highlights of agricultural research

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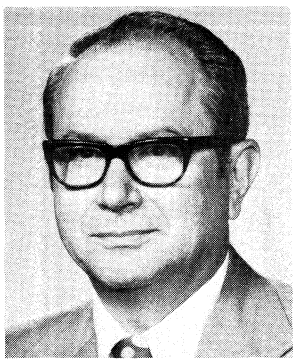
AGRICULTURAL EXPERIMENT STATION
R. DENNIS ROUSE, DIRECTOR

AUBURN UNIVERSITY
AUBURN, ALABAMA

DIRECTOR'S COMMENTS

ALCOHOL or alcohol blended with gasoline (GASOHOL) to stretch our liquid fuel supply and decrease the amount of petroleum the United States must import is almost certain to be increasingly important. Much has been written and spoken both optimistically and pessimistically on this recently. During the last several weeks, a team of scientists at this Station has analyzed knowledge on this subject and our conclusion is that production of alcohol can be a major new profitable enterprise for Alabama farmers. In fact, the potential to change Alabama agriculture is as great as that brought about by soybeans. To realize this potential for alleviating critical energy problems will require concerted effort by federal and state governments, industry, producers, and consumers.



R. DENNIS ROUSE

Scientists at Batelle Institute have projected that the greatest potential for producing ethyl alcohol (ethanol) at competitive prices is from sweet sorghum or similar sugar crops. They predict by the year 2000 the United States could be producing 8.3 billion gal. annually from sweet sorghum. That could mean 3 to 4 million acres of new crops for Alabama farmers. We believe that with aggressive research and development these are conservative estimates and can occur in a shorter time than the Batelle estimate.

Man has long known how to produce alcohol from sugar and starch but has not done so for fuel except for special purposes and when petroleum-based fuels were in short supply. In these instances, costs have not been the determining consideration. To produce alcohol for fuel at competitive prices requires development of production systems that utilize the total product of photosynthesis along with development of crops specifically for high alcohol production. Agricultural Experiment Station and School of Engineering scientists have training and experience to combine effective production systems. However, funding must be found to support this work.

We can visualize small or medium size alcohol distillation and dehydration plants with cattle feedlots to utilize some components and a methane gas production system to utilize others. Perhaps one of the greatest challenges for such a system is to provide for year-round operation. This is where Alabama and the Sunbelt have the competitive advantage. Your Agricultural Experiment Station has begun research to find the best crop plants, cropping systems, and methods of utilization. This requires both applied research directed to answer short-term questions and basic research to find solutions to long-term problems and opportunities. We are fortunate to already have the network of Outlying Units throughout the State to complement the Main Station at Auburn University.

Millions of federal dollars are being directed to other areas of energy conversion. We need to inform our congressmen on the potential for production of energy through agriculture. With funding, the Alabama Agricultural Experiment Station can perform the needed research program and lead the way in developing a renewable source of energy.

In spite of enthusiasm for the potential from this system, we must be cautious at present. Many questions must be answered before a system of production and utilization can be outlined and recommended to Alabama producers. Those who invest before a workable system has been developed and evaluated by this Station should recognize it as a high risk investment. Those who profit in the long run will be those who combine the use of sound research information and good management.

may we introduce . . .

Dr. Paul A. Lemke, new head of the Department of Botany, Plant Pathology, and Microbiology. A native of New Orleans, Dr. Lemke comes to Auburn from Mellon Institute, Carnegie-Mellon University, Pittsburgh, Pennsylvania, where he served as associate professor and senior scientist and then as adjunct professor and director at the Institute of Research during 1972-78. Previously he worked with Eli Lilly and Company for 6 years as a senior scientist.

Dr. Lemke received his B.S. in biology from Tulane University, M.A. in mycology from the University of Toronto, and Ph.D. in genetics from Harvard University. He has authored or coauthored 45 publications and served on the editorial board, editorial committee, or as editor of three different professional journals.

His honors include membership in Phi Beta Kappa, Woodrow Wilson Fellow, National Academy of Science exchange scientist with the Czechoslovak Academy of Sciences during 1978-1979, Humboldt Award, and fellowship in the American Academy of Microbiology in 1978.

HIGHLIGHTS of Agricultural Research

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ON THE COVER. Preparing seedbed on reclaimed surface mine with springtooth harrow.

FIG. 1. Pearlmillet growing on a plot at the Kellerman-4 mine that had been fertilized, disced, and mulched with straw. FIG. 2. Pearlmillet growing on a plot at the Kellerman-4 mine that had been fertilized and disced but not mulched.

Cultural Effects on Forage Plant Establishment For Alabama Surface Mines

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FOR A NUMBER OF YEARS, surface mine reclamationists in Alabama have been discing, liming acid soils, fertilizing nutrient-poor soils, and mulching seedbeds to facilitate surface mine revegetation.

They have been performing these treatments singly and in combinations, but there has been no agreement regarding the best combination of treatments. Reclamationists have been known to eliminate all the above treatments when sowing forage crop seed. Under conditions of good weather and fertile soil it is possible that an adequate forage cover could be established without any of these treatments. However, the occurrence of good weather conditions cannot be predicted with reliability even when a fertile soil is available. Therefore, it seems more desirable to enhance the chances for successful revegetation by using any cultural treatments that aid plant establishment. The experiment described in this article was intended to show the value, singly and in combination, of the above cultural factors for establishing a forage cover on minesoils.

Three minesoils (Kellerman-3, -4, and -5) of widely ranging characteristics were chosen for this experiment. They varied in texture, acidity, and nutrient content. This range of minesoils encompasses most of the ones found in Alabama. The cultural treatments used were: discing, adding soil amendments, lightly covering the seed with soil, and mulching with straw. The order in which all treatments were applied was: application of soil amendments, discing, sowing, light raking to cover the seed with a thin soil cover, and straw mulching. The treatment combinations were as follows: (1) fertilizer only, (2) fertilizer and mulch, (3) fertilizer and seed cover, (4) fertilizer, seed cover, and mulch, (5) fertilizer and discing, (6) fertilizer, discing, and mulch, (7) fertilizer, discing, and seed cover, (8) fertilizer, discing, seed cover, and mulch, (9) discing, seed cover, and mulch, and (10) no treatment. Lime was also applied to the Kellerman-5 minesoil to correct the high-soil acidity. Sudangrass was planted on the Kellerman-3 mine due to the alkalinity of this minesoil. The Kellerman-4 minesoil was neutral and Kellerman-5 was acid. Pearlmillet was planted on both of these minesoils. All planting was done in the middle of August and harvests were made 3 months later during November.

The best growth and cover was obtained on Kellerman-4 minesoil, see table. This minesoil was less stony than the other two minesoils and had a better soil texture for seed germination and root development. Kellerman-3 mine appeared to be paved with stone after the first rain had washed all soil-sized particles between and beneath the surface stones. This condition significantly reduced the amount of surface area for the support of vegetation. Kellerman-5 was intermediate in stone content, but the soil material was high in silt and clay. The silt and clay formed a hard crust at the soil surface after the first rain, and prevented seedling establishment after seed germination.

The table shows yields and percentages of soil surfaces covered for each of the treatment combinations. It was assumed that treatment 8 would produce the best yield and soil cover since it utilized all cultural treatments that individually had appeared to be beneficial to plant growth on minesoils. However, this was not the case. Treatment 6, which did not include seed cover, appears to be the best combination for forage production. The detrimental effect of seed covering was probably due to burying seed too deeply for seedling emergence. Figure 1 (left) shows one of the plots on Kellerman-4 that was fertilized, disced, and mulched. Figure 2 (right) shows a plot on Kellerman-4 that was fertilized and disced, but was not mulched. The value of straw mulch is obvious from these figures and the table.

It is concluded from this study that the individual treatments must be used in combinations for best forage crop yields. This is evidenced by the results from treatments 4, 6, and 8 shown in the table. Ground cover results followed the same general pattern, but the inclusion of volunteer plants in cover measurements obscured treatment effects. The yield results from treatments 1, 2, and 5 show the futility of fertilizing and liming without other treatments such as discing or mulching. The differences in yield between treatments 8 and 9 show the value of lime and fertilizer even though detrimental physical effects of the soils have been ameliorated by discing and mulching.

FORAGE YIELD AND GROUND COVER ON THREE ALABAMA SURFACE MINES
THREE MONTHS AFTER SOWING

Treatment[1]	Kellerman-3		Kellerman-4		Kellerman-5[5]	
	Yield[2]	Cover[3]	Yield[4]	Cover[3]	Yield[4]	Cover[3]
	Lb./acre	*Pct.*	*Lb./acre*	*Pct.*	*Lb./acre*	*Pct.*
1—F	14	4.9	6	4.0	0	3.6
2—FM	244	20.3	968	56.8	24	20.0
3—FC	158	14.9	513	28.5	114	13.3
4—FCM	424	23.5	2,754	52.1	234	37.9
5—FD	200	15.3	972	30.6	146	17.6
6—FDM	530	17.9	3,128	52.8	940	55.1
7—FDC	372	27.6	1,187	36.6	260	18.8
8—FDCM	422	17.2	2,187	41.3	676	36.3
9—DCM	4	6.6	328	37.1	0	16.2
10—Control	0	1.0	0	1.7	0	0.3

[1]F—fertilizer, M—mulch, C—seed covering, D—discing.
[2]Sudangrass, dry weight.
[3]Includes sowed and volunteer plants.
[4]Pearlmillet, dry weight.
[5]Applied lime as well as fertilizer.

