANCE COMPARISONS OF TALL FESCUE VARIETIES DURING 1974

Variety	Appearance rating[1]					
	Jan.	Mar.	May	July	Sept.	Average
Kentucky-31	7.1	7.0	6.7	7.3	7.8	7.2
Goar	6.1	6.1	5.9	5.8	7.7	6.3
Fawn	6.5	6.2	6.3	5.8	6.7	6.3
Kenhy	6.9	7.8	6.9	7.8	5.0	6.9
Kenwell	6.7	6.9	6.8	6.2	6.7	6.7
Penngreen	6.8	6.5	6.8	5.7	6.2	6.4
Fortune	5.5	5.8	6.4	2.5	2.0	4.4

[1]Ratings 1-9, with 9 = best appearance.

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