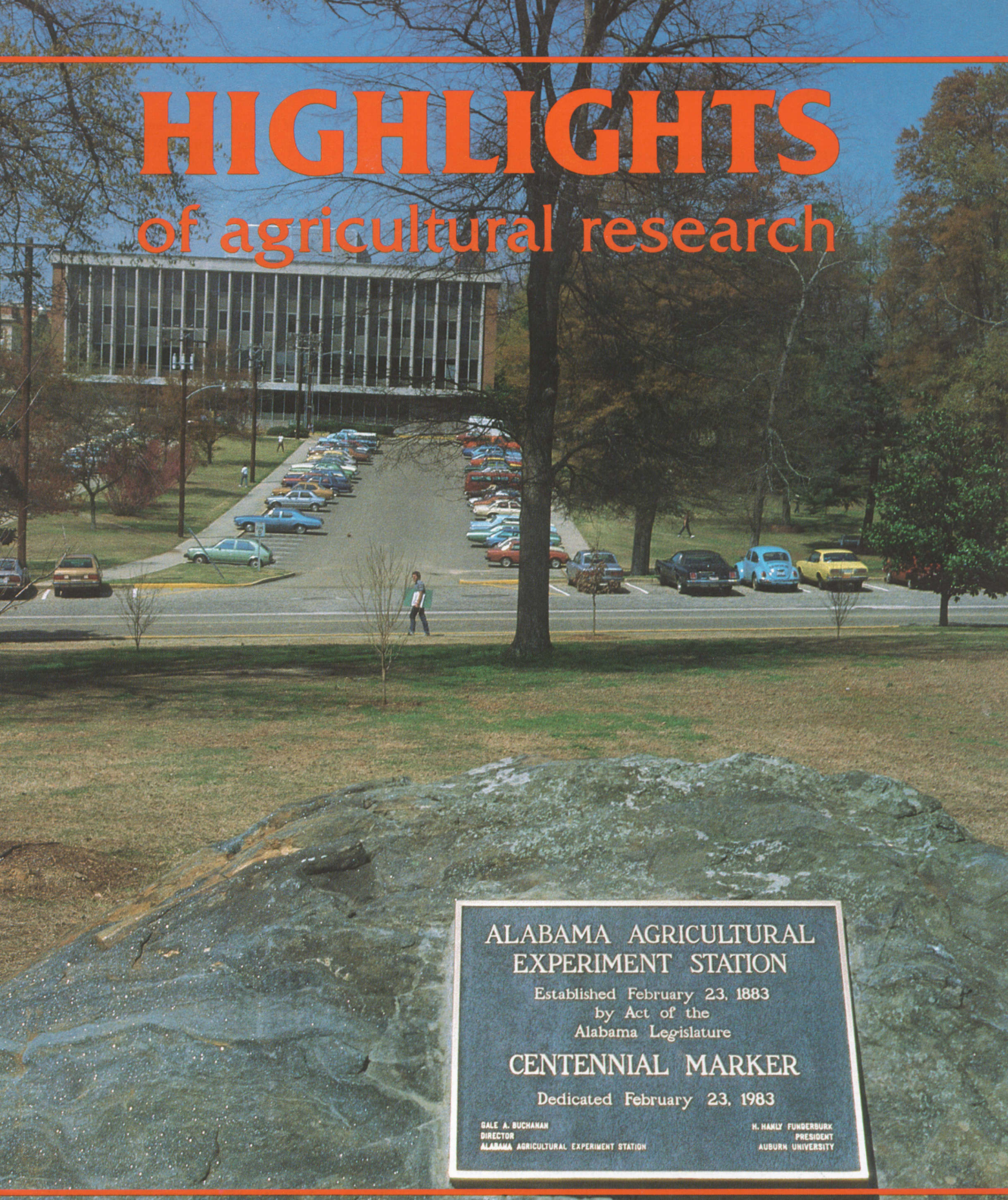
HIGHLIGHTS
of agricultural research



Vol. 30 No. 2 Summer 1983
ALABAMA AGRICULTURAL EXPERIMENT STATION AUBURN UNIVERSITY
GALE A. BUCHANAN, DIRECTOR AUBURN UNIVERSITY, ALABAMA

DIRECTOR'S COMMENTS

THE CELEBRATION and accompanying festivities held February 23, 1983, commemorating the 100th anniversary of the founding of the Alabama Agricultural Experiment Station are now history. The occasion provided a real opportunity to reflect on how past results of Experiment Station research efforts have touched the lives of every Alabamian and have contributed immensely to our highly productive agricultural and forestry industries. But the real focus was on the future.

GALE A. BUCHANAN

As we begin a second century of service, it is reasonable to ask, "Are agricultural and forestry research programs still needed and, if so, what direction should they take?" I can answer, firmly and without equivocation, that the need for research in support of agriculture and forestry is just as real today as it was 100 years ago. The argument that, "because of existing surpluses of certain agricultural commodities, the need for research is thereby diminished" cannot be supported and reflects lack of understanding of the highly technological society in which we live.

Agriculture and forestry as practiced in the United States today are "high technology" industries. A great deal of research is needed just to maintain existing levels of productivity. Of even greater importance is the research needed to expand the level of technology required to cope with increasing population, decreasing availability of relatively inexpensive energy, and the need for improvements in the overall standard of living.

Few will disagree that the cost or value of energy will escalate in the future. Research that is concerned with the development of new varieties of legumes, more efficient methods of tillage, utilization of solar energy in production agriculture as well as in the home, and the recovery of valuable products from animal waste will undoubtedly address this major concern. Finding more effective, economical, and environmentally safe methods of control of pests that affect man, his livestock, and crops will challenge our best scientists. Continued development of low energy diets that effectively utilize forage for beef production will serve Alabama and the South in the years ahead.

The opportunities that will be made possible by improving the photosynthetic efficiency of green plants, developing nitrogen fixing capability of grasses, and manipulating genetic capability of organisms through genetic engineering are difficult to comprehend. What is not difficult to believe is that if success in these areas is to occur, significant new research support must be provided.

The direction of research in the Alabama Agricultural Experiment Station must properly address the immediate problem confronting agriculture and forestry—need of increased productivity and efficiency of production—but never lose sight of the need for accumulation of basic knowledge necessary for development of future technology.

Even with the budget problems experienced by the Alabama Agricultural Experiment Station in recent years, I'm convinced we are stronger and more effective than we've ever been. We have been successful in employing highly trained new scientists, which is the most important component of an effective research organization.

Unfortunately, we have lagged in providing maintenance support and updating equipment and facilities necessary for high technology research. It is imperative that these needs be addressed in the near future.

A valid reason for optimism about our research programs is the receptive climate that exists today for new agricultural technology. Those who use our agricultural research findings recognize the necessity of continuing research to ensure successful agricultural and forestry industries for the future.

may we introduce . . .

Dr. Kenneth S. Rymal, Associate Professor in the Department of Horticulture. A food science teacher and researcher, Rymal's special interests are in the chemistry of foods, flavors of horticultural crops as related to processing and storage, and instrumental analysis of foods. His story on page 6 reports on one phase of his Auburn research.

A graduate of Massachusetts Institute of Technology in food science (B.S. 1949), Rymal worked in research and development and quality control positions in the food industry and operated a restaurant before returning to school in 1964. He received the M.S. degree from Universitiy of Florida and Ph.D. from University of Georgia. He joined the Auburn faculty in 1966.

In addition to his research in food processing, Rymal has worked with plant breeders in identifying compounds that determine insect resistance in vegetable varieties. He developed a rapid spot test for ascorbic acid that is a practical aid to tomato breeders seeking to increase vitamin C content of breeding lines.

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ON THE COVER. Unveiling of a bronze marker commemorating the 100th anniversary of the founding of the Alabama Agricultural Experiment Station was a highlight of the centennial celebration, held February 23, 1983, at Auburn University.

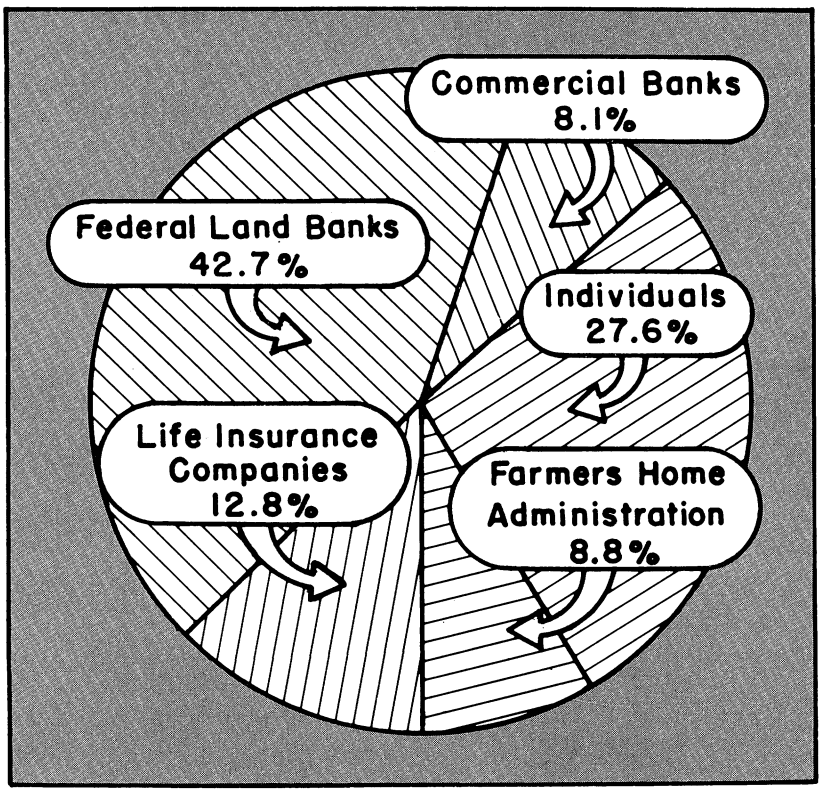
An Objective Evaluation of Federal Land Bank Borrowers

WILLIAM E. HARDY, JR., and JAMES E. PATTERSON,
Department of Agricultural Economics and Rural Sociology

INCREASED VOLUME of all agricultural real estate lending in recent years has placed pressure on lenders to effectively evaluate all loans so total loan loss is held to a minimum. Borrowers, as well as financial institutions, benefit if the volume of bad loans is reduced. If loans are carefully evaluated, then borrowers are less likely to get so deeply in debt that they might encounter problems in meeting repayment obligations. Also, if few bad loans are made, borrowing costs to cover loan loss rates are minimized for all borrowers.

Statistical procedures are available which assist in the evaluation of risk associated with a particular loan. Discriminant analysis may be used to determine the characteristics of individual borrowers that are most important in predicting whether the borrower should be classified as either a good or bad credit risk.

To analyze characteristics of real estate borrowers in the Fifth Farm Credit District (Alabama, Louisiana, and Mississippi), data were collected from the Federal Land Bank of New Orleans by Alabama Agricultural Experiment Station researchers. Data were used from the Federal Land Bank, an organization that is the primary real estate lender in agriculture, see figure. Data provided for the analysis included over 22,000 loans made during the 5-year period from 1974 to 1978. Data were coded by personnel at the Federal Land Bank so no names or other information that might reveal the identity of a particular borrower were given. A 10% sample was drawn from the data for use in the statistical model.



Distribution of farm real estate debt by lending source, 1982.

Data from the loan accounts contained several characteristics concerning both the borrower and the loan. Specific variables found in the data were: age of borrower; loan amount; total loan commitment; appraisal value of security; house value; building value; acres operated; acres owned; gross and net agricultural income; nonagricultural income; living expenses; annual debt service; current, intermediate, and fixed assets; and current, intermediate, and long-term debt. In addition, several financial variables and ratios were constructed from the data. Also, values were included which were calculated by Federal Land Bank personnel to represent difficult to quantify factors such as repayment ability and the man factor which is designed to show moral character, repayment history, and managerial ability.

These variables were analyzed using discriminant analysis to determine which were the most significant in determining whether a loan would be classified as acceptable (requiring little, if any, repayment supervision) or problem. Of all variables considered, two appeared to possess significant discriminating power to distinguish between good and bad loans. These variables were: total debt multiplied by 100 and divided by total assets (X_1), and loan commitment divided by net worth (X_2).

As expected, both variables had higher values for problem loans than for acceptable loans. The discriminant equation, SCORE $= -1.9554 + 0.0332X_1 + 0.4217X_2$, which was derived from the data, indicates that as the levels of total debt and loan commitment increase relative to total assets and net worth, respectively, the likelihood of a loan being bad increases.