Pasture vs. Drylot SYSTEMS for Growing-Finishing BEEF CALVES

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BOTH WINTER GRAZING and drylot feeding are suitable systems for growing and finishing beef calves. Each system has advantages. Drylot feeding gets the job done quicker, but the pasture system is more economical.

These conclusions are based on a 2-year Auburn University Agricultural Experiment Station study at the Lower Coastal Plain Substation, Camden. Post-weaning performance of crossbred steers and heifers was measured on two systems: (1) a drylot plan, which included feeding of corn silage with corn and cottonseed meal from weaning until slaughter; and (2) a pasture system of small grain-clover swards, which were grazed from November until the forage was depleted (late May or early June), after which calves were fed harvested feedstuffs until they were judged to have reached Good-Choice slaughter grades.

Calves sired by Angus or Charolais bulls and out of Angus x Hereford cows were used for the study. They were born in the fall (October 15—January 15) and weaned at approximately 250 days of age. Following weaning, all calves were full-fed corn silage with about 4 lb. of corn and 1.5 lb. of cottonseed meal daily for about 45 days (September 1—late October). Grazing began October 29, 1976, and November 3, 1977.

Silage Fed All Calves

In 1976-77, the drylot calves were limit-fed silage, with corn fed to appetite. As a result, these calves ate equal quantities of silage and corn (14 lb. per head daily) plus 1.5 lb. cottonseed meal. This feeding plan caused several cases of founder late in the feeding period; therefore, relatively more silage was fed in the 1977-78 drylot system. Silage intake during 1977-78 averaged about 25 lb. daily, with a maximum of 15 lb. of corn, and founder was not a problem.

Calves on the pasture program were full-fed silage with 4 lb. of corn and 1.5 lb. of cottonseed meal per head daily during January-February when grazing was not sufficient. At the end of grazing, calves were judged to be less than Good or Choice grades, therefore they were finished in drylot. In 1976-77, they were fed limited silage with corn and cottonseed meal during the 56-day, post-grazing, finishing period. A blended high-roughage mixture (30% hay, 70% concentrate) was fed during the 86-day, post-grazing period of 1977-78. The calves grown on pasture were slaughtered in late July or early August, whereas those grown and finished in drylot were finished for slaughter by late May.

Initial weights of steers averaged 600-650 lb. and heifers averaged 575-600 lb. Steers averaged gaining 2.1 lb. daily during the 200-day drylot feeding period. Comparable heifers gained 1.82 lb. daily when fed similarly. Average rate of gain was slower during the 265-day period that pasture-system calves were kept, 1.66 and 1.36 lb. per day, respectively, for steers and heifers.

Final Weights Similar

Final weights attained under the two plans were similar, averaging about 1,030 lb. for steers and 945 lb. for heifers, but slaughter grades were quite different. Nearly all of the cattle from the drylot system finished with Choice carcasses (91%), as compared with 51% for cattle on the pasture program. The remainder graded Good.

As a general rule, heifer carcasses graded one-third of a quality grade higher than steers (low Choice vs. high Good). Usually, calves by Angus sires graded about one-third grade higher than those by Charolais sires (low Choice vs. high Good).

Pasture Replaces Much Feed

The stocking rate on cool season pasture was 0.76 acre per animal. This amount of grazing substituted for 1,290 lb. of corn silage, 2,118 lb. of shelled corn, 167 lb. of cottonseed meal, and 386 lb. of fattening mixture. Based on current market prices, the ¾ acre of grazing substituted for $159 worth of feed. Stated another way, an acre of grazing would be worth $209 based on its substitution value at current market prices. Cost of pasture is about $100 per acre.

In the study reported, Good and Choice slaughter beef was produced using either a corn silage system or a small grain-clover pasture system. However, a higher percentage of animals in the drylot group produced Choice carcasses. The pasture program required about 65 days longer to produce finished beef, but it was more economical using current price inputs.

Calves on the pasture system were not finished for slaughter at the end of grazing and required about 70 days of feeding to reach weight and grade comparable to those fed on the silage plan. When fed or grazed for the same length of time, heifers averaged 85 lb. lighter than steers, but their carcasses were one-third of a grade higher (low Choice vs. high Good).

CAPTAFOL SPRAY Effective Against SOOTY BLOTCH AND FLYSPECK of Apple

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SOOTY BLOTCH AND FLYSPECK are problem diseases on apples grown in humid areas, such as Alabama. Besides having an unappealing appearance, heavily diseased fruit may fall several weeks earlier than disease-free fruit.

Spray schedules recommended in apple growing areas call for fungicide application for control of sooty blotch and flyspeck, generally to begin with the second to fourth cover spray and continue until harvest. But this schedule does not appear to coincide with development of the disease in Alabama. The fungi that cause sooty blotch and flyspeck (*Gloeodes pomigena* and *Zygophiala jamaicensis*, respectively) are active during humid, cool spring weather, but may be entirely absent during hot, dry summer weather.

TABLE 1. SOOTY BLOTCH AND FLYSPECK DEVELOPMENT ON APPLES, 1975

Treatment[2]	Disease index, bagged and unbagged[1]		
	Blossoms bagged	Juvenile apples bagged	Not bagged
Sooty blotch			
Benomyl 50W	1.51	1.70	4.95
Captafol 4F	.60	.56	.80
Check	1.52	1.94	5.00
Flyspeck			
Benomyl 50W	.32	.25	3.89
Captafol 4F	.09	.07	.24
Check	.16	.22	3.61

[1]Scale of 0—5: 0 = no disease, 1 = trace, 2 = 2—10%, 3 = 11—25%, 4 = 26—50%, 5 = 51—100% of fruit surface diseased.
[2]Rates were 0.5 lb. of benomyl and 5 qt. of captafol, each with 1 qt. of nonphytotoxic oil, per 100 gal. of water.

TABLE 2. EFFECTIVENESS OF FUNGICIDE APPLICATIONS FOR CONTROL OF SOOTY BLOTCH AND FLYSPECK OF APPLES, 1976 AND 1978

Fungicide, rate per 100 gal.	Disease index[1]	
	Sooty blotch	Flyspeck
1976		
Captafol 4F, 5 qt.	1.09	0.52
Captafol 4F, 5 qt., followed by metiram 80W, 2 lb.	1.63	.97
Check	5.00	4.00
1978		
Captafol 4F, 5 qt., followed by metiram, 80W, 2 lb.	1.01	.16
Dodine 65W, 0.5 lb., followed by metiram 80W, 2 lb.	1.43	.28
Check	4.73	3.62

[1]Scale of 0—5: 0 = no disease, 1 = trace, 2 = 2—10%, 3 = 11—25%, 4 = 26—50%, 5 = 51—100% of fruit surface diseased.

Early sprays with captafol (Difolatan 4F®) appeared to provide needed control of the two diseases in 1975, 1976, and 1978 experiments by the Auburn University Agricultural Experiment Station at the North Alabama Horticulture Substation, Cullman. Other fungicides tested were benomyl (Benlate 50W®) in 1975 and dodine (Cyprex 65W®) in 1978. Treatments using captafol and metiram 80W (Polyram 80W®) and dodine and metiram 80W also were tried in 1976 and 1978.

Fungicides Compared

In 1975, benomyl (0.5 lb. plus 1 qt. non-phytotoxic oil per 100 gal. water) and captafol (5 qt. plus 1 qt. non-phytotoxic oil per 100 gal. water) were applied at the silver tip, tight cluster, and petal fall stages of growth to Richared Red Delicious apples. Subsequently, Golden Delicious apple pollen was applied to the stigmas of blossoms on sprayed and unsprayed trees (with a camel hair brush). The blossoms were covered with plastic bags to make sure that later infection did not occur.