If the errors of misclassifying any problem loan as acceptable and an acceptable loan as problematic were considered to be of equal severity, then the cut-off score for predicting whether a loan would be good or bad would be 0.32. If the calculated score fell above 0.32, then past loan experience and characteristics of loans and borrowers would indicate that problems in repayment might be expected. Scores below this level would point to the likelihood of a good loan with little, if any, repayment difficulties. Using this cut-off score, 71% of the loans in the sample were classified correctly. In addition, 68% of the loans in a separate test sample were classified correctly.

Examples may be used to illustrate the use of the credit scoring technique. Borrower 1 has total debt of $200,000, total assets of $410,000, net worth of $210,000, and loan commitment of $20,000. The score for this borrower would be -0.295. Since this value is below 0.32, the borrower would be classified as a good loan risk. Another borrower may have total debt of $820,000, total assets of $1,430,000, net worth of $600,000, and loan commitment of $800,000. Since the score for this borrower, 0.533, is above the cut-off value, he would be classified in the problem loan category.

Research results presented above should be useful to both lenders and borrowers. The discriminant equation will aid in determining whether credit should be granted. Lender and borrower should remember, however, that nothing can replace the evaluation made by an experienced analyst. The credit evaluation given in this report merely gives additional objective information which should help the analyst do a better job.

FIG. 2. Aspirating adult *Culicoides* from deer.

Potential Vectors of Bluetongue and Hemorrhagic Disease in Cattle and Deer

G.R. MULLEN and M.E. HAYES, Department of Zoology-Entomology

AMONG THE INSECTS which attack livestock in Alabama are minute blood-sucking flies known as biting midges, no-see-ums, punkies, and ceratopogonids (referring to the family Ceratopogonidae to which they belong). Despite their tiny size, these flies represent a significant health problem to both domestic and wild animals. Not only do they cause annoyance by their persistent feeding, but they also play a significant role in the transmission of two important diseases of cattle and wild deer.

A statewide survey initiated in 1978 has documented more than 180 species of ceratopogonids in Alabama. Approximately 45 of these are *Culicoides* spp., the most troublesome group attacking man and animals. The immature stages are typically found in damp or wet, highly organic soil.

Since the discovery in 1954 that *Culicoides variipennis* is a vector of bluetongue (BT) virus in the United States, considerable interest has been focused on biting midges and their role in the transmission of animal diseases. It is now known that *Culicoides* spp. also transmit a related virus which causes a fatal disease in white-tailed deer. This latter condition, know as epizootic hemorrhagic disease (EHD), is responsible for die-offs in wild deer populations in which infected animals die from massive internal bleeding.

Recent surveys in Alabama have revealed the presence of antibody to bluetongue virus in cattle throughout most of the State with 70% or more of the cattle in some herds indicating previous exposure to this virus. Infected cattle usually exhibit little or no overt symptoms and thus serve as undetected sources of the virus for transmission to other individuals within a herd. In acute cases, animals often develop oral and muzzle lesions, have difficulty walking, and may experience reproductive complications resulting in deformed calves, abortions, and stillbirths. It is illegal to export live cattle or bovine semen from the United States for fear of this insect-borne virus being introduced to other bluetongue-free countries.

FIG. 1. Restrained Holstein bull beneath trap.

Outbreaks of hemorrhagic disease in white-tailed deer have been documented in at least one southeastern deer herd every year since 1971. The last major outbreak occurred in 1980 when deer in 156 counties in eight Southeastern States showed clinical evidence of this disease. Deer can also become infected with bluetongue virus resulting in pathological signs indistinguishable from EHD.

To determine the species of biting midges involved in the transmission of these two viruses in Alabama, researchers of the Alabama Agricultural Experiment Station have been studying *Culicoides* spp. which attack cattle and white-tailed deer. In cooperation with the Auburn University School of Veterinary Medicine and the wildlife program at Auburn, entomologists field collected biting midges from cattle and deer throughout the 1982 season. Drop-type closure traps were constructed to capture midges attracted to cattle, figure 1. Following 15-minute exposure periods, 4 x 6 x 9-ft. Saran-cloth cages were lowered via a winch and pulley system over Holstein bulls restrained in an open pasture and bordering woodland. Collectors then entered from beneath the trap to aspirate the flies as they rested on the inside of the cage after feeding on the host. Specimens were collected directly from captive deer, figure 2. Collections were made from cattle primarily at dusk and from deer in the early morning hours when biting activity for each host group was highest.

Thirteen *Culicoides* spp. were collected from cattle. The four most prevalent species were *C. stellifer*, *C. paraensis*, *C. obsoletus*, and *C. sanguisuga*, comprising nearly 84% of the total specimens collected. Also attacking cattle throughout the study period from May to October were *C. debilipalpis*, *C. variipennis*, and *C. venustus*. The same species were also commonly collected from deer, indicating they readily feed on both host groups. *Culicoides debilipalpis* was by far the predominant species taken on deer, representing 98% of the nearly 5,000 specimens collected from deer.

Based on their host-feeding behavior, each of these species represents a potential vector of BT and EHD viruses in Alabama. Further research is currently being conducted to determine which of these species can actually support the development of these viruses and thus serve as natural vectors of these disease agents.

Breeding Watermelons for Disease Resistance

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C.C. CARLTON, Chilton Area Horticulture Substation
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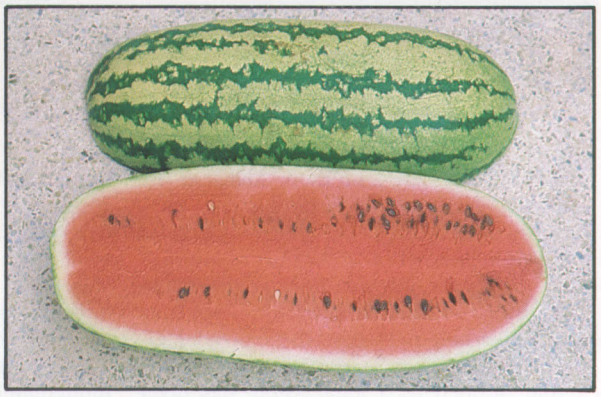


ABOVE: AU-Producer—an inbred line from the cross Crimson Sweet x P.I. 189225.
BELOW: AU-Jubilant—an inbred line from the cross Jubilee x P.I. 271778.

DISEASE is a major factor limiting production of watermelons in Alabama. Gummy stem blight and anthracnose are two of the most serious diseases. Severe crop losses and reduced yields of melons have resulted from both gummy stem blight and anthracnose in certain fields in Alabama. Although the damage seemed to be more widespread in the Gulf Coast area, frequent reports of damage in central and north Alabama have occurred.

Although satisfactory control of gummy stem blight and anthracnose may be accomplished with the proper application of organic fungicides during normal weather conditions, no control measure is effective during periods of high humidity and rainfall. Furthermore, the three leading cultivars, Charleston Gray, Jubilee, and Crimson Sweet, are not resistant to gummy stem blight and race 2 anthracnose.

The discovery that certain plant introductions (PI 189225 and PI 271778) were resistant to gummy stem blight and race 2 anthracnose led to the initiation of an Alabama Agricultural Experiment Station watermelon breeding program in 1971 to develop multiple disease resistant breeding lines that produce high yields of excellent quality fruit. Two of these lines, AU-1 and AU-3, are currently being released as AU-Jubilant and AU-Producer, respectively.

AU-Jubilant is an inbred line from the cross Jubilee x P.I. 271778. AU-Producer is an inbred line from the cross Crimson Sweet x P.I. 189225. Following the crosses, backcrossing and disease screening programs were followed with selection of disease resistant seedlings that produced horticultural type fruit. Thus, both AU-Jubilant and AU-Producer originated from programs of backcrossing and inbreeding to obtain resistance to gummy stem blight (*Didymella bryoniae*), Fusarium wilt (*Fusarium oxysporium niveum*), and anthracnose (*Colletotrichum laginarium*, race 2). They have been grown in trials as AU-1 and AU-3 at Auburn and a number of substations of the Alabama Agricultural Experiment Station and in the Southern Cooperative Watermelon Variety trials in the Southern States.

Fruit of AU-Jubilant are large and elongate with uniform diameter for the length of the melon. The rind has a light green background color with dark green irregular stripes continuous for the length of the fruit. The rind is hard and tough and about 4/5 in. thick. The flesh is an attractive bright red color.

Fruit of AU-Producer are round to oblong-round with few cull shapes. Sizes are mostly in the 20 to 30-lb. range, but weights of 35 lb. are not uncommon. The rind color is light green with dark green stripes. The rind is smooth, hard, and tough and about 3/4 in. thick. The flesh is bright red and firm, but not tough.

These Auburn developed varieties are superior to the current cultivars of their type in yield, quality, and disease resistance, tables 1 and 2. Breeding lines currently being evaluated offer the possibility of further development of cultivars with high levels of fruit quality and multiple resistance to diseases.

TABLE 1. DISEASE RESISTANCE OF CULTIVARS AND BREEDING LINES OF WATERMELON

Cultivar or breeding line	Disease index[1]			Average
	Anthracnose	Fusarium wilt	Gummy stem blight	
Charleston Gray	5.0	3.0	5.0	4.3
Jubilee	5.0	3.0	5.0	4.3
Crimson Sweet	5.0	3.0	5.0	4.3
AU-Jubilant	2.5	3.0	2.2	2.6
AU-Producer	2.1	1.0	1.7	1.6

[1]Disease index: 0 = no injury, 5 = all plants severely injured.

TABLE 2. YIELD AND FRUIT CHARACTERISTICS OF CULTIVARS AND BREEDING LINES OF WATERMELONS AT FIVE LOCATIONS IN ALABAMA, 1978 THROUGH 1982

Cultivar or breeding line	Yield/ acre	Fruit wt.	Soluble solids	Quality[1] preference	Width length ratio	Rind thickness	Days to maturity	Rind color
	Lb.	*Lb.*	*Pct.*			*In.*		
Charleston Gray	38,656	22	11.1	7.5	0.44	0.56	80	Gray
Jubilee	31,880	22	10.5	7.6	.43	1.00	90	Striped
Crimson Sweet	31,974	18	11.0	7.9	.62	.86	80	Striped
AU-Jubilant	46,314	25	11.2	8.0	.43	.82	85	Striped
AU-Producer	39,558	20	11.8	8.1	.84	.75	80	Striped

[1]Quality preference: 10 = best, 5 and below = unacceptable.

Proper Use of Alar on Apples Poses No Residue Problem

K.S. RYMAL, W.A. DOZIER, JR., J.W. KNOWLES, and R.D. COSPER, Department of Horticulture

APPLE PRODUCTION in Alabama has increased considerably in the last 20 years, despite physiological problems associated with apple production at the lower latitudes. One reason for this increase has been the availability of growth regulators, such as Alar®, that help overcome these physiological problems.

Alar applied as a foliar spray has been shown to decrease vegetative growth, enhance flowering and fruiting of young apple trees, increase fruit firmness and red color development, delay maturity, prevent fruit drop, reduce scald, and delay the development of water core. These effects are of great economic advantage to apple growers, consequently Alar is used extensively in Alabama apple orchards.

Alar is currently under review by the U.S. Environmental Protection Agency. It has been implicated in the production of tumors in mice, and its hydrolysis or thermal breakdown product, 1,1-dimethylhydrazine (UDMH), has been shown to be a carcinogen.

Serious questions have been raised regarding the hazard to humans of exposure to Alar and UDMH. UDMH is suspected as a contaminant in the commercial product or as a breakdown product in thermally processed apple products. Therefore, the Alabama Agricultural Experiment Station began research to determine if Alar is safe to use.

Using a grant by the Southern Region Pesticide Impact Assessment Program, a study was conducted at the Chilton Area Horticulture Substation, Clanton, and the Main Station at Auburn to assess the potential hazard of human exposure to Alar residues in apples. Alar-85 was applied with a hand gun as a fine mist foliar spray to the point of runoff on 18-year-old Starkrimson apple trees.

Spray concentrations used were the recommended amount of 1½ lb. of Alar-85 to 100 gal. water (1,500 p.p.m.) and excessive rates of 3,000 and 6,000 p.p.m. Sprays were applied at the recommended periods before harvest of 21 days after full bloom or at 8 weeks before harvest, and at several periods closer to harvest—4 weeks and 2 weeks before harvest and at harvest. Residues were determined on the fresh fruit and on standard applesauce prepared from the fruit immediately after harvest and after 30, 60, and 90 days of storage.

Alar residues in both fresh and processed fruit were directly proportional to the concentration of Alar in the foliar sprays. The lowest and highest average values are shown in the table. There was no significant difference between residue levels in the raw fruit samples, which included the peeling, and the processed applesauce, which did not include the peeling. This is especially notable for the harvest day treatment, indicating that spray material was absorbed through the skin within 24 hours of treatment and that no significant amount of spray material remained in the skin.