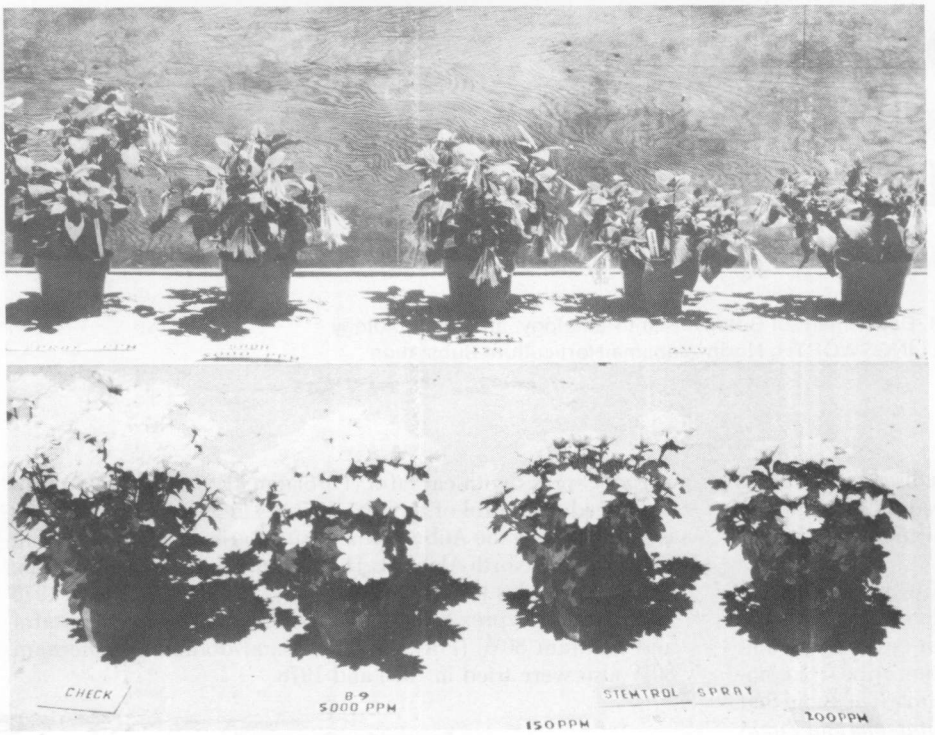
The next year, captafol was applied during the pink and full bloom stages to 12 Red Delicious trees. Six trees received no additional fungicide, whereas the other six were sprayed with metiram during the cover spray period. In 1978, captafol was applied at the green tip stage, followed by metiram cover sprays. Dodine was applied during bloom, also followed by metiram cover sprays. Unsprayed trees served as checks during year year.

Captafol Reduced Disease

Results of the 1975 test showed no disease control from benomyl, but captafol reduced indices of both sooty blotch and flyspeck below those of the controls, table 1. Development of the diseases on apples grown in plastic bags indicated that the inoculum of both fungi was on the twigs, foliage, or blossoms at the time they were covered.

In the 1976 and 1978 tests, use of captafol resulted in disease indices of only 0.5 to 1.63 (0.1 to 5.0% diseased fruit surfaces), table 2. Chemical toxicity showed up as fruit russet when captafol was used after the green tip stage of growth.

Early application of captafol at the green tip stage showed promise as an eradicant to prevent infection by the sooty blotch and flyspeck pathogens. The single application recommended by the manufacturers of captafol for control of apple scab permitted only trace amounts of sooty blotch and flyspeck when followed by appropriate cover sprays.



Stemtrol drenches were observed to delay flowering (top) and stemtrol sprays were comparable to the standard commercial retardant treatment (bottom).

STEMTROL

A New Growth Retardant for Flowering Potted Plants

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Department of Horticulture

GROWTH of such flowering potted plants as chrysanthemum and fuchsia may be controlled readily by Stemtrol[1] — a new growth retardant.

Fuchsia, a plant that does not respond well to growth retardants, has shown a cultivar response to Stemtrol. Sprays reduced the height of the cultivars Bagdad, Winston Churchill, and Gartenmeister Bonstedt plants but were ineffective on Dollar Princess plants. B-Nine and A-Rest[1] (another commercially available broad spectrum retardant) were sprayed on the plants to give the following comparison:

Spray treatment	*Cultivar height, in.*			
	Bagdad	*Dollar Princess*	*Gartenmeister Bonstedt*	*Winston Churchill*
None	16.0	12.0	16.0	12.8
100 p.p.m. Stemtrol	14.8	12.8	13.2	10.4
150 p.p.m. Stemtrol	14.8	13.6	13.2	11.2
200 p.p.m. Stemtrol	13.6	12.4	13.2	11.2
5,000 p.p.m. B-Nine	14.4	12.4	14.8	13.6
150 p.p.m. A-Rest	16.4	13.2	14.0	11.6

[1]Stemtrol, trademark of Hoffmann-LaRoche, Inc., Nutley, New Jersey for 1—(3, 7-dimethyloctyl)—1—(2-propenyl piperidinium bromide). B-Nine trademark of Uniroyal Chemical, Bethany, Connecticut, for butanedioic acid mono (2,2-dimethylhydrazide). A-Rest, trademark of Elanco Products Co., Indianapolis, Indiana, for α-cyclopropyl-α-(-p-methoxyphenyl)—5-pyrimidine-methanol.

In separate experiments at the Auburn University Agricultural Experiment Station, the chrysanthemum cultivars Bright Golden Yellow Princess Anne, Sunny Mandalay, and Orange Bowl were treated with Stemtrol spray and drench. Treatments were applied 2 weeks after plants were pinched when new shoots were 1-1¼ in. long. Plants were sprayed until incipient runoff using approximately 0.4 oz. of solution per pot of five plants. Drenches were applied to the growing medium consisting of equal parts of soil, peat moss, and pine bark at the rate of 4 oz. per 6-in. pot.

In the spray experiments, Stemtrol at the rates of 50, 100, 150, and 200 p.p.m. was compared to no treatment and 5,000 p.p.m. B-Nine[1] (the standard commercial treatment). Plants sprayed with Stemtrol and B-Nine had deep, dark green foliage.

A 150 p.p.m. Stemtrol spray gave adequate height control as shown here:

Spray treatment	*Plant height, in.*		
	Orange Bowl	*Bright Golden Yellow Princess Anne*	*Sunny Mandalay*
None	14.3	14.0	14.3
50 p.p.m. Stemtrol	12.8	11.8	12.8
100 p.p.m. Stemtrol	11.7	10.8	11.7
150 p.p.m. Stemtrol	11.1	10.8	11.1
5,000 p.p.m. B-Nine	10.4	10.0	10.6

The experiments on Orange Bowl and Sunny Mandalay plants were conducted during April to August, indicating that Stemtrol is effective at high growing temperatures.

Results from drench experiments show that Stemtrol is an effective drench on Bright Golden Yellow Princess Anne chrysanthemum plants:

Drench treatment	*Plant height, in.*	*No. of flowers per plant*
None	15.8	3.3
50 p.p.m. Stemtrol	14.8	3.0
100 p.p.m. Stemtrol	13.2	3.1
200 p.p.m. Stemtrol	11.5	3.4
5,000 p.p.m. B-Nine	11.9	3.1

Stemtrol drenches were also observed to delay flowering in chrysanthemum.

Stemtrol has also been tested on petunia, poinsettia, English ivy, dieffenbachia, tomato, and Southern bleeding heart plants with mixed results. Stemtrol sprays reduced the growth of petunia and poinsettia but caused severe damage to foliage. Stemtrol sprays and drenches have not given growth control on English ivy, dieffenbachia, tomato, and Southern bleeding heart. The mechanism of Stemtrol action is not known. It represents a new class of retardants and may not be an anti-gibberellin like B-Nine and A-Rest.

In conclusion, Stemtrol is an effective growth retardant on certain plants and cultivars. It is effective as a spray and drench and at high temperatures. At present, an experimental use permit has been obtained for Stemtrol in the United States.

"Field Crop Insects" May Become "FOREST INSECTS" in Forest Tree Nurseries

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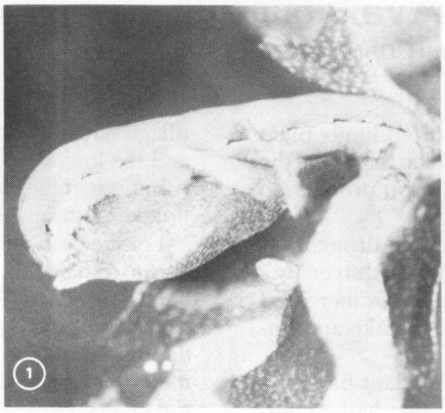
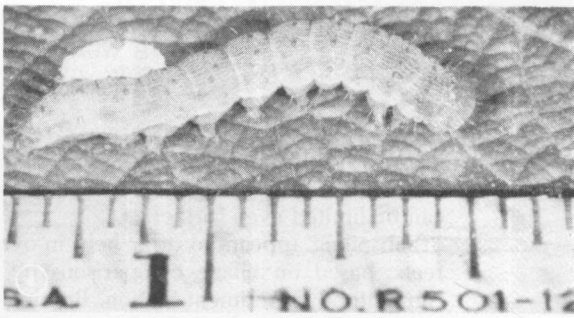
FOREST TREE nurseries mass produce seedlings for reforestation and ornamental plantings. Historically production has been predominantly pine, but in recent years, interest in hardwood reforestation using nursery-grown seedlings has increased and production of these species has expanded. Insect pests of pine seedlings are well defined, but those associated with hardwood seedlings are relatively unknown. Consequently, a study was conducted in 1977-78 in one industry and three state nurseries on insect pests of nursery-grown hardwood seedlings.

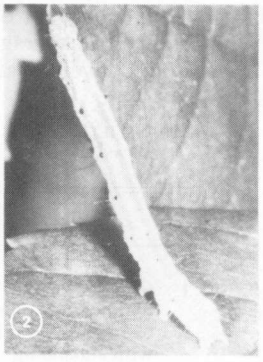
Results of these nursery studies revealed the presence of approximately 54 species of insects causing or associated with damage to seedlings of some 24 different deciduous plant species. Many insects involved were species previously known to feed on deciduous trees and shrubs or belonged to insect groups which contained some species known to have this habit. Several species, however, were interestingly conspicuous by their presence in an "uncommon" habitat. Reference is to six common and important field-crop insects noted for their damage to such crops as cotton, soybeans, and corn. These were beet armyworm, soybean looper, fall armyworm, corn earworm, tobacco budworm, and yellowstriped armyworm. Larvae of these species fed on foliage of several seedling species and caused typical caterpillar damage. Early instar larvae of fall armyworm also fed on seedling stems.

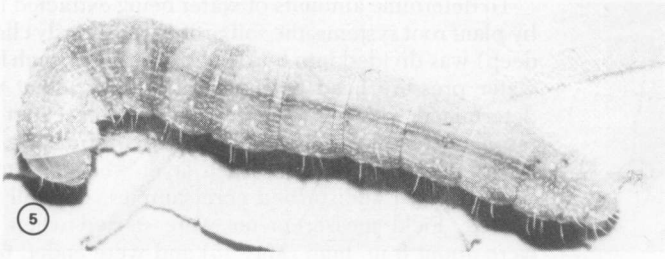
Beet armyworm, figure 1, was the most abundant of the field-crop species, reaching a peak population at one time of 110 larvae per 100 sq. ft. of nursery bed. It occurred on 11 seedling species, including white and water oak, ash, tuliptree, dogwood, and sycamore. Larvae were initially noted early in the growing season — May and June — and were present through August. Early occurrence when seedlings are small and foliage is limited could increase this insect's potential as a serious pest. Soybean looper, figure 2, and fall armyworm, figure 3, were fairly abundant with peak population densities of 55 and 33 larvae per 100 sq. ft., respectively. Both species occurred in late season, July through September. Soybean looper was found on tuliptree, ash, and catalpa; fall armyworm on sycamore, tuliptree, and water oak. Corn earworm, figure 4, tobacco budworm, figure 5, and yellowstriped armyworm, figure 6, populations were relatively low, 4 to 13 larvae per 100 sq. ft. Earworm was collected only from red oak, with budworm and yellowstriped armyworm occurring on several hosts. Of the six species, only beet armyworm, soybean looper, and fall armyworm caused sufficient damage to warrant application of control measures.

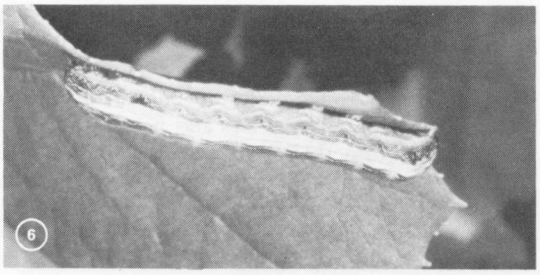
Adults of these insects apparently moved to nurseries from surrounding fields of cotton, soybeans, and corn. Oviposition occurred and larvae of each species completed development on seedling foliage, indicating suitability of seedlings as hosts.











FIGS. 1-6. (1) Beet armyworm larva on autumn olive; (2) soybean looper larva on green ash; (3) fall armyworm larva feeding on tulip tree foliage; (4) corn earworm larva on sycamore; (5) tobacco budworm larva on Chinese chestnut; and (6) yellowstriped armyworm larva on sycamore.

Field crops may still be preferred hosts for these insects; however, it should be noted that all have great reproductive potential, thus could possibly become serious pests in forest tree nurseries during periods of high population.

Effect of Tillage on Availability of Soil Water for Corn Growth

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DROUGHT DURING THE GROWING SEASON often limits plant growth. If there is a hard pan near the soil surface to reduce the amount of soil water available to plant roots, crop production can be limited even further.

Subsoiling appears to offer help in overcoming drought effects, based on tillage comparisons by Auburn University's Agricultural Experiment Station. Rooting depth was increased by subsoiling, which resulted in greater water uptake and improved production.

The field experiments were conducted at the Plant Breeding Unit, Tallassee, on a Cahaba sandy loam soil that had a compacted layer beginning abruptly at 6 in. (depth of disking) and extending to a depth of 12 in. (about 4 in. below the depth of plowing).

Tillage treatments compared were:

1. Conventional tillage (turning 8 in. deep and disking to 6-in. depth) without subsoiling[1]
2. Conventional tillage (turning 8 in. deep and disking to 6-in. depth) with subsoiling[2]
3. No tillage without subsoiling[1]
4. No tillage with subsoiling[2]

The corn (Pioneer 3369A) was planted April 24, 1978, in 50-ft. long rows spaced 36 in. apart. Fertilizer and herbicides were applied according to recommendations. The conventional tillage without subsoiling and conventional tillage with subsoiling plots were cultivated twice during the growing season.

To determine amounts of water being extracted from the soil by plant root systems, the soil profile (arbitrarily chosen as 56 in. deep) was divided into 8-in. thick layers. For each layer the soil water pressure head and the soil water content values were determined with tensiometers and neutron scatter equipment, respectively. The hydraulic conductivity function and the soil water retention curve for each layer were determined in the laboratory on undisturbed core samples. Rainfall was also recorded. Field measurements were started when corn plants were about 8 in. high (May 15) and were ended 60 days later when water-use patterns indicated little uptake of soil water. At the end of the growing season, pits were dug in each plot for observation of root distribution in the soil profile.

The manner in which soil water data were collected necessitated the comparison of water-use data on the basis of ear weight differences. The tensiometers and neutron-probe access tubes were installed directly between healthy corn plants. Therefore, water movement measurements were made on a plant basis and not on a plot basis. The table reflects (as indicated by number of ears per row) the poorer stand with subsoiling and/or no tillage than with conventional tillage without subsoiling.

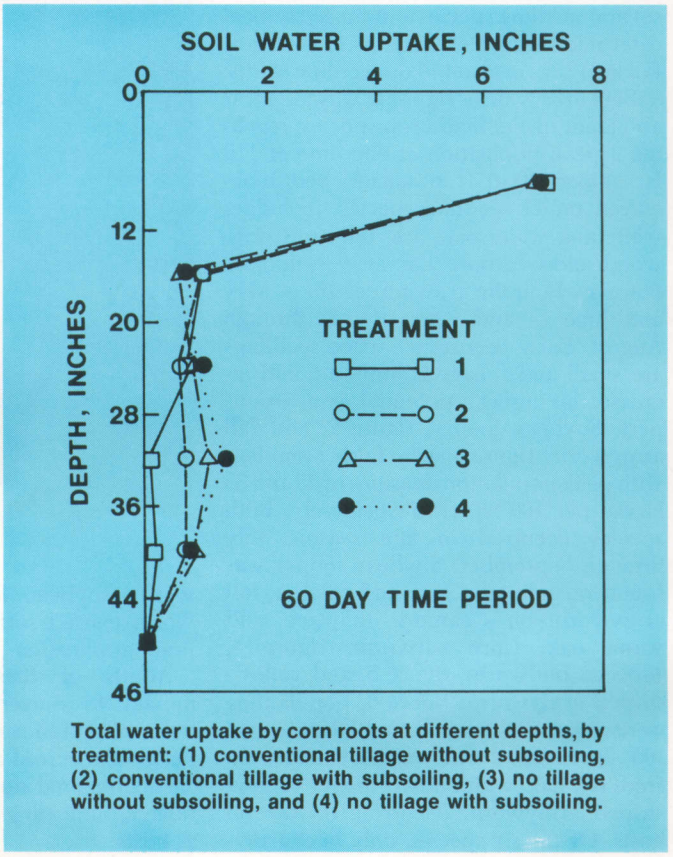
Yields for the different tillage treatments are presented in the table, with corresponding water consumptions by depth given in the chart. The no tillage with subsoiling treatment, which resulted in the highest yield on a weight per ear basis, also resulted in the greatest water uptake (10.6 in.). The conventional tillage with subsoiling and the no tillage without subsoiling treatments resulted in similar weight per ear and almost identical water uptake values (10.0 and 10.2 in., respectively). The conventional tillage without subsoiling treatment resulted in the smallest ears and the lowest water uptake (8.9 in.). Observations of root distributions at the end of the growing season agreed with the water uptake patterns of the different layers.