Residue levels were highest at all spray concentrations in fruit from trees sprayed 14 and 28 days before harvest. This makes it obvious that spray materials were translocated to the fruit from the trees within 14 days and that less of the Alar was dissipated through metabolism up to that time than was the case from earlier sprays.

All Alar residues were persistent in 32°F storage up to 90 days after harvest in both the fresh and processed fruit.

Despite excessive concentration rates and application up to the day of harvest, only fruit sprayed with 4 times the recommended level at 2 and 4 weeks prior to harvest exceeded the tolerance level (30 p.p.m.) set by the Food and Drug Administration. The highest residue level found was 32 p.p.m. Residues from recommended spray treatments were only a fraction of the tolerance level.

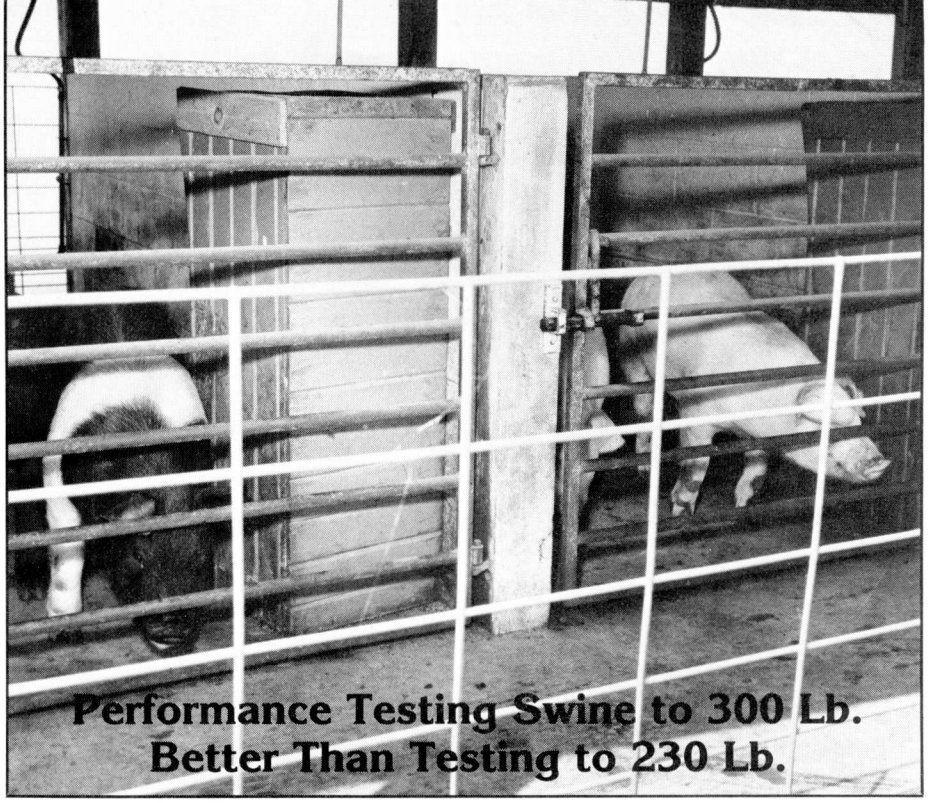
UDMH levels in the applesauce were directly proportional to the Alar residues in the thermally processed applesauce, see table. The Food and Drug Administration has not set tolerance levels in food products for UDMH due to its toxicity. However, the levels of UDMH determined in samples of applesauce made from fruit from the trees sprayed according to the Alar-85 label directions were exceedingly low (less than 0.05 p.p.m.). UDMH levels in the applesauce with Alar residues approaching the FDA tolerance levels of 30 p.p.m. still averaged less than 1 p.p.m.

It would appear from this study that if the label directions for Alar use are followed, there is little potential for human hazard from the consumption of fresh fruit or applesauce made from treated fruit.

EFFECT OF SPRAY CONCENTRATION AND TIME OF APPLICATION ON ALAR AND UDMH RESIDUES IN RED DELICIOUS APPLESAUCE

Alar-85 concentration, p.p.m.	Residues from treatments, weeks before harvest					
	18 weeks		8 weeks		2 weeks	
	Alar	UDMH	Alar	UDMH	Alar	UDMH
	p.p.m.	*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*	*p.p.m.*
0[1]	1.37	<0.01	1.19	<0.01	0.85	<0.01
1,500	2.50	.03	5.29	.02	6.44	.13
6,000	6.12	.11	19.25	.38	27.02	.80

[1]Any residue from the 0 treatment is carryover from the previous year.



Performance Testing Swine to 300 Lb. Better Than Testing to 230 Lb.

D.L. KUHLERS and S.B. JUNGST, Department of Animal and Dairy Sciences

SWINE IN THE UNITED STATES have traditionally been marketed at weights of 210 to 240 lb. Because of this, most performance testing programs evaluate swine to weights of 220 and 240 lb. with 230 lb. being the recommended weight by the National Swine Improvement Federation. Because of the difference in the rates of fat deposited in boars and barrows, it has been hypothesized by seedstock producers that testing prospective replacement breeding stock to weights heavier than 230 lb. would improve the accuracy of selection for the performance traits commonly measured in performance tests—growth rate and backfat thickness.

The objective of a recent study by the Alabama Agricultural Experiment Station was to estimate heritabilities for growth rate (ages) to 230 and 300 lb., to determine heritabilities of backfat thickness at these same two weights (ultrasonically), and then to determine which weight would improve these heritable traits most efficiently at the normal marketing weight of 230 lb.

The study involved 522 crossbred pigs by 68 purebred boars and 76 purebred sows of the Duroc and Landrace breeds. The heritabilities for traits were calculated by measuring the similarity between the performance measurements in the parents and their offspring. All pigs were farrowed in a central farrowing house and moved to an open-fronted, sow-pig nursery at 10 to 14 days of age. Pigs were given starter feed and water at 3 days of age, were weaned at 5 weeks of age, and at 90 days were moved to a solid-floored, open-fronted, growing-finishing building until they reached 300 lb. The pigs were vaccinated with bacterins for atrophic rhinitis and erysipelas.

The heritabilities estimated from the pigs studied are given in table 1. The heritability for growth rate to 300 lb. was larger than the heritability for growth rate to 230 lb. If the goal of the swine industry is to improve the performance of pigs to 230 lb., these results would indicate that selection of animals based on growth rate to 300 lb. would give more genetic improvement in the growth rate to 230 lb. than would selection based directly on growth rate to 230 lb.

To show this is true, the performance of offspring of parents selected either for slow or rapid growth at 230 or 300 lb. is given in table 2. It shows that the difference between the progeny performance at 230 lb. of parents selected for slow growth and rapid growth at 230 lb. was 10.2 days, whereas it was 14.9 days between the lines selected at 300 lb. This indicates that parental selection based on 300-lb. performance was more effective than parental selection based on 230-lb. performance. A similar response was seen in the offspring's performance at 300 lb.

In contrast to growth rate, the heritability of backfat thickness at 230 lb. was larger than the heritability of backfat thickness at 300 lb. These results suggest that measuring backfat thickness at 230 lb. would give more genetic improvement in backfat thickness at 230 lb. than measuring backfat thickness at 300 lb.

This can also be seen in the differences in the backfat thickness of the offspring of parents selected for high or low backfat thickness at 230 lb. or at 300 lb., table 3. The difference in the offspring's performance in backfat at 230 lb. from the high and low line parents selected at 230 lb. was larger than the difference found in the progeny of parents selected at 300 lb. (0.22 in. versus 0.16 in.). Therefore, selection for and against backfat thickness was more effective at 230 lb. than 300 lb. A small advantage in favor of parental selection at 230 lb. was seen in the backfat measurement at 300 lb. in the offspring. These results then suggest that backfat thickness measurements should be taken in prospective breeding stock at 230 lb., but growth performance should be measured at 300 lb.

Even though testing swine to 300 lb. seems to be desirable for genetic improvement for growth rate, there are some problems associated with testing to heavy weights that need to be considered. There are the increased testing costs associated with the longer testing period and the possibility that fewer pigs could be tested in a year and thus less selection pressure would result for growth rate and backfat thickness. These factors need to be studied further, but testing pigs to 300 lb. does a better job of identifying genetically superior breeding stock for growth than does testing these pigs only to 230 lb.

TABLE 1. HERITABILITIES FOR GROWTH RATE AND BACKFAT THICKNESS AT TWO WEIGHTS

Trait	Heritability[1]
Growth rate to 230 lb.	0.20
Growth rate to 300 lb.	.36
Backfat thickness at 230 lb.	.78
Backfat thickness at 300 lb.	.62

[1]The proportion of the variation which is genetic.

TABLE 2. PERFORMANCE OF OFFSPRING BY PARENTS WHICH WERE SELECTED FOR EITHER SLOW OR RAPID GROWTH AT 230 OR 300 LB.

Parents selected for	Offspring performance for	
	Days to 230 lb.	Days to 300 lb.
Slow growth to 230 lb.	196.2	234.9
Rapid growth to 230 lb.	186.0	221.8
Difference	10.2	13.1
Slow growth to 300 lb.	199.0	241.8
Rapid growth to 300 lb.	184.1	220.2
Difference	14.9	21.6

TABLE 3. PERFORMANCE OF OFFSPRING BY PARENTS WHICH WERE SELECTED FOR EITHER HIGH OR LOW BACKFAT THICKNESS AT 230 OR 300 LB.

Parents selected for	Offspring performance for	
	Backfat at 230 lb.	Backfat at 300 lb.
	In.	*In.*
High backfat at 230 lb.	0.83	1.01
Low backfat at 230 lb.	.61	.75
Difference	.22	.26
High backfat at 300 lb.	.77	.95
Low backfat at 300 lb.	.61	.71
Difference	.16	.24

The Use of Sodium Bicarbonate in Dairy Cow Diets

K.A. CUMMINS and G.E. HAWKINS, Department of Animal and Dairy Sciences

DAIRY COWS consuming high concentrate diets in early lactation run the risk of developing an acidotic condition. This condition is caused by excessive production of volatile fatty acids and lactic acid in the rumen during the fermentation of large amounts of carbohydrates. Because early lactation is the period of highest milk production and greatest energy demand by the cow, there is considerable interest among dairymen in methods that allow feeding high concentrate diets without risk of metabolic upset.

The addition of sodium bicarbonate as a buffer to silage-based and other high energy diets for ruminant animals often, but not always, produces beneficial responses even in diets adequate in dietary fiber. Increased intakes of ration dry matter and increased milk production are among the beneficial responses observed from adding sodium bicarbonate to silage-based diets.

Research was begun at the Alabama Agricultural Experiment Station during 1979 and conducted over a 3-year period to determine the value of sodium bicarbonate-buffered diets, adequate in dietary fiber, on the productivity and health of confined dairy cattle fed blended corn silage-based rations throughout a complete lactation. Forty-two lactating and pregnant Holstein cows in the E.V. Smith Research Center dairy herd were divided into two groups based on age and reproductive status. Within groups, the cows were assigned randomly to either a regular or bicarbonate-buffered diet. Cows were started on the assigned diets approximately 18 days before expected calving and continued on it until their lactation was complete, or until they left the herd.

Diets were corn silage-based and contained corn and soybean meal as primary supplements. The blended experimental diets were formulated to be equal except for the 1.1% sodium bicarbonate (dry matter basis) in the buffered diet, table 1. The diets were adequate in fiber and met other nutritional requirements. Cows were group fed, except for representative cows individually fed in the late spring and early summer to estimate dry matter intake. Digestibility was determined in steer calves.

Average daily intakes of dry matter per unit of body weight were not significantly affected by 1.1% sodium bicarbonate in the ration dry matter, table 2. The absence of detectable differences in dry matter intakes caused by the sodium bicarbonate supplement agrees with findings by other researchers feeding corn silage-based diets with 1% sodium bicarbonate or 1.5% sodium bicarbonate plus 0.5% magnesium oxide. Milk production (adjusted by covariance for production during the previous lactation) was significantly higher for cows fed the buffered diet. Milk fat percent was lower for cows fed the buffered ration and total 305-day mature equivalent (ME) milk fat production was equal compared to that of the cows fed the basal ration.

The incidence of displaced abomasum, ketosis, or calving difficulties following a lactation did not differ for cows fed the basal and buffered diets. Digestibilities of dry matter in the basal and buffered diets also did not differ.

The acid detergent fiber content in the basal diet essentially met National Research Council requirements. Hence, there was no apparent need for a buffer to overcome the effects of a low fiber diet on rumen fermentation. As a result, the positive effect on milk fat percent associated with supplementing high energy, low fiber diets with sodium bicarbonate was absent in this experiment. The higher 305-day ME milk production by cows fed the buffered diet is similar to findings of shorter-duration experiments reported by scientists at other agricultural experiment stations. The 305-day ME milk production of cows consuming the buffered diet during the experimental lactation averaged 102% of that for the same cows preceding lactation. Therefore, the increased milk production by cows on the buffered diet appears to be a true ration response to the addition of sodium bicarbonate.