For the particular soil studied, and for a relatively dry growing season (5.6 in. rain from May 10 to July 16, 1978), subsoiling evidently permitted greater root penetration into the 20- to 40-in. soil layers and thus allowed greater water uptake at these depths. No tillage with subsoiling was the most effective tillage method in permitting water uptake by the roots from the lower soil layers. However, subsoiling would be of less benefit during years when rainfall is more nearly adequate for the crop.

Overall yield data for eight locations over a 3-year period showed an average yield increase of 25-45% due to subsoiling of both conventional tillage and no tillage treatments.

MEAN YIELD OF CORN BY TREATMENT FOR PLOTS ON WHICH SOIL WATER MEASUREMENTS WERE OBTAINED, MEAN OF FOUR 25-FT. ROWS, PLANT BREEDING UNIT, TALLASSEE, 1978

Treatment	Yield per row	Ears per row	Weight per ear
	Lb.	*Lb.*	*Lb.*
1. Conventional tillage without subsoiling	7.4	27.0	0.28
2. Conventional tillage with subsoiling	7.9	21.5	.37
3. No tillage without subsoiling	6.6	20.0	.33
4. No tillage with subsoiling	7.6	19.0	.40



Total water uptake by corn roots at different depths, by treatment: (1) conventional tillage without subsoiling, (2) conventional tillage with subsoiling, (3) no tillage without subsoiling, and (4) no tillage with subsoiling.

[1]In-the-row subsoiler was used at time of planting; chisel width = 2 in., chisel depth = 5 in.

[2]In-the-row subsoiler was used at time of planting; chisel width = 2 in., chisel depth = 14 in.

IMMUNIZATION of Broiler Breeder Replacements Against FOWL CHOLERA

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FOWL CHOLERA remains an important disease of broiler breeder replacements in some areas of the Southeastern United States. Although a commercially prepared inactivated vaccine that reduces morbidity and mortality associated with this disease is available, problems with administering it has limited its usefulness. This vaccine must be given to each bird by injection, twice at 4-week intervals, and the labor involved with catching and handling is costly.

New Vaccine Tried

Recently a new commercial vaccine (Orachol®)[1] containing a live virulent strain of *Pasteurella multocida* (the bacterium that causes the disease) was developed for protecting turkeys against fowl cholera. This product has been effective in turkeys when administered in the drinking water, but has failed to adequately protect chickens against cholera when given this way. Effectiveness of Orachol® in protecting broiler breeder replacements against fowl cholera was determined in a test at the Auburn University Agricultural Experiment Station using a single injection of the vaccine.

Commercially-reared broiler breeder replacements (Hubbard x Hubbard) from the replacement farm of an integrated company in Alabama were vaccinated at either 8 or 9 weeks of age with Orachol®. To minimize handling of the birds, this vaccine was mixed with a commercially prepared fowl pox vaccine and given by wing web stab, a method commonly used to administer fowl pox vaccine alone. The standard dose of pox vaccine and one-fifth of the Orachol® dose recommended for turkeys was mixed with the pox diluent and given by a trained vaccination crew.

Vaccinated, Unvaccinated Birds Challenged

Representative samples of unvaccinated and vaccinated birds were transported to Auburn and placed in wire battery cages. Half of the birds in each group were then challenged with *Pasteurella multocida* strain X-73 (10^8 organisms swabbed on the palatine cleft).

All birds were weighed just before and 7 days after challenge.

[1]American Scientific Laboratories, Madison, Wisconsin.

MORTALITY FROM CHALLENGE WITH *PASTEURELLA MULTOCIDA* IN BROILER BREEDER REPLACEMENTS VACCINATED WITH ORACOL®

Treatment group		Mortality
Orachol	Challenge	
	TRIAL 1[1]	
No	no	0 of 10— 0%
Yes	no	0 of 10— 0%
No	yes	6 of 10—60%
Yes	yes	3 of 10—30%
	TRIAL[2,3]	
No	yes	4 of 4—100%
Yes	yes	6 of 10— 60%
	TRIAL[4]	
Yes	no	0 of 20— 0%
No	yes	15 of 20—75%
Yes	yes	4 of 20—20%

[1]Straight run broilers were vaccinated at 53 days of age and challenged 32 days after vaccination.
[2]Straight run broilers were 6 weeks of age when challenged.
[3]Pullets were vaccinated when 11 weeks old and challenged 7 weeks after vaccination.
[4]Straight run broilers were vaccinated at 8 weeks of age and challenged 3 weeks after vaccination.

Dead birds were examined and impression smears taken from the liver were stained and examined for presence of *Pasteurella* type organisms. Selected specimens were also taken for bacterial isolation on appropriate media.

Three separate challenge trials were undertaken with different replacement flocks. In all trials, birds dying 24 hours or more after challenge had gross lesions suggestive of cholera. Impression smears and isolation cultures from these birds were positive for *Pasteurella*.

Vaccination Reduced Mortality

Results given in the table indicate success of the vaccination. In trial 1 there was a 50% reduction in mortality in vaccinated birds, trial 2 had a 40% reduction, and trial 3 a 70% reduction when compared to mortality of the control birds that were challenged but had not been vaccinated with Orachol®. In two of the three trials, Orachol® did not meet the U.S. Department of Agriculture's recommendations that 80% of the chickens should be protected from clinical disease. However, it is noted that the challenge used in these immunity checks was considerably more severe than what is typically encountered under field exposures.

Mixing with Fowl Pox Vaccine Suggested

As stated in Auburn recommendations, if Orachol® is selected for use in a vaccination program it should be mixed with fowl pox vaccine and given by wing web stab to breeder replacement birds between 8 and 12 weeks of age on farms with a history of cholera. Farms with a history of severe cholera may want to give a second vaccination with Orachol® only, by injection, approximately 4 weeks after the first. If the second injection must be used, cost of using this vaccine should be compared to the cost of the inactivated product.

Dates for Planting CORN In Alabama

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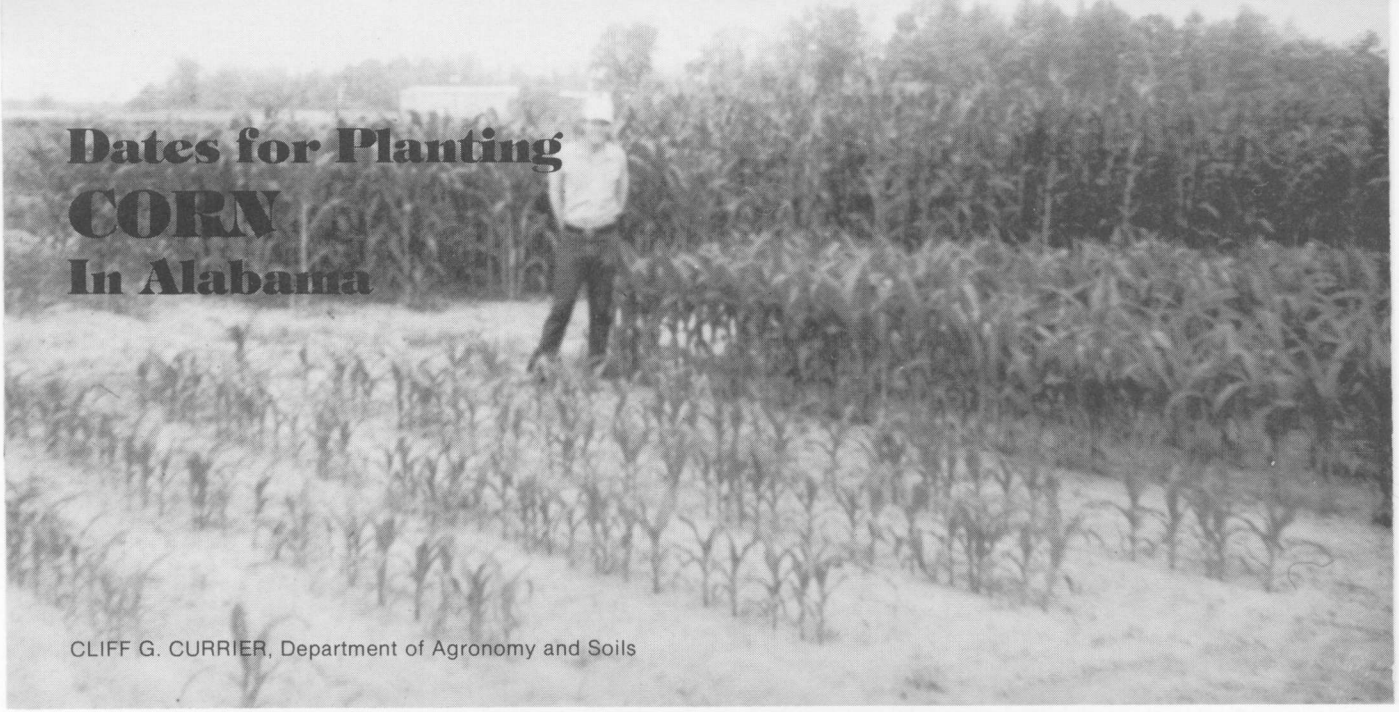

Corn plots at E. V. Smith Research Center showing four dates of planting corn.

SELECTION of the best hybrid and dates of planting are two major decisions made by farmers to maximize corn yields. Hybrids differ in yield potential and the number of days required to reach maturity. Relative yields and maturities are published annually in the Auburn University Agricultural Experiment Station Corn Hybrid Report.

It is desirable to plant corn at a time to ensure adequate rainfall during the critical 3- to 4-week period of flowering, pollination, and grain fill. However, rainfall distribution in any one season is unpredictable. Experience has shown that the best time to plant corn is soon after the average date of the last frost in the spring. Moisture is generally adequate at this time for germination and plant establishment. Published results by this Station from date of planting tests in 1957 suggest that the optimum periods for planting corn are March 20 to April 20 for southern Alabama and April 1 to April 30 for central and northern Alabama. In 1977, date of planting corn studies were initiated to determine how several currently recommended hybrids responded when planted on dates ranging from mid-February to mid-June.

TABLE 1. AVERAGE NUMBER OF DAYS FROM PLANTING REQUIRED FOR FOUR HYBRIDS TO REACH MIDSILK, COMBINE READY, AND RANGES IN COMBINE READY VALUES

Hybrid	Midsilk average, days	Combine ready average, days	Combine ready range, days
	No.	*No.*	*No.*
Coker 16	66	126	115-138
Pioneer 3369A ..	72	130	116-143
Pioneer 3147 ...	77	136	123-149
McNair 508	80	138	126-150

The date of planting corn studies were conducted at three locations in northern, four in central, and three in southern Alabama. Two early-maturing hybrids were chosen from Pioneer 3369A, Coker 16, and Funk's G-4507. Two late-maturing hybrids were chosen from Pioneer 3147, McNair 508, Funk's G-4864, and Funk's G-4848. The four hybrids were planted on three or five dates at approximately 2-week intervals. The average number of days from planting until one-half of the plants in the plot produced silks (midsilk), and the number of days from planting until the grain reached 25% moisture (combine ready) for several of these hybrids are presented in table 1. Hybrids, on the average, matured 4 to 6 days earlier for every 2-week delay in planting. The lower values in the combine ready ranges were obtained from the latest planting dates.

Two-year averages of yield data are presented in table 2. It is recognized that 2 years of data are not an adequate basis for recommendation. Data indicated that early-maturing hybrids produced their highest yields in the southern region when planted in late February or March and during March for late-maturing hybrids. Early-maturing hybrids planted in March and late-maturing hybrids planted March 22 produced highest yields in the central region. In the northern region the highest corn yields resulted when corn was planted at the first date of planting, April 8. When planting was postponed, beyond late March in central and southern Alabama or beyond early April in northern Alabama, yields declined. The early- and late-maturing hybrids used in these tests were similar in yield response to all planting dates.

TABLE 2. TWO-YEAR AVERAGE REGIONAL YIELDS FOR EARLY- AND LATE-MATURING HYBRIDS PLANTED ON SEVERAL DATES IN ALABAMA IN 1977-78

Region and hybrid maturity	Number of tests	Dates of planting							
		2/23	3/08	3/22	4/08	4/24	5/07	5/20	6/12
Northern Alabama[1]	5								
Early					90.7	71.4	----	74.0	61.5
Late					92.2	82.3	----	68.9	56.1
Central Alabama[2]	6								
Early			64.1	73.5	45.3	40.8	----	31.6	----
Late			48.2	63.1	43.2	47.8	----	38.6	----
Southern Alabama[3]	8								
Early		90.4	91.4	100.3	79.1	79.1	42.9	----	----
Late		79.8	90.1	93.9	79.7	74.9	53.3	----	----

[1]Sand Mountain, Tennessee Valley, and Upper Coastal Plain substations.
[2]Lower Coastal Plain and Piedmont substations, Prattville Experiment Field, and E. V. Smith Research Center.
[3]Gulf Coast and Wiregrass substations and Monroeville Experiment Field.

An Objective Method of Evaluating CREDIT WORTHINESS

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THE INCREASED VOLUME of agricultural borrowing in recent years has placed added pressure on lenders to effectively evaluate all loans. Borrowers, as well as financial institutions, benefit if the volume of bad loans is reduced. If all 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, the costs of borrowing which must cover loan loss rates, are minimized.

Statistical Analysis Valuable

Statistical analysis is of great value in determining and evaluating the most important characteristics of a set of data. A technique called discriminant analysis is particularly useful in determining which characteristics most strongly differentiate between two or more groups of data. The technique is ideally suited for objective credit analysis since the goal for such research work would be to determine which characteristics are most useful in predicting whether a borrower will eventually be classified in either of the two groups—good credit risk or bad credit risk.

To analyze characteristics of Alabama agricultural borrowers, data were collected by researchers in the Department of Agricultural Economics and Rural Sociology from all eight Production Credit Associations in the State. Each association president was asked to provide data on existing loan accounts. PCA personnel recorded necessary information for each loan on a questionnaire so that confidentiality of the borrower records would be preserved. Data on a total of 220 loans were obtained — the lenders classified 143 of these as acceptable loans and 77 as problem loans.

Data Collected Descriptive

Data collected from the loan accounts contained several characteristics concerning both the loan and the borrower. The following variables were constructed from the data for use in the analysis: Age of operator; acres owned; acres rented; current assets divided by current liabilities; current liabilities divided by total liabilities; total assets divided by net worth; current liabilities divided by net worth; total liabilities divided by total assets; underlying security value divided by total loan commitment; total loan commitment divided by net worth; total loan commitment divided by current assets; total liabilities divided by net worth; loan repayment made divided by loan repayment anticipated; loan repayment made plus marketable inventory divided by loan repayment anticipated; and loan repayment anticipated divided by total assets.

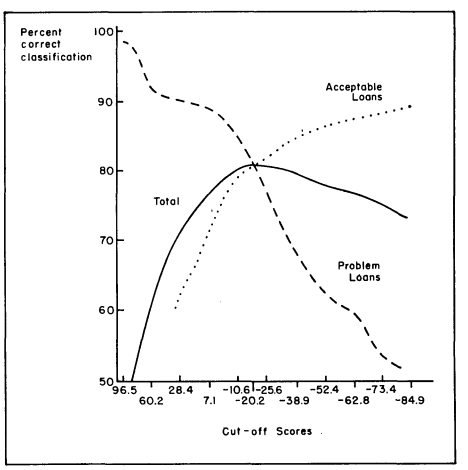
These variables were analyzed using step-wise discriminant analysis to determine which were the most significant in determining whether a loan would be classified as acceptable (requiring little, if any, repayment supervision) or problem. Of the 15 variables considered, two appeared to have the greater discriminating power. These were: total liabilities divided by total assets (X^1) and loan repayment anticipated divided by total assets (X^2).

Both significant variables reflect that the debt load and associated repayment requirement are important in predicting loan repayment success. The discriminant equation—SCORE = 186 − 460.8 X_1 − 161.2 X_2—which was derived from the sample data indicated that as the levels of debt and expected repayment increase then the score for the particular loan would decline. If the errors of misclassifying a problem loan as acceptable and an acceptable loan as problem were considered to be of equal severity then the cut-off score for predicting the eventual outcome of a loan would be −20.2. If the calculated score for a loan fell below this level, then past loan experience and characteristics of loans and borrowers would indicate that problems in repayment might be expected. If the score was above this level, then the account would likely be good. Tests with this estimated scoring equation on the sample data indicated that it correctly classified 88% of the loan accounts.

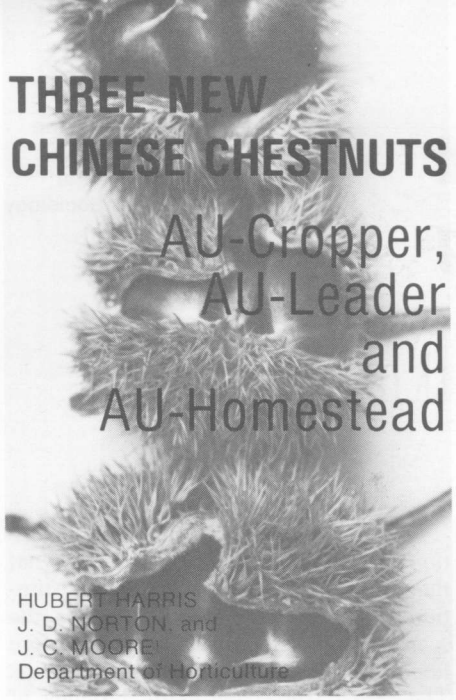
Lending Policies Are Important

Lending policies of the financial institutions are important in determining what the cut-off score should be. If the institution is relatively conservative, then the score should be relatively high. More liberal policies would justify a lower score. The −20.2 value represents a policy of treating misclassification of good and bad loans equally. The figure represents the trade off that exists between correct classification of good and bad accounts. If the required score is raised, then the portion of bad loans classified correctly increases and the percentage of good loans classified correctly decreases. Lower cut-off values have an opposite effect.

Objective credit scoring techniques can be an aid to credit analysts. These tools will in no way replace the valuable judgment of the trained professional, but will assist him in categorizing his accounts. By being able to classify an account with little effort, he will be able to spend more time working with customers who are in financial trouble and need assistance.



Percentage of correct classification for acceptable, problem, and total loans at various cutoff scores.



THREE NEW CHINESE CHESTNUTS

AU-Cropper, AU-Leader and AU-Homestead

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J. C. MOORE[1]
Department of Horticulture

THE CHINESE CHESTNUT, *(Castanea mollissima)* Blume, was introduced into the United States in 1907 by the U.S. Department of Agriculture with small plantings initially made over a wide area. Progress has been made in breeding and selection for improved varieties, and this appears to offer the greatest opportunity for further improvement of this crop.

The Chinese chestnut is resistant to blight and the best seedlings and varieties bear abundant crops annually. Nuts of the better selections are excellent in quality. Annual yields of 50 to 70 lb. of nuts per tree, from 10- to 12-year-old trees, have been reported. Yields above 130 lb. per tree have been obtained from mature Chinese chestnut trees at Auburn. A gross income of $1,320 to $2,850 per acre may be received for an orchard in full production based on earlier figures by Davidson and Reed. The tree grows well throughout the southern part of the natural range of the American chestnut and southward to the Gulf Coast.

A planting of Chinese chestnuts has been growing at the Auburn University Agricultural Experiment Station since 1935, with attention being given to seedling evaluation, propagation, and utilization. The first planting was established at the U.S. Department of Agriculture Hillculture Farm under the supervision of the late J. C. Moore. The Hillculture Farm became the Main Station Horticulture Farm when expansion of the University required this relocation.

Three blight resistant seedlings that were selected for nut appearance, size, and quality are being released. They are the product of controlled mass pollination and selection from two generations of approximately 2,000 seedlings.

[1]Deceased

TABLE 1. YIELD AND NUT SIZE OF CHINESE CHESTNUTS, AUBURN, ALABAMA, 1967-1975[1]

Cultivar	Date seed planted	Date top worked	Nut size	Yield by years 1967	1968	1969	1970	1971	1974	1975
			No./lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Black Beauty	1935	----	41	----	112.9	55.5	----	----	----	----
AU-Cropper	1935	----	38	107.0	70.6	89.3	71.6	130.9	79.4	132.0
AU-Cropper	1954	1965	41	----	----	39.0	45.3	60.6	65.2	88.2
AU-Leader[2]	1954	----	35	----	----	19.3	25.9	47.5	36.1	48.0
AU-Leader	1954	1967	34	----	----	----	2.8	27.0	25.9	46.8
AU-Homestead	1954	----	39	42.5	50.4	71.0	62.5	88.3	65.3	98.0
AU-Homestead	1954	1965	41	8.4	10.1	11.3	8.9	25.6	24.5	25.3

[1]Records are on single trees. Maintenance has been limited to occasional mowing. Nuts removed by squirrels and individuals not recorded.
[2]Original tree of AU-Leader was top worked to another seedling by mistake. Therefore, a delay in production resulted.

AU-Cropper was selected and evaluated as seedling 35-A-4-4. It consistently produces high yields of excellent quality nuts, table 1. The nuts are equal in size to commercial market chestnuts; the number per pound is 38. Color of the nuts is dark, chocolate brown (grayish brown 7.5 YR 3/2)[1] overlain with thin gray pubescence which is more prominent near the apex. They are glossy and attractive. Two to three nuts are present in a medium large burr. Nuts separate readily from the burr upon maturity and opening of the burr, table 2.

AU-Leader was selected and evaluated as seedling 54-13. It also produces high yields of excellent quality nuts. The nuts of AU-Leader are larger than those of AU-Cropper and AU-Homestead. The number of nuts per pound of AU-Leader is 35. Nut color is dark chocolate brown (grayish brown 7.5 YR 3/2) overlain with thin grayish brown pubescence which is more prominent near the apex. They are glossy and attractive. Two to three large nuts are held in an attractive medium size burr. Nuts separate readily from the burr upon maturity.

AU-Homestead was selected and evaluated as seedling 54-26. It also produces high yields of excellent quality nuts which mature over a relatively long period. This longer period of maturity would be desirable for the homeowner. The nuts are equal in size to commercial chestnuts; the number per pound is 39.

The nut color is dark, chocolate brown (moderate brown 5 YR 3/3) overlain with a grayish pubescence which turns white near the apex. This nut is darker and more glossy than AU-Cropper and AU-Leader. The large burr contains two to three nuts with fair separation of the nuts from the burr.

Trees of AU-Cropper, AU-Leader, and AU-Homestead should be available from nurseries for planting in the winter of 1980-1981.

A limited quantity of wood for propagation may be secured from J. D. Norton, Department of Horticulture, Auburn University, Auburn, Alabama 36830.

[1]Nickerson Color Fan, Maximum Chroma, 40 hues, Munsell Color Co., Inc.

TABLE 2. HARVEST DATES, NUT UNIFORMITY, AND BURR OPENING OF CHINESE CHESTNUTS, AUBURN, ALABAMA

Cultivar	Harvest dates 1967	1968	1969	1970	1971	Maturity date[1]	Nut uniformity[2]	Burr opening and nut shed[3]
Black Beauty (original)	10/1	10/8	10/17	----	----	E	G	1
Black Beauty (topworked)	----	10/12-10/20	10/15	----	----	E	G	1
AU-Cropper (original)	10/14	10/8	10/17-10/24	9/28-10/2	9/16-9/27	M	F	1
AU-Cropper (topworked)	----	----	10/15-10/17	9/24-10/2	9/16-9/30	M	F	1
AU-Leader (original)	----	----	10/15-10/23	9/24-10/2	9/17-9/27	M	G	1
AU-Leader (topworked)	----	----	----	9/24	9/17-9/27	M	G	1
AU-Homestead (original)	10/1-10/12	10/4	10/17-10/23	9/24-10/2	9/17-10/4	L	G	2
AU-Homestead (topworked)	10/12	10/30	10/23	9/25-10/2	9/20-10/5	L	G	2

[1]Maturity date: E = early; M = midseason; and L = late.
[2]Uniformity: G = good; F = fair; and P = poor.
[3]Burr opening and nut shed: 1 = excellent, burr opens well and nuts shed well; 2 = fair, burr opens fairly well, and 3 = poor, many burrs drop without opening.

Evaluation of Hybrid Sunfish

for Alabama Farm Ponds

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SMALL IMPOUNDMENTS in the Southeastern United States are usually stocked with largemouth bass and bluegill sunfish. In fertilized ponds, bluegills are stocked at a rate of 1,000 fingerlings per acre during November-February; bass fingerlings are stocked the following spring. One year after stocking, fish populations should be in balance. At this time bluegills average 0.25 lb. and approximately 6 in. in length. Bass typically weigh 0.75 lb. and measure 9 in.

Good fishing for harvestable size bluegills and bass can be maintained year after year if annual bass harvest is limited to 15-20 lb. per acre. Many bluegills escape predation without an adequate number of bass to prey on them. Too many bluegills in the pond results in competition for food and slow growth. Regulation of bass harvest, however, is difficult to achieve because of their desirability to fishermen and susceptibility to angling.

The use of hybrid sunfish with low reproductive potential was tested in ponds as an alternative to bluegill stocking. One hybrid of particular interest is that produced by crossing the green sunfish male and redear sunfish female. This hybrid is aggressive, has a large mouth similar to that of the green sunfish, feeds on a wide variety of organisms, and is said to grow rapidly. In experiments at the Auburn University Agricultural Experiment Station, hybrids were produced by stocking male green and female redear sunfish into a recently renovated pond. In this case the sex ratio of the hybrid population (F_1 generation) was 70:30 males to females.

The green x redear hybrid was stocked into 0.25-acre Station ponds at two densities (500 and 1,500 per acre), both with and without 100 bass per acre. Growth and reproduction of the hybrid and survival and growth of the bass were of special interest.

Periodic seining of the pond's fish populations (March-September) indicated that hybrid sunfish grew considerably faster in ponds stocked at the lower rate. The presence of bass in this case did not have an effect.

More sunfish reproduction (F_2 generation) was found in ponds stocked at the higher rate. A large number of hybrids stocked meant more females in the population and a greater potential for spawning. Bass were effective in reducing the number of young fish surviving in the ponds by 81% and 68% at the low and high stocking densities, respectively.