Based on this and other published experiments, it appears the addition of sodium bicarbonate to well-formulated lactation diets will result in an increase in milk production of 2 to 6%, which is enough to pay for the additional expense of the added bicarbonate. However, addition of sodium bicarbonate buffers to lactation diets should be considered only after it is certain the diets fed are properly balanced. The greatest value will be seen in high producing dairy cows consuming diets inadequate in dietary fiber. Cows consuming diets adequate in fiber will not show as large a response with the addition of buffers to the diet. Bicarbonate addition should be considered a "fine tuning" of management, not a means to cover up poor management practices or inadequate ration formulation.

TABLE 1. RATION COMPOSITION, NUTRIENT ANALYSIS, AND DRY MATTER DIGESTIBILITY

	Rations (dry matter basis)	
	Basal	Buffered
Corn silage, pct.	49.1	49.1
Corn grain, pct.	25.2	24.3
Pelleted supplement, pct.	26.6	26.6
Sodium bicarbonate	--	1.1
Nutrient analysis		
Crude protein	15.4	15.2
Acid detergent fiber	20.7	21.3
Calcium	.70	.69
Phosphorus	.45	.43
Dry matter digestibility, pct.	70.6	71.3

TABLE 2. DAILY DRY MATTER INTAKE AND 305-DAY MATURE EQUIVALENT MILK AND MILK FAT PRODUCTION

	Rations	
	Basal	Buffered
Dry matter intake, lb. per 100 lb. body weight	2.75	2.87
Milk, 305-day ME, lb.[1]	16,447	17,587
Fat, 305-day ME, lb.	621.7	624.4
Fat, pct.	3.81	3.58

[1]Milk and milk fat production adjusted for previous production by covariance.

1982 Dairy Legislation UNFAIR to Southern Dairymen

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EXPANDING DAIRY SURPLUSES and annual price support program costs exceeding $2 billion led to legislation authorizing the Secretary of Agriculture to levy an assessment of $0.50 per hundredweight on all milk marketed. Effective date was to be October 1982, with an additional $0.50 assessment authorized to be effective April 1, 1983. The second assessment was subject to refunds for producers who reduced milk marketings. The initial assessment, announced to begin December 1, 1982, was blocked in Federal Court in South Carolina and was not collected.

In March 1983, Secretary of Agriculture John Block announced implementation of a $0.50 assessment to be effective April 16, 1983. All milk marketed is subject to the assessment program whether it is used in fluid milk products or manufactured products purchased under the price support program. Purposes of the legislation are to obtain funds from dairy farmers to help pay costs of the price support program and to bring about reductions in milk supply.

Dairy industry leaders in several Southern States objected to this approach to reduce supply because no milk surplus problem exists in the region. Almost all milk marketed in the South is Grade A eligible for fluid use, and most of it is used in fluid products. Manufactured dairy products, such as cheese, butter, and non-fat dry milk, represent a small fraction of marketings in the region. Few, if any, of these products made in the region are sold to the Commodity Credit Corporation.

Impact of the assessment program was seen to be a price reduction to dairy farmers in an area where milk supply is already short. Further, there would be no price reductions to consumers to encourage increased milk consumption.

Shortly after announcement of the assessment program, a study was initiated that addressed the assessment issue and some program alternatives relevant to the dairy industry in the Southeast (Alabama, Florida, Georgia, Louisiana, Mississippi, and South Carolina). The Alabama Agricultural Experiment Station cooperated in this study and produced the project report.[1]

In 1982, about 98% of all milk produced in the Southeast was sold to plants and dealers. This amounted to about 6.4 billion lb. Essentially all marketings were Grade A. Milk product consumption in the six states was calculated using 1980 population data and national per capita consumption of milk products. Total fluid products consumption was 6% greater than the volume of Grade A milk marketed by farmers in the six states. Aggregate milk product consumption was about 2.5 times the regional milk supply. Thus, the region is largely sufficient on local supply for fluid markets, which is about 43% of total milk product consumption, but almost entirely dependent on other areas for manufactured products.

Producer cost data published by the USDA show that assessments will have varying impacts among regions on producer returns, see table. The all-region total returns per hundredweight of milk marketed to operator labor, family labor, and management have been decreasing since 1979, down to $1.97 in 1981. The Appalachian region is most likely typical of the Southeast, and it is the region in which returns to producers at $0.70 per hundredweight were lowest. The $0.50 assessment represents 71% of returns in the region, but only 20.6% of the Upper Midwest producers. Application of the second $0.50 amounts to 143% of net returns in the Appalachian region.

Alternative programs, including support price changes, also were studied in relation to the assessment program. As a basis for program comparisons, estimates were made of 1983 milk marketings and values in the six Southeastern States.

In the absence of any price support changes in 1983, volume of milk marketings was estimated to total 6.4 billion lb. with a value of $974 million, or $15.22 per hundredweight. Application of the assessment program would reduce value of marketings 3.9 to 9.7% in the Southeast. With this program, there were no changes projected in milk product prices or consumption.

Support price reductions of $1.00 and $1.50 per 100 lb. would reduce value of milk marketed 7.7 and 11.4%, respectively. Volume of milk marketed would decline 1.7 and 2.5%. With price support reductions, milk product prices decrease and there would be a consumption response.

Two modified price support reduction programs were considered. In the first case, Class I prices were maintained at levels existing prior to a support cut of $1.00. This program had the least negative impact on milk marketings and value in the Southeast. Marketings would decline only 0.3%, total value would be 1.5% less, and blend price would drop $0.17 per 100 lb. The reason for the smaller impact is that only classes II and III uses (19%) would be affected by the lower support price. In the second case, support price was cut $1.50 and Class I prices $0.50. This would result in a total volume marketings decline of 1.2% and a drop in value of 5.3%.

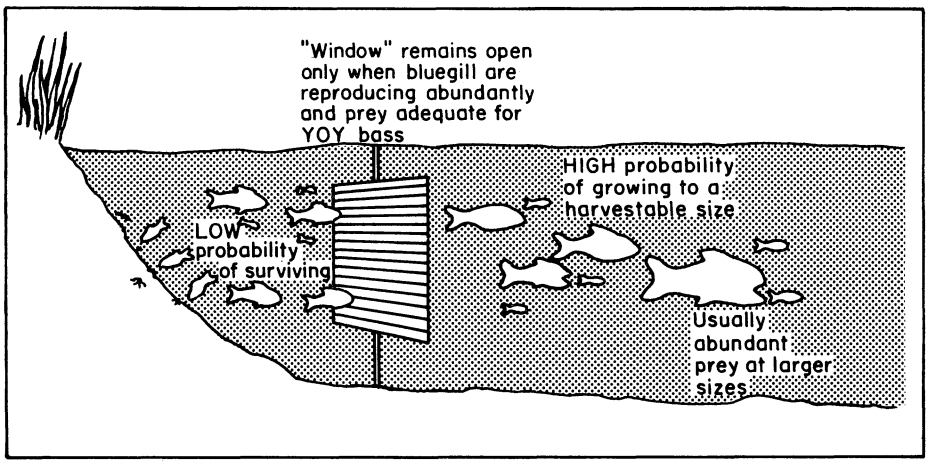
An assessment program appears to be inequitable by endangering supply adequacy in areas where milk is produced primarily for the fluid milk market, such as the Southeast. Programs that provide price support reductions offer incentive to decrease production in surplus regions and encourage increased nationwide consumption of surplus milk products through lower consumer prices.

EFFECTS ON MILK PRODUCTION RETURNS AMONG REGIONS AS A RESULT OF ALTERNATIVE ASSESSMENTS

Region	Return per hundredweight[1]	Relationship of assessment to returns			
		$0.50 assessment		$1.00 assessment	
		Absolute	Relative	Absolute	Relative
	Dol.	*Dol.*	*Pct.*	*Dol.*	*Pct.*
Northeast	2.31	0.50	21.6	1.00	43.2
Upper Midwest	2.43	.50	20.6	1.00	41.2
Corn Belt	.76	.50	65.8	1.00	131.6
Appalachian	.70	.50	71.4	1.00	142.9
South Plains	1.73	.50	28.9	1.00	57.8
Pacific	2.06	.50	24.3	1.00	48.5
All regions	1.97	.50	25.4	1.00	50.8

[1]After payment of all costs, this is return to the operator, family labor, and management.

[1]CARLEY, DALE H., LOWELL E. WILSON, WAYNE M. GAUTHIER, AND HAROLD M. HARRIS. The 1982 Dairy Legislation: Impact on Six Southern States; Some Program Alternatives. A contributing report to the Southern Regional Dairy Marketing Research Project S-166. Ala. Agr. Exp. Sta. Agr. Econ. Dept. Ser. 34. January 1983.



A conceptual model depicting the importance of small sized bluegill as food for young-of-the-year largemouth bass. When the "window" is open (i.e., bluegills are spawning frequently), young-of-the-year largemouth bass grow rapidly and pass "through the window" to reach a harvestable size.

Regulating Largemouth Bass Harvest on West Point Lake with a 16-inch Minimum Size Limit

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THE CHALLENGE for fisheries managers in the 1980's is to develop management strategies for improving fishing in established waters now that fewer rivers and streams are being impounded. The best strategy will include not only the concept of maximizing yield, but will also involve socioeconomic considerations. As a result, appropriate strategies will be based on an understanding of the dynamics of growth, reproduction, and death of fish populations, on knowledge of inter-species relationships, and ultimately, on fishermen interactions with the resource.

A management strategy developed for West Point Lake, a 25,000-acre impoundment on the Chattahoochee River, illustrates an attempt by fishery managers to optimize the benefits from the resource. The management strategy is based on a 16-in. minimum size limit for harvest of largemouth bass. As is usually the case, there is an initial cost associated with the strategy. The "cost" in this situation is complete restriction of the harvest of largemouth bass less than 16 in.

The reasons for restricting bass harvest in this manner are based on the results of the ongoing fishery study on West Point Lake by Alabama Agricultural Experiment Station researchers. This research began when the lake was impounded in the fall of 1974. The study emphasizes the estimation of growth and death rates of largemouth bass and measures the rate that bass are added to the system.

It was found that West Point Lake was typical of many mainstream reservoirs, in that relatively few bass were present. If all the fish in West Point lake could be weighed, largemouth bass would comprise less than 10% of the total; compared to other systems such as farm ponds and community fishing lakes, this percentage is low. For example, in a well managed farm pond where fish populations are "in balance," usually 20-25% of the total standing stock (by weight) consists of bass. Why, then, are there fewer largemouth bass per acre comprising less total weight in West Point Lake?

In West Point Lake there are more than 20 species of fish, whereas in bream/bass-stocked farm ponds, there are only two or three species. Having a large number of species is good in one sense because the system is fairly stable, i.e., not subject to much variation due to factors stressing the system. On the other hand, a large number of species competing for the available food resources means that the growth and reproduction of each species may be limited. Also, in many mainstream reservoirs and community fishing lakes in the Southeast where bluegill and gizzard shad coexist, the shad tend to out-compete the bluegill. As a result, bluegill grow more slowly and spawn less frequently throughout the summer in shad-dominated reservoirs than in farm ponds containing only bass and bluegill. In farm ponds, bluegill spawn frequently from May through September; therefore, in the farm pond-environment, young-of-the-year (age 0) bass have ample small fish as prey throughout the summer and grow rapidly to reach a harvestable size 1 year later.

In West Point Lake, relatively few bass reach harvestable size; they grow slowly and suffer a high death rate because few small forage fishes, e.g., recently hatched bream, are available to them in the shoreline areas. Based on this information, a conceptual model depicting the relationship between "bream" reproduction and the growth and survival of bass was developed, see figure. In West Point Lake, the "window" in the figure remains virtually shut. This situation, coupled with a high catch rate of bass that do reach harvestable size, limits the standing stock of bass in the system. The fish populations in West Point Lake, therefore, are essentially "unbalanced" because catch per unit of effort of harvestable size fish (bass as well as bream, catfish, and crappie) is often less than satisfactory.

The specific problem in West Point Lake, then, is with the prey populations, particularly the bluegill, which are comprised of slow growing individuals of small average size that do not spawn frequently. One solution to this problem is to create a situation where bluegill growth is improved so that average size increases and individuals in the population spawn more frequently; this would result in more bass reaching harvestable size and larger bluegill, catfish, and crappie in the fish harvest.

The only cost effective management alternative available to managers concerned with reservoir fish production is to use the beneficial effects of bass predation. Larger largemouth bass are an extremely important component of the system because they can effectively prey on the slow growing, larger-sized prey, thus reducing their abundance and competitive edge. In fact, in many large impoundments with a diversity of species, there simply may not be a surplus of largemouth bass for harvest in most years; therefore, the management objective is to allow bass predation to beneficially affect prey populations dynamics and fish harvest.

If the 16-in. minimum size restriction on largemouth in West Point Lake is accepted by fishermen, there will be initially a greater catch (not harvest) rate of largemouth bass as bass accumulate in the system and predate more heavily on prey populations. Eventually, a greater average size in the bream, crappie, and catfish populations will be achieved. This, in time, will allow these populations to spawn more frequently, and result in a greater production of bass when larger numbers survive to reach a harvestable size.

At some future time, the resource will achieve a "state of balance" where the production of harvestable size fish will be optimized. Such populations are of greater socioeconomic worth because the resource will produce a greater number of "satisfactory" fishing trips (higher catch rates). Ultimately, the restrictions on bass harvest can be modified to allow for a gradual increase in fish removed from the system, while still retaining sufficient bass to maintain "balance" in the fish community.

New Auburn Processing Method Could Boost Sweet Potato Market

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SWEET POTATOES are a good source of nutrients, but they have had poor consumer acceptance outside the traditional consuming areas. This poor acceptance is generally blamed on the difficulty of handling and shipping the fresh product, lack of convenience in preparation and serving, and the marginal quality of most processed products.

Previous research at the Alabama Agricultural Experiment Station established that sweet potato purees are excellent food ingredients and are well liked by consumers. The problem was that purees produced with conventional processing methods had to be kept in frozen storage. A shelf-stable pack could be produced by conventional pressure retort processing, but quality and nutritional value were low due to the processing time required.

A new processing method developed at the Experiment Station has overcome the previous problems. It produces a product that can be stored at room temperature and still maintain the superior quality required for the market. The method is adaptable to continuous line production using high-temperature, short-time sterilization and aseptic packaging. Thus, the product has convenience and affords a net energy saving by shelf storage rather than freezer storage.

The Auburn processing system prevents the fouling problem (burning of material on the heat exchange surface) that occurs with conventional shell and tube and plate-type heat exchangers.

To avoid fouling, a specially designed heat exchanger which allows uniform heating and accurate temperature control was used. Sterilization was accomplished by direct injection of superheated steam into a primary mixing chamber where the puree and steam were admixed by the high velocity steam impinging on the puree as it was pumped into the chamber. Pressure differentials created within the mixing chamber aided the turbulent mixing and helped to guarantee uniform temperatures. This combination of direct heating and the use of turbulent mixing chambers eliminated the heat transfer problems inherent in conventional heat exchangers. The heated puree was further mixed in a secondary mixing chamber before being pumped through a holding tube to the filler where it was filled into cans.

The sufficiency of the thermal process for the aseptically packaged puree was tested by producing an inoculated pack. Flash heating a puree inoculated with sporulated spoilage organisms to temperatures of 270°F or above with holding times of 13 seconds produced a commercially sterile product.

Starch conversion normally requires from 45 minutes to 1 hour when done by batch processing of whole roots. Similar conversion was accomplished in 15 minutes by slicing the roots into 1/2-in. thick slices and gently agitating the slices as they were held in a moist environment at 167°F.

Normally, the hot sweet potatoes are pulped to produce purees. Pulping removes much of the fiber, thus producing the smooth consistency. A similar quality product was produced by grinding the hot sweet potatoes through a colloid mill. The grinding reduces the fiber to a sufficiently small particle size to allow a smooth consistency. This fiber incorporation increases the product yield and the percent dietary fiber.

Quality of the shelf-stable puree was equal to that of frozen puree, table 1. After 4 months' storage, the aseptically packaged purees had better color retention than the frozen purees. When the various purees were incorporated into souffles and rated by taste panel for color, flavor, and texture, no significant quality differences could be attributed to the processing variables, table 2.

Acceptance of the Auburn processing method by commercial processors could result in greater markets for Alabama sweet potatoes.

TABLE 1. EFFECT OF PROCESSING VARIABLE ON THE SOLUBLE SOLIDS, TOTAL SOLIDS, AND COLOR AFTER 4 MONTHS' STORAGE

Processing variable	Soluble solids	Total solids	Color[1]		
			L	a	b
	Pct.	*Pct.*			
Pulped aseptically packed	18.3	20.0	55.4	24.5	36.4
Pulped frozen	18.5	20.5	54.0	23.5	30.8
Ground aseptically packed	18.0	23.0	49.9	22.8	29.8
Kettle cooked (whole potatoes) pulped and frozen	22.4	21.7	53.8	23.5	30.3

[1]L = total light transmittance; a = redness; b = yellowness.

TABLE 2. EFFECT OF THE PUREE PROCESSING VARIABLES ON THE ORGANOLEPTIC QUALITY OF SOUFFLES[1]

Processing variable	Color	Texture	Flavor
Pulped aseptically packed	8.7	8.5	8.7
Pulped frozen	8.4	8.2	8.5
Ground aseptically packed	8.0	7.0	8.6
Kettle cooked (whole potatoes) pulped and frozen	8.8	8.8	8.7

[1]Ten-point scale with 10 being excellent and 6 being the borderline of aseptically.

SWINE WASTE Can be Valuable for Refeeding and On-Farm Energy Production

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RECENT NATIONAL economic conditions have made it essential that producers use the most efficient production methods and techniques to realize a profit. Experience during the decade of the 1970's, when availability and cost of energy were often unpredictable and unstable, also established the need for a stable, on-farm energy source for the commercial production of livestock.

Results obtained in a 2-year study at the Alabama Agricultural Experiment Station indicate that swine producers may have the answer to both of these situations right at hand. Swine residue (formerly classified as "animal waste") actually contains the potential for reducing the greatest cost of production, feeding, and at the same time provide an economically feasible, on-farm energy supply.

Flushing systems for waste removal from swine production facilities are the most common method used in Alabama. The waste utilization system currently being investigated at Auburn makes use of these existing flushing systems to recover valuable residue materials from the waste. A standard commercial vibrating screen solid-liquid separator is used for recovery.

The properties of the two fractions (solid and liquid) were determined for four flow rates, each tested with five screen mesh sizes. Both fractions were evaluated for their refeeding and methane production potential.

For methane production using conventional anaerobic fermentation, the total solids should be in the 5-10% range, while refeeding requires 15-20% total solids. The data show that an 18-mesh screen and a flow rate of 456.8 or 685.3 liters per square meter-minute give the best product for refeeding. Methane production would require a mesh size of 60, since total solids values are in the 5-10% range for all flow rates on the 60-mesh screen.

For refeeding, the nutrient composition of the waste solids was determined for each screen size and flow rate. As shown in the table, both screen size and flow rate greatly affected the dry matter, protein, ash (mineral), and fiber content of the solids.

To refeed the solids, it is necessary to use a screen size and flow rate that will produce a material that contains enough dry matter to be easily handled, yet retains as high a level of nutrients as possible. Using high flow rates with small screen size results in solids that are too wet to handle and contain high levels of ash. If the flow rate is low with a large screen size, the solids retained are largely the seed coverings from the grain, which are high in fiber and low in energy. Therefore, intermediate levels produce the most desirable product for refeeding.

Gestating sows were used in digestibility experiments since the high level of fiber and relatively low energy content in the solids make them unsuitable for the growing-finishing pig. Waste solids were added to the diets to replace either energy or protein in typical corn-soy gestation diets.

The results indicate that the energy in the waste solids is moderately digestible (55%), but the protein is poorly digested. Thus, the solids should be used as an energy feed. The metabolizable energy content of the solids was found to be about 50-60% of the value of corn. The maximum intake of the solids by the sow was 4 lb. of dry matter per day due to the high fiber content. Based on these results, it was determined that the waste solids could replace 60% of the energy in a standard gestation diet.

Waste solids in this study were collected daily and fed to the sows without further processing. The sows readily consumed the solids, and no health problems were observed. Swine waste solids offer excellent potential as an alternative feed source for the sow herd.

The requirement of an 18-mesh screen for producing a good refeeding material and a 60-mesh screen for a good methane feedstock would suggest that the simultaneous utilization in refeeding and methane production is impossible. This conclusion is also supported by data from this study. Using the 60-mesh screen and 456.8 liters per square meter-minute flow rate allows approximately 60% of the potential methane to be lost in the liquid. The 18-mesh screen, which is ideal for refeeding, allows even more of the potential methane to pass in the liquid.

EFFECT OF SCREEN SIZE AND FLOW RATE ON NUTRIENT COMPOSITION OF WASTE SOLIDS

Treatment	DM[1]	CP[1]	Fat	Ash	Cell walls
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Screen size, mesh					
8	19.0	11.4	3.6	5.1	69.2
18	15.9	12.8	2.1	5.2	67.7
30	13.4	12.8	3.4	7.9	66.7
60	6.1	13.6	5.0	8.7	58.2
150	4.6	20.9	6.0	10.8	50.2
Flow rate, l/m²-min.					
228.4	13.9	11.2	3.3	4.4	71.6
456.8	12.4	13.1	2.9	7.1	65.5
685.3	11.6	15.0	3.9	9.2	56.4
913.7	9.3	18.0	6.0	9.4	56.2

[1]DM = dry matter; CP = crude protein.

With the screening system used in the study, the 18-mesh solids are a good material for refeeding, while the liquid material has approximately 70% of the potential methane production of the raw waste. Thus, the screening process produces two products, each best suited for a specific purpose.

Refeeding of swine waste has already progressed to the point where reasonable estimates can be made regarding its use in conventional diets. The production of methane using the liquid fraction of the separate is just now being developed using a novel anaerobic fermentation technology. This approach uses a biological reactor termed the "anaerobic filter" and differs significantly from conventional technology. Requirement for total solids concentration ranges from below 1.5 to 2.0%, with small particulate solids and a major portion of the solids in the dissolved form. The liquid portion meets this requirement as well as having approximately 70% of the original methane potential.

The utilization system currently under development at Auburn would use both fractions of this mechanically separated swine waste simultaneously. The solids are currently being refed in rations as high as 60% of the total diet. When the methane technology using the anaerobic filter and the liquid portion of the separate is perfected, the combination system should increase production efficiency while simultaneously providing an economical, stable, on-farm energy supply.

Creep-Grazing Tifleaf 1 Pearlmillet Provides Dual Benefits

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IN PASTURES comprised of perennial grasses such as bermudagrass, bahiagrass, and fescue, forage quality generally declines rapidly after July 1. This is because of increased lignification of the plants, resulting in decreased digestibility and lower daily gains of cattle. In an effort to avoid this period of depressed performance and to increase beef production per acre, a creep-grazing system using Tifleaf 1 pearlmillet was initiated. The trial was conducted during 1981 and 1982 at the Sand Mountain Substation. Tifleaf 1 is a low growing, leafy pearlmillet variety which tillers extensively and is more digestible than other varieties of pearlmillet and most other species of summer annual grasses.

Ten cow-calf pairs (Charolais cows bred to a Simmental bull) were randomly assigned to each of four existing 15-acre pastures consisting mostly of fescue with small amounts of white clover and dallisgrass. The calves were born during February and March and were equally divided according to sex when assigned to either control or creep-grazing treatments. In two of the pastures, a 2-acre area was planted with Tifleaf 1. During the first year, seedbed preparation in these 2-acre areas involved turning the fescue sod with a moldboard plow followed by disking. Tifleaf 1 was planted in mid-April at a rate of 20 lb. of seed per acre using a cultipacker-seeder. At the time of planting, nitrogen was applied at the rate of 45 lb. per acre and phosphorous and potassium were applied according to soil test recommendations. A topdress application of ammonium nitrate (33 lb. of nitrogen per acre) was subsequently made in July.

Tifleaf 1 establishment the following year differed in that the ground was disked twice and only nitrogen fertilizer was applied (at planting and top dressed later). Soil tests showed that phosphorous and potassium were not needed. In both years, an initial plant height of 12 to 18 in. was allowed before creep-grazing was begun. The areas planted with the pearlmillet were fenced with two strands of electric fence with a narrow wooden gate to allow access by the calves. Cows and calves were weighed monthly. In 1981, grazing began June 2 and ended October 5 (125 days). In 1982, it began June 22 and ended September 14 (84 days).

Gains of the control calves averaged 1.38 lb. daily compared to 2.1 lb. for creep-grazed calves, table 1. This resulted in an additional 375 lb. of beef per acre of Tifleaf 1 pasture. The actual cost of seed and fertilizer involved in Tifleaf establishment was $53 per acre. If all other costs such as land, labor, interest on operating capital, and fuel are included, the total cost per acre was $100. Assuming the establishment cost was $100 per acre and the beef produced was valued at $0.65 per lb., a net return of $144 per acre of Tifleaf 1 could be realized.