Survival of bass was reduced through competition with hybrid sunfish at the higher density. The large mouthparts of the hybrids allowed them to eat the same size food items as the bass. Only 40% of the bass survived in ponds stocked with 1,500 hybrids compared to 80% survival where only 500 hybrids per acre were present.

After 6 months of growth, 86% of the hybrids from the low stocking density were of harvestable size (6 in.) compared to only 16% from the high stocking density. Growth of bass was less than that expected from farm ponds stocked with bass and bluegills at the recommended rates.

Hybrids stocked at low densities can develop into a fishable population in a relatively short time. They were easily caught by fishing gear commonly used for bluegill.

Although excessive reproduction is not a problem, especially with bass present, the growth potential of the F_2 generation has not been adequately evaluated. Maintaining good fishing may depend on periodically restocking F_1 hybrids. These and other questions (feeding hybrid populations stocked at a high density, for example) are the subject of continuing sport fisheries research.

Increased length of promalin treated apple (right) in comparison with untreated one held at left shows how apple shape can be altered by growth regulators.

Apple Color and Shape Improved by Growth Regulators

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POOR FRUIT SHAPE and color limit the market potential of apples grown in the South. The high post-bloom temperatures cause fruit of Red Delicious apples to be flatter and lack the points near the fruit calyx that are typical of fruit grown in the Northwest. High night temperatures during the ripening season in the South limit red color development.

Fortunately for Southern apple growers, there are growth regulators that can be sprayed on the foliage to manipulate apple fruit color development, quality, shape, and maturity.

Ethephon is used to enhance red color development, fruit quality, and maturity.

Alar has been used to enhance red color, increase fruit firmness, and delay maturity. However, alar also reduces fruit elongation and percent soluble solids.

Foliar sprays of promalin have increased the prominence of the points near the fruit calyx, fruit length, fruit length-diameter (L/D) ratio, and fruit weight. But promalin does not alter fruit diameter or color.

Since no single growth regulator has all the desired effects, different combinations of the three regulators have been tried in Auburn University Agricultural Experiment Station research. Fruit shape, maturity, and red color development were compared for the different treatments in a test orchard at the Piedmont Substation, Camp Hill.

Promalin was applied as a foliar spray at the king blossom stage (April 5) at the rate of 50 p.p.m. A foliar spray of alar was applied 6 weeks prior to the anticipated harvest day (July 1) at the rate of 1,500 p.p.m. Ethephon was applied as a foliar spray 12 days before anticipated harvest (August 6) at the rate of 300 p.p.m. A stop-drop material, 2, 4, 5-TP, was applied with the ethephon treatments at the rate of 20 p.p.m. These treatments were applied alone and in all possible combinations. Whole tree plots of Miller's Sturdeespur Red Delicious on MM106 rootstock were used.

The fruit was harvested on August 18. Evaluations were made to determine effects of treatments on fruit firmness, percent soluble solids, length, diameter, L/D ratio, weight, and percent of fruit surface with red color and a red blush.

Firmness. Alar treated fruit were firmer than those receiving other treatments, with the exception of promalin alone. However, fruit treated with promalin were not firmer than the check fruit. The percent soluble solids of the fruit was not affected by any treatment.

Fruit length. Alar had a shortening effect on fruit. Length of fruit getting the other treatments did not vary from the check fruit. Promalin treated fruit was longer than fruit treated with alar + promalin or alar + promalin + ethephon. Fruit treated with promalin + ethephon did not vary in length from that treated with promalin alone. Therefore, it appears that alar counteracts the effect of promalin on fruit length but ethephon does not.

Fruit diameter. The diameter of fruit treated with alar, alar + promalin, and alar + promalin + ethephon was less than the check fruit. Fruit getting the other treatments showed no diameter difference from the check fruit. However, treatment with promalin, alar + ethephon, and promalin + ethephon resulted in fruit with about the same diameter as alar treated apples.

L/D ratio. Promalin increased the L/D ratio when applied either alone or in combination with ethephon or ethephon + alar. Promalin + alar did not affect L/D ratio. Treatments with alar or ethephon, or combinations of the two, did not affect the L/D ratio.

Fruit weight. Fruit weight was reduced by treatments of alar, alar + promalin, and alar + promalin + ethephon. Other treatments did not affect fruit weight.

Color development. All fruit treated with ethephon or ethephon in combination with alar or promalin increased the percentage of the fruit surface with red color and red blush. Alar and promalin applied alone had no effect on red color development.

Results of this study indicate that shape and color of Red Delicious apples can be improved with foliar treatments of promalin and ethephon. In contrast, alar treatments resulted in smaller, shorter, and firmer fruit, and use of alar decreased the effect of promalin on fruit shape.

EFFECT OF GROWTH REGULATORS ON FRUIT DEVELOPMENT OF RED DELICIOUS APPLES

Treatment	Fruit firmness[1]	Fruit size		Fruit L/D ratio	Wt./ fruit	Red color rating[2]	
		Length	Diameter			Blush	Total surface
	Lb.	*In.*	*In.*		*Oz.*	*Pct.*	*Pct.*
Check (no treatment)	14.5	2.53	2.88	0.88	6.32	21.9	48.7
Alar alone	16.7	2.30	2.67	.86	4.77	16.1	48.5
Ethephon alone	13.6	2.56	2.83	.90	5.65	41.9	74.0
Promalin alone	15.3	2.62	2.70	.97	5.33	23.0	48.3
Alar + promalin	14.6	2.38	2.61	.91	4.94	28.0	57.3
Alar + ethephon	14.5	2.48	2.80	.88	5.54	38.5	74.5
Promalin + ethephon	12.9	2.67	2.73	.98	5.72	39.1	68.4
Alar + promalin + ethephon	14.5	2.43	2.58	.94	5.01	37.9	72.2

[1]Fruit firmness was measured with an Instron 1122 universal testing instrument.
[2]The percentage of the fruit surface with any red color evident and the percentage of the surface with a red blush were subjectively rated.

AGRICULTURE'S ROLE IN THE ECONOMY

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AGRICULTURE and agribusiness include farms that produce agricultural products, the firms that handle, process, finance, store, and distribute these products, and firms that supply items used in production. While the number of farms and people on farms have declined, output per farm and total value of production have increased. Also, the value or cost of inputs used in production and marketing has increased.

Farmers are producers of food and fiber. Their products are basic to the needs of man. Their production is essential for domestic markets and of growing significance and concern in holding down the balance of trade deficit. Food and fiber are the raw materials on which many industries are based. Employment is supplied for a substantial segment of the population. Thus agriculture, in terms of the total number of firms and people involved in all the inputs and outputs used, plays a major role in the economy of communities, the State, and the nation.

Changes

Two major changes are cited in connection with the significant role that agriculture plays in the economy. A generation or more ago, two-thirds of the resources used in farming came from within the farm; they were produced on farms. Today two-thirds or more of the resources used are of nonfarm origin. These resources as inputs are supplied by numerous manufacturers, wholesalers, retailers, and other distributors.

The change in farm production expenses for Alabama farms from 1960 to 1978 is as shown in table 1.

One of the major changes between 1960 and 1978 was the purchase of seed which increased 852% or an average of about 47% per year. Second in importance was the increase in interest paid on the farm mortgage debt, which showed a 707% increase for the 18-year period. Net rent to nonoperating landlords was another expense that went up substantially.

TABLE 1. CHANGE IN FARM PRODUCTION EXPENSES, ALABAMA, 1960 TO 1978

Item	1960	1978	Chge.
	Mil. dol.	*Mil. dol.*	*Pct.*
Feed	98.0	412.8	321
Livestock bought	28.6	83.4	192
Seed	6.9	65.7	852
Fertilizer and lime	43.8	104.1	138
Repairs and operation of capital items	49.6	156.0	215
Hired labor	38.1	80.6	112
Depreciation	55.5	261.7	372
Taxes on farm property	7.2	12.9	79
Interest on farm mortgage debt	8.8	71.0	707
Net rent to nonoperator landlords	3.1	24.1	677
Miscellaneous	39.5	227.7	476
Total	379.1	1,500.0	296

Increases in production expenses as indicated in table 1 mean that volume of business for firms supplying these items has increased. There has also been an increase in the amount of capital and credit required to operate farms both from the standpoint of financing real estate and operating capital items.

The second major change involves consumers. They desire food packaged in certain ways, ready for use with a minimum of effort. Many wives work away from home and wish to minimize their time in the kitchen in preparation and serving of food. More meals than ever before are eaten away from home. As a result, a growing number of firms and people are involved in preparing, precooking, packaging, and distributing food and food products.

Total agricultural production from Alabama farms also increased as indicated in table 2. The right hand column shows the change in constant dollars.

The level of agricultural output and changes that occur have a multiplier effect on the economy in terms of both employment and income generated. An input-output study of Alabama's agriculture