In addition, large differences in body weight of the brood cows occurred depending upon whether their calves were creep-grazed, table 2. Control cows lost an average of 60 lb. of body weight in contrast to a gain of 27 lb. by the cows nursing creeped calves. Most of the weight loss by control cows occurred during July and August. It is an established fact that cows in good body condition at the time of calving breed back faster, thus contributing to a shorter breeding season and more uniform calves at time of weaning.

It should be noted that the 10 creep-grazed calves in each 2-acre pasture were unable to keep the Tifleaf 1 grazed to recommended height (between 6 and 24 in.), thus the areas had to be clipped two or three times each year. This suggests that the stocking rate of five calves per acre was too low. A practical alternative, which might have further favorable impact on animal performance, would be to let the mature cows graze for short periods as necessary.

Results of this experiment show that dual benefits result from the creep-grazing of Tifleaf 1 by calves in a forage system in which fescue is the predominant species. Creep-grazing increased growth rate and economic returns of the calves in addition to allowing the cows to be in better body condition as they entered calving season. Additional research is planned to evaluate this system in other parts of the State and in conjunction with pastures dominated by other perennial grasses.

TABLE 1. EFFECT OF CREEP-GRAZING TIFLEAF 1 PEARLMILLET ON CALF PERFORMANCE

Item	1981 (125 days)		1982 (84 days)		Average (104 days)	
	Control	Creep	Control	Creep	Control	Creep
Initial weight, lb.	281	287	319	316	300	302
Final weight, lb.	467	559	422	482	444	521
Weight gained, lb.	186	272	103	166	144	219
Av. daily gain, lb.	1.49	2.18	1.23	1.98	1.38	2.10

TABLE 2. COW WEIGHT CHANGES AS AFFECTED BY CALVES GRAZING TIFLEAF 1 PEARLMILLET

Item	1981 (125 days)		1982 (84 days)		Average	
	Control	Creep	Control	Creep	Control	Creep
Initial weight, lb.	1,159	1,162	1,111	1,064	1,135	1,113
Final weight, lb.	1,112	1,185	1,037	1,094	1,075	1,140
Weight change, lb.	-47	+23	-74	+30	-60	+27

Proper Soil Fertility Levels Necessary for Economical Production by Winter Legumes

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AGRICULTURE in the United States relies heavily on the use of inorganic nitrogen fertilizers. These fertilizers often represent the major cost input for nonleguminous crop production. Estimates indicate that the cost of already expensive nitrogen fertilizer will more than double within the next 5 years.

In the Southeast, growing annual winter legumes as a nitrogen source for summer grain crops has the potential to economically maintain high levels of production by reducing dependence on inorganic N fertilizer. Currently, however, the cost of growing these legumes is approximately equal to the value of the nitrogen they produce. Using various systems with reseeding legumes can eliminate yearly seeding, which is the primary cost associated with growing legumes. This approach is being investigated in Alabama Agricultural Experiment Station research.

The amount of nitrogen produced varies with the legume species and the environment in which it is grown. Factors such as soil pH and general fertility levels are relatively simple to alter, and these factors may greatly influence nitrogen and dry matter production of both planted and reseeded legumes.

Field studies were begun in 1980 at the E.V. Smith Research Center, on a Norfolk sandy loam soil, to determine the effects of soil pH and phosphorus levels on legume nodulation, yield, and nitrogen production. Legumes included in the study were Yuchee arrowleaf clover, Dixie crimson clover, and Vangard common vetch, all of which are reseeding winter annual legumes well adapted to the moderate to slightly acid soils of the Alabama Coastal Plains.

Initial soil pH was 5.0 and soil-test values were 5 lb. per acre P (Very Low), 208 lb. per acre K (High), and 375 lb. per acre Ca (High). Lime and superphosphate treatments were applied in November 1980. Lime rates were 0 and 2 tons per acre, and superphosphate was applied at 0, 250, and 500 lb. per acre P_2O_5. Potassium chloride was broadcast uniformly to provide 120 lb. per acre K_2O. Fertilizer treatments were disk incorporated and inoculated seeds were surface broadcast.

TABLE 1. LEGUME YIELD AS AFFECTED BY APPLICATION OF LIME AND PHOSPHORUS

Applied P_2O_5/acre, lb.	Yield/acre, by species and soil pH					
	Arrowleaf clover		Crimson clover		Common vetch	
	5.0	5.6	5.0	5.6	5.0	5.6
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	1,010	2,000	2,260	2,120	1,300	2,060
250	6,680	7,020	3,910	5,410	3,130	3,930
500	6,470	6,960	4,350	4,880	2,470	4,270

TABLE 2. TOTAL NITROGEN PRODUCTION BY WINTER LEGUMES AS AFFECTED BY APPLICATION OF LIME AND PHOSPHORUS

Applied P_2O_5/acre, lb.	Yield/acre, by species and soil pH					
	Arrowleaf clover		Crimson clover		Common vetch	
	5.0	5.6	5.0	5.6	5.0	5.6
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	16	40	40	26	24	33
250	136	136	61	100	63	78
500	110	142	66	78	69	89

In the spring of 1981, average soil pH levels were 5.0 and 5.6, respectively, on the no lime and 2-ton rate plots. Soil-test P levels averaged 5 (Very Low), 49 (Medium), and 94 (High) lb. per acre, respectively, following the 0, 250-, and 500-lb. P_2O_5 applications. The test was repeated during the winter of 1981-82.

Soil treatment effects on nodulation were determined by digging root samples and taking nodule weights and numbers. Arrowleaf and crimson clover nodulation did not respond to lime, but increased significantly with increasing P levels. Vetch nodulation showed no response to P, but improved with liming. Percent nitrogen in the top growth of the three legumes ranged from 2.1 to 4.8 at bloom stage, and 1.5 to 2.8 at maturity; however, no correlation to soil pH or P was found.

Dry matter yields at maturity are summarized in table 1. The first rate of phosphate greatly increased yields for all species, but the high rate did not produce a further increase. Lime also increased yields, but to a lesser extent. Yields of arrowleaf clover showed the greatest response, improving from 1,010 to 7,020 lb. per acre dry matter, with low soil pH and P and high soil pH and medium P rates, respectively. Crimson clover yields ranged from 2,120 to 5,410 lb., while vetch ranged from 1,300 to 4,270 lb.

The percent nitrogen at maturity was multiplied by the dry matter production to determine the total amount of nitrogen produced and incorporated into the above ground portion of the plant, table 2. Total nitrogen production for each species increased slightly with liming, and dramatically from the 250 lb. per acre P_2O_5 rate.

The greatest response occurred with arrowleaf clover (almost a nine-fold increase), where total nitrogen in the above ground tissue ranged from 16 lb. per acre (without lime or P_2O_5) to 142 lb. (with lime and the high rate of P_2O_5). Differences in nitrogen production reflected differences in yield and nodulation rather than nitrogen concentrations in the tissue.

The results of this study indicate that adequate phosphorus and suitable pH levels are critical for economical nitrogen production by winter legumes. Attempting to use winter legumes as a nitrogen source on low fertility soils, without applying lime and fertilizer, will most likely not be cost effective. Excessive fertilization, however, is an extra cost that will probably not improve growth or nitrogen production.

Optimum production in this test was achieved with Medium soil-test P levels and soil pH between 5 and 5.6. This pH value is lower than the requirement for perennial legumes, such as white clover and alfalfa. As with other crops, liming and fertilizing according to soil test results will ensure proper soil fertility levels for winter annual legumes.

Effect of RELIABILITY on Equipment AVAILABILITY

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EQUIPMENT BREAKDOWN is one of the more frustrating problems that confront equipment managers. Thus, managers want more reliable and maintainable equipment. Manufacturers can design highly reliable and maintainable equipment, but only by increasing the cost of the equipment. At some point this additional expense is not justified by the savings resulting from the additional operating time.

Suppose an equipment owner/manager could pay an additional 20% to purchase a machine with an average time between failures of 100 hours rather than a less expensive machine with an average time between failures of 50 hours. Would this be a cost effective investment? Maybe not. An Alabama Agricultural Experiment Station study was done to answer such questions.

The objective of this study was to determine how reliability (time between failures) affected the operational availability (time available for work) of equipment.

A theoretical curve representing a breakdown of machine time for different times between failures was developed with collected data, figure 1. The 8 scheduled machine hour (SMH) day is divided into service time, delay time waiting for parts or a mechanic, repair time, and available or operating time. Since the machine is serviced for 1 hour each day, the service time percent is always 12.5. This leaves a maximum operating time of 87.5%, or 7 hours per day.

The availability curve would start at zero and continue to increase as time between failure (TBF) increased, but at a decreasing rate. As the TBF increases from 0 to 25 hours, availability increases from 0 to 75.4%. However, as the TBF increases from 25 to 50 hours, availability increases only from 75.4 to 81.0%, a very marginal gain. To obtain an additional 5% increase in availability, the TBF would have to be increased from 50 to 250 hours. Also, as TBF increases, repair and delay time become less important.

A simulation program was written to calculate the operational availability, based on time between failures, time to repair, and delay time. It also includes daily service when necessary. Distributions of time between failures, time to repair, and delay time were collected on feller bunchers.

Figure 2 shows the effect of reliability or time between failures on availability for two different times to repair the feller bunchers. Since the simulations were run for a limited time using the same time to repair (TTR) and delay time distributions, the points do not fall along a smooth curve as would be expected.

The two curves have the same shape and are approximately parallel over the range shown. The difference in the height of the two curves is due to the amount of time the machine is down once it has failed. In this case the difference is 4.30 hours. Note that as the time between failures increases so does availability, but at a decreasing rate. The shape of the curve is independent of machine type. Although the data are for feller bunchers, an analysis of any other machine with the same time distributions would yield a similar graph.

An increase in availability of a more reliable machine can be translated into increased operating time, which results in increased production and its associated return or income. The increase in machine reliability would result from some modification, redesign, or change in maintenance practices. The cost of the change that brought about the increase in reliability can be compared to the return to see if the changes are economically feasible.

In conclusion, the effect of time between failures on availability indicates that: (1) if availability is poor, the largest gains can be made by increasing the time between failures up to the point where the average is about 20 to 25 hours; (2) if the average time between failures is about 20 to 30 hours, the gains by increasing the time between failures are about equal to those achieved by decreasing time to repair or delay time; and (3) once the average time between failures reaches approximately 40 hours, efforts should be concentrated on reducing repair or delay time.

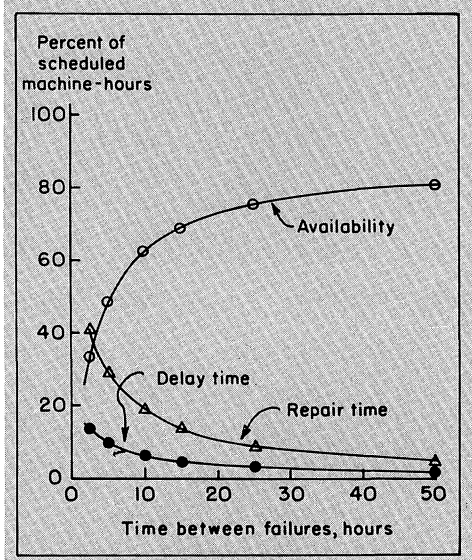


FIG. 1. A theoretical curve of operational availability, repair time, delay time, and service time percentages for different times between failures, given an 8 scheduled machine hour day, 1 hour of service per day, and 1 hour of delay time and 3 hours of repair time for each failure.

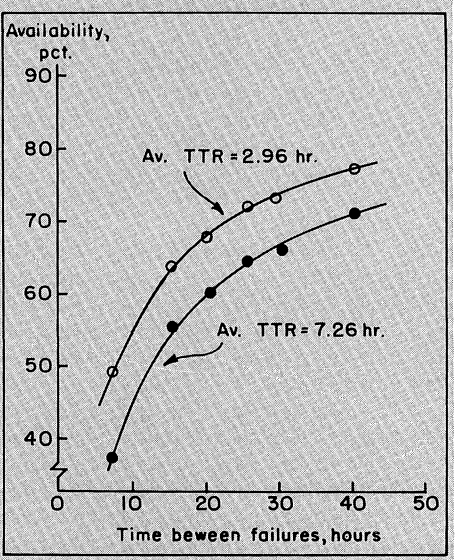
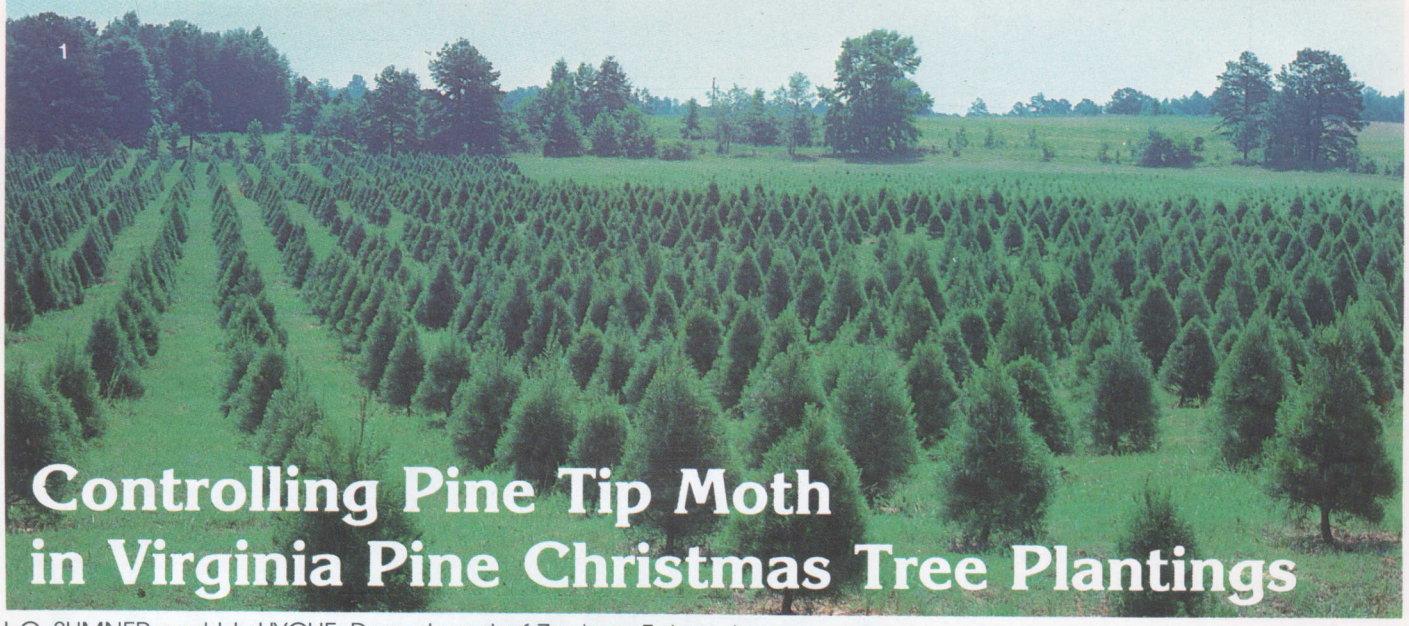


FIG. 2. Operational availabilities as determined from the simulation of machine operation for different times between failure for two different times to repair (TTR), an average delay time of 2.73 hours, 8 scheduled machine hours per day, and 1 hour of service per day.



Controlling Pine Tip Moth in Virginia Pine Christmas Tree Plantings

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NANTUCKET PINE TIP MOTH is common in young loblolly, shortleaf, and Virginia pines throughout Alabama. It prefers open-grown, single-species stands, such as those established by transplanting nursery stock in old fields or on similarly cleared sites. It also prefers plantations in early stages of development, i.e., from first year of planting until trees reach 10-12 ft. in height. These conditions preferred by tip moth essentially describe the standard conditions of Virginia pine Christmas tree plantings, figure 1. Therefore, it is not surprising that injurious populations seem to be present in these fields every season.

Injury to trees is caused by tip moth larvae tunneling in new-growth buds and shoots. Infested twigs die, resulting in loss of main-stem terminals, poor tree form, and undesirable discoloration, figure 2. Most growers say control of tip moth to prevent this damage is essential for production of marketable trees. One approach to control is by use of insecticidal sprays. Success of spray programs, however, depends on two things: use of an effective insecticide and proper timing of applications to reach the vulnerable stage of the insect. Results of investigations at the Alabama Agricultural Experiment Station furnish some insight into these two areas.

Knowledge of the habits of tip moth reveals that: (1) eggs are laid primarily on needles of shoots, and (2) newly hatched larvae mine needles and/or feed exposed on the outside of new-growth twigs for a period prior to boring into buds and shoots. Thus, larvae are vulnerable and controllable if spray applications coincide with the periods of egg hatch. The table shows results obtained with four insecticides applied during the egg-hatch period of each of the four moth generations occurring at Auburn. In each insecticidal treatment, the percentage of damaged twigs was significantly lower than that in untreated trees; damage in trees sprayed with permethrin (Ambush®, Pounce®) was less than 1%. In each case, only one application was made per tip moth generation.

FIG. 1. Typical Virginia pine Christmas tree plantation.

FIG. 2. Twigs killed by tunneling of tip moth larvae.

FIG. 3. Pine tip moth adult.

Pine tip moth eggs and newly hatched larvae are small and inconspicuous. They are not readily visible except by examination of needles and twigs under magnification, a practice not very practical in the field. How then can periods of egg hatch be defined for timing of spray applications? The answer comes from further understanding of the habits and development of the insect.

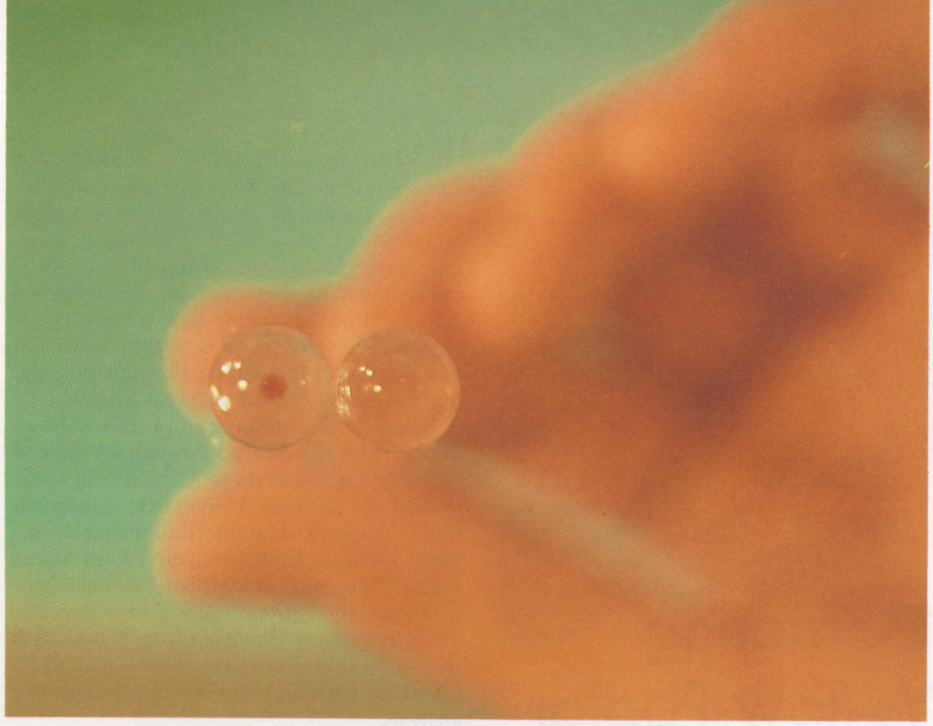
Pine tip moth activity tends to follow a regular pattern. This pattern may vary from place to place and year to year; however, once activity begins in a season, the sequence and time of occurrence of subsequent events (oviposition and egg hatch) at that place may be fairly predictable. For example, results of 3 years of observations on rates of tip moth development at Auburn indicate that the beginning of egg hatch for each generation will likely fall within a predictable range of days subsequent to the date of first emergence of the parent moths (the adult moth is distinctive and rather easily recognized in the field, figure 3). Average number of days (with range) from first moth emergence to first egg hatch observed for each moth generation in the Auburn vicinity is as follows: first generation - 27.3 (range, 25-31); second generation - 14.0 (range, 11-18); third generation - 7.3 (range, 6-9); fourth generation - 12.5 (range, 11-14). In each year of these observations, emergence of parent moths for the first generation began during the first 10 days of March.

Again, time of tip moth emergence and egg hatch will vary by year and/or locality, temperature being an important factor. However, an awareness of the schedule of developmental phases of the insect in a locality may determine the success of a control program.

CONTROL OF PINE TIP MOTH WITH INSECTICIDAL SPRAYS

Treatment[2]	Mean percentage[1] of tips damaged by each generation			
	1st	2nd	3rd	4th
Check - none	8.8	12.6	34.4	8.9
Dimethoate (Cygon®), 0.12 pct.	0.3	3.2	10.6	3.5
Chlorpyrifos (Lorsban®), 0.05 pct.	1.5	0.7	3.3	1.5
Permethrin (Ambush®, Pounce®), 0.25 pct.	0.0	0.1	0.6	0.0
Diazinon (Spectracide®), 0.07 pct.	1.2	1.9	3.9	3.0

[1]Mean of five replications.
[2]One application per generation made during periods of egg hatch.



Results of agglutination test indicate whether bird has resistance to specific disease.

Genetic Control of Poultry Disease

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THE AFFORDABLE, high quality of poultry meat and eggs did not happen by chance. It came about because of increased efficiency of production, made possible largely by elimination of poultry diseases which once threatened the industry. Only poultrymen on the scene 50 years ago can fully appreciate what has been accomplished to control the gamut of diseases caused by infectious agents ranging from viruses to animal parasites.

This story of success is typical of many in which application of basic biological knowledge in agricultural research has solved otherwise insurmountable practical problems. Development of highly effective drugs and vaccines has been the most dramatic part of the story, but improvement of inborn resistance has also played an important role. In fact, all means of control depend ultimately on well tuned modifications of inherited patterns of internal chemistry controlled by the genes of an animal. Genes are both the objects of study and the tools of the plant or animal geneticist.

Research begun at the Alabama Agricultural Experiment Station in the 1930's continues to provide the know-how to fine tune the genes of chickens for maximum inborn resistance to diseases. Results from the early gene substitution technique (family selection) employed in the Auburn strain Leghorn show both the enormity of the original problem and the effectiveness of genetic intervention—laying house mortality of 89% in 1935 reduced to 17% in 1951. In succeeding years, certain commercial strains showed much less mortality than others in random sample egg production contests. Presently, the average laying house mortality in such tests is 10% and molecular genetics may further reduce it.

Another experiment in the Auburn strain showed that by two-way selection for coccidiosis immunity, genes for resistance to coccidiosis were isolated in a daughter line, R, and alternative genes for susceptibility to coccidiosis were isolated in another daughter line, S. The lines R and S have been used extensively in the past 27 years to study individual genes having measurable effects on persisting disease problems in the industry.

Each such gene produces a distinctive molecule on the surfaces of various cells of the body, including blood cells and other cells active in immunity against infectious organisms and other foreign substances. At least some of the molecules are self-markers in the bodies of individual animals, promoting coordination between cells with identical molecules, but triggering destructive processes (immune responses) against cells or substances with nonidentical molecules. When blood cells of a donor bird bearing such a cell-surface molecule are transfused into a recipient bird lacking the donor-gene product on its cells, cells of the immune system of the recipient recognize the foreign molecule as an antigen and produce antibodies against it.

In typing tests, antiserum (reagent) from the recipient clumps cells of the donor and cells from any other individual having the same gene as the donor, but it does not clump cells of individuals lacking the gene. By accumulating reagent for the product of each gene in a population of animals, it is possible by typing tests to determine which genes an individual possesses. With knowledge of the effect of each gene on resistance to disease, the breeding value of each individual can be determined directly without the delays, expense, and errors inherent in earlier methods of selection.

The typing reagents produced in lines R and S have aided production of similar reagents in the Auburn laboratory for 11 other lines of Leghorns and 14 lines of broilers from public and commercial cooperators. These products of Auburn research constitute one of the two largest such resources in existence for research on the immunity of chickens.

Lines R and S have almost totally different sets of genes. Studies of the seemingly large effects of several kinds of genes on coccidiosis are continuing. Genes in both lines show large differences in resistance to Marek's disease (MD), a recurrent problem in the industry. In R line, few birds having the B2 gene die of MD, but almost all of their brothers and sisters having only the B5 gene die by 2 years of age. By mating parents having only the B2 gene. MD can be virtually eliminated in R line.

Extensive studies of B genes in commercial primary broiler breeder lines have shown that all possess genes resistant and susceptible to MD. The results indicate that the impact of MD on the industry could be reduced one-half by merely managing commercial matings to exclude the most susceptible genes in each line. Significant additional improvement could be made by transferring the most resistant genes into all lines. In such maximally improved lines, the current MD vaccine would possibly be proportionately more effective, and the impact of the disease might be largely eliminated.

Basic knowledge used in poultry research benefits not only the industry but is recycled as added knowledge for research and human well-being, most often in unexpected directions. Research on the chicken many years ago showed for the first time that a virus (RSV) could cause cancer. More recently, poultry research showed clearly that the immune systems of vertebrates are composed of two parts, B cells and T cells, giving new impetus to research in mammals. Local research on chickens suggests that the red blood cells may be a third component of immune systems. Recent medical research implicates red cells in human immunity.

Estimating Yellow-Poplar Volume in the Hilly Coastal Plain

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YELLOW-POPLAR is a well-formed valuable timber species especially useful for veneer production. It is relatively abundant on the hilly Coastal Plain of Alabama, Georgia, and Mississippi, primarily on well-drained stream bottoms and on protected slopes. However, cubic-foot volume equations specifically for this region were not available until developed through the Alabama Agricultural Experiment Station.

Data were obtained from 173 yellow-poplar trees distributed throughout most of the hilly Coastal Plain in Alabama, on lands owned by Auburn University, American Can Company, Hammermill Paper Company, Georgia Kraft Company, Gulf States Paper Company, MacMillan-Bloedel Company, and the United States Forest Service. Trees ranging in diameter from 6.8 to 24.0 in. were felled and cross-sectional disks taken at regular intervals for laboratory analysis.

Using established procedures, equations were developed which estimate the total cubic-foot wood volume in a tree bole, using diameter at breast height (d.b.h.) and total height as input. Separate equations were developed which allow estimation of volume with or without bark. These can be more readily used for field work in tabular form, table 1.

A further refinement was made which allows calculation of *merchantable* volume from the total volume. Merchantable volume normally includes only that volume below a specific minimum top diameter of the tree bole. Formulas were developed to estimate the ratio of merchantable volume to any specified top diameter to the total tree volume, both with and without bark. These took the form, Ratio = $1.0 + b_1 (T^{b_2}/D^{b_3})$, where Ratio = the ratio of merchantable volume, inside or outside bark, to total cubic-foot volume; T = merchantable top diameter (in inches), outside bark; D = d.b.h. (in inches); and the b's are appropriate coefficients. The coefficients are shown in table 2.

As an example, to determine the merchantable volume to a 6-in. top for a tree of 16 in. d.b.h. and a total height of 90 ft.: (1) use table 1 to determine the total volume, which is 49.25 cu. ft. for outside bark and 43.50 cu. ft. for inside bark (from the formula in the footnote); (2) determine the ratio of merchantable volume to total volume using the formula cited above and the coefficients from table 2 for outside bark, e.g.,

$$R = 1.0 + \left[-0.663955 \left(\frac{6^{3.392287}}{16^{3.263456}} \right) \right] = 0.9659$$

(0.9664 for inside bark); (3) multiply this ratio by the total volume determined in step 1, resulting in a merchantable volume of 47.57 cu. ft. outside bark (42.04 cu. ft. inside bark).

This information provides professional foresters and landowners with the tools to accurately estimate the amount of volume in standing yellow-poplar timber. Such volume estimates are essential in planning timber management, scheduling harvesting, and projecting revenues.

TABLE 2. COEFFICIENTS FOR ESTIMATING RATIO OF MERCHANTABLE VOLUME TO TOTAL VOLUME, INSIDE AND OUTSIDE BARK, OF YELLOW-POPLAR IN THE HILLY COASTAL PLAIN

Ratio equation	Coefficients		
	b_1	b_2	b_3
Inside bark.....	-0.682552	3.406393	3.287484
Outside bark ...	-0.663955	3.392287	3.263456

TABLE 1. TOTAL VOLUME (CUBIC FEET), OUTSIDE BARK[1], FOR YELLOW-POPLAR IN THE HILLY COASTAL PLAIN

D.b.h., in.	Total height, ft.														
	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115
6	5.14	5.51	5.88	6.25	6.62	6.99									
7	6.34	6.84	7.35	7.85	8.36	8.86	9.37	9.87							
8	7.73	8.39	9.05	9.71	10.37	11.03	11.68	12.34	13.00	13.66					
9	9.31	10.14	10.97	11.81	12.64	13.48	14.31	15.14	15.98	16.81	17.65				
10	11.07	12.10	13.13	14.16	15.19	16.22	17.25	18.28	19.30	20.33	21.36	22.39			
11	13.01	14.26	15.51	16.75	18.00	19.24	20.49	21.74	22.98	24.23	25.47	26.72	27.97		
12		16.63	18.11	19.59	21.08	22.56	24.04	25.52	27.01	28.49	29.97	31.46	32.94	34.42	
13				22.68	24.42	26.16	27.90	29.64	31.38	33.12	34.87	36.61	38.35	40.09	
14					28.04	30.06	32.07	34.09	36.11	38.13	40.15	42.17	44.18	46.20	
15						34.24	36.55	38.87	41.19	43.50	45.82	48.14	50.46	52.77	
16							41.34	43.98	46.61	49.25	51.89	54.52	57.16	59.80	62.43
17							46.44	49.42	52.39	55.37	58.34	61.32	64.30	67.27	70.25
18							51.85	55.18	58.52	61.86	65.19	68.53	71.87	75.20	78.54
19								61.28	65.00	68.71	72.43	76.15	79.87	83.58	87.30
20								67.70	71.82	75.94	80.06	84.18	88.30	92.42	96.54
21								74.46	79.00	83.54	88.08	92.63	97.17	101.71	106.25
22									86.53	91.51	96.50	101.48	106.47	111.45	116.43
23										99.85	105.30	110.75	116.20	121.65	127.09
24												120.43	126.36	132.29	138.22
25												130.52	136.96	143.39	149.83

[1]Total volume (outside bark) = 1.798654 + 0.002060 (D^2H) where D = d.b.h. (inches) and H = total height (feet). Total volume for inside bark = 1.425697 + 0.001826 (D^2H).

"420 LANDPLASTER" AND GYPSUM, GOOD CALCIUM SOURCES FOR PEANUTS

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CALCIUM LEVELS in the soil affect peanut yields and grades in a highly consistent manner. This is because of the unique way in which peanuts get calcium for pod development.

Like other plants, the root system of the peanut plant absorbs all the calcium needed for vegetative growth. Calcium absorbed in this manner moves freely through the stems into the leaves and flowers. Probably all soils in the Wiregrass area have enough calcium to meet the need for maximum vine growth.

Peanuts' special need for calcium develops after the peg, which is the pollinated flower, enters the soil. Immediately after the peg enters the soil, calcium stops moving from roots via the main stem of the plant to the peg. Consequently, the developing pod must get the rest of the calcium it needs directly from the surrounding soil. Because of this unusual way in which calcium is obtained by peanut pods, soil surrounding the nuts must be higher in available calcium than is necessary for the soil occupied only by roots.

Most Alabama farmers supply calcium to their peanuts by building soil calcium levels with applications of agricultural limestone. However, 15-20% of peanuts grown in Alabama need supplemental calcium in the top 2 to 3 in. of soil during the period of pod filling. Since about 1950, the most common method to meet this need has been either by liming or by dusting gypsum (calcium sulfate) on the plant at the early flowering stage. When gypsum is applied in this manner, it falls in the zone of pod formation and is present when the need for calcium by pods is greatest. Although finely ground gypsum is excellent for this purpose, other calcium sulfate sources should be equally satisfactory.

Field studies were conducted by the Alabama Agricultural Experiment Station in 1980, 1981, and 1982 on farmers' fields to evaluate a granular calcium sulfate material known as "420 landplaster." Marketed by the U.S. Gypsum Corporation,[1] 420 landplaster was compared with regular, finely ground gypsum. These two materials were compared at 250 and 500-lb.-per-acre rates. Two dates of application were compared: (1) broadcast at planting (no incorporation of material), and (2) band placement in a 12- to 14-in. band over the row about 60 days after planting (early bloom).

There was no difference in the effects of the 250 and 500-lb.-per-acre rates of either 420 landplaster or gypsum on yield or percent sound mature kernels (SMK) in any of the experiments. Neither did time of application of either material affect yield or grade. Therefore, yields and grades listed in the table are averages of the rates and times of application for each material.

No yields were obtained from the 1980 experiments because of a severe drought. Two experiments were harvested in 1981. One was on an Americus loamy sand, located 3 miles east of Headland in Henry County. The field was low in available calcium and had not been cropped for the past 10 years. Peanut foliage exhibited a normal green color throughout the growing season except on the untreated plots, which remained dark green and were still blooming profusely at harvest time. Yields were increased an average of 1,440 lb. per acre by gypsum and 1,450 lb.by 420 landplaster. Percent SMK was increased 5 or 6 percentage points by each calcium source.

The other experiment was on a Bonifay loamy sand that was low in calcium and had not been cropped for the past 20 years. The calcium amendments significantly increased yield and grade. Yield increases averaged 1,390 lb. per acre from gypsum and 1,760 lb. from 420 landplaster. Percent sound mature kernels (SMK) was increased 11 percentage points by gypsum and 13 points by 420 landplaster.

One experiment was harvested in 1982. It was on a Troup loamy sand that was low in calcium and had not been planted to any crop for the past 21 years. Yields of plots receiving gypsum averaged 2,920 lb. per acre. Plots receiving 420 landplaster averaged 2,810 lb. per acre, and plots receiving no supplemental calcium averaged only 1,010 lb. per acre. Gypsum increased SMK by 8 percentage points, and 420 landplaster increased SMK by 9 percentage points.

In summary, available soil calcium was deficient at all three test sites. Yields and grades of peanuts were increased equally by regular, finely ground gypsum and by 420 landplaster. These materials proved to be equal as sources of calcium for peanuts.

[1]Research supported by a grant from U.S. Gypsum Corporation.

EFFECTS OF GYPSUM AND 420 LANDPLASTER ON YIELD AND GRADE OF FLORUNNER PEANUTS, 1981-82

Soil series	Soil-test calcium		Per acre yield			Percent sound mature kernels		
	Lb./acre	Index	None	Gypsum	420 landplaster	None	Gypsum	420 landplaster
			Lb.	*Lb.*	*Lb.*	*Pct.*	*Pct.*	*Pct.*
Olin and Billy Deal, Dale County, 1981 Bonifay loamy sand	140	L 60	1,240	2,630	3,000	60	71	73
Parker Farms, Henry County, 1981 Americus loamy sand	138	L 60	1,210	2,650	2,660	57	63	62
Olin and Billy Deal, Dale County, 1982 Troup loamy sand	100	L 40	1,010	2,920	2,810	66	74	75

Bermudagrass Hay Depletes Soil Potassium

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THE REMOVAL OF HAY from a field takes with it a large amount of potassium (K). For example, 5 tons of Coastal bermudagrass hay containing 2% K would remove 200 pounds of K from the soil. Removal of this much K can affect hay production and also the production of succeeding row crops.

The effects that hay removal had on the potassium fertilizer need of a succeeding corn crop was studied for 2 years at the Alabama Agricultural Experiment Station's Tennessee Valley Substation. The site had previously been in Coastal bermudagrass hay for 13 years and had been fertilized according to soil test during that period.

Available soil K on this Emory silt loam was "Medium" when the bermudagrass was turned in 1980. Wheat was then planted for winter grazing and was followed by no-till corn in wheat stubble in late March or early April. Potassium treatments for the 1981 corn crop included fall (1980) and spring (1981) applications; in 1982, K was applied to corn at planting and as a sidedressing.

In both 1981 and 1982, K-deficiency symptoms appeared in the unfertilized plots approximately 2 weeks after the corn emerged. The corn stopped growing, was a light green color, and leaf margins began dying back. Development of a severe K deficiency so early in the season was quite unexpected.

Deep soil samples (12-24 in.) revealed that the subsoil was uncharacteristically "Low" in available K. Apparently, when this field was in bermudagrass, not enough fertilizer K was added to replace the K removed by the hay crop. This allowed the bermudagrass to deplete the subsoil of its available K.

In both 1981 and 1982, 80 lb. per acre of K_2O fertilizer was required to correct K-deficiency symptoms and produce top corn yields. This is about double the normal fertilizer rate needed when the soil test K is "Medium" in the surface soil. In 1981, no difference between fall and spring applications of potash was found. In 1982, however, 80 lb. per acre of sidedressed K_2O applied after deficiency symptoms appeared did not correct the deficiency. This result was unexpected, and the reason for no response to sidedressed fertilizer is not known.

Potassium fertilizer requirements of crops following hay removal is a special situation and requires special attention. This test showed the importance of subsoil K in the corn plants' nutrition and demonstrates how long-term hay removal can deplete subsoil K to the detriment of succeeding crops. Because of the high K requirements of hay crops, following crops can be expected to require higher than normal K fertilizer rates.

Potassium deficiency symptoms such as these may occur on corn planted following bermudagrass hay crop.

EFFECT OF POTASH (K_2O) FERTILIZER RATES ON CORN YIELDS FOLLOWING 13 YEARS OF COASTAL BERMUDAGRASS HAY PRODUCTION

Per acre rate of K_2O, lb.	Time of application	Per acre corn yield
		Bu.
	1981	
0	---	68
40	To wheat in fall	83
80	To wheat in fall	96
80	At planting	100
160	At planting	102
	1982	
0	---	34
40	At planting	102
80	At planting	120
80	Sidedressing	47
160	At planting	119

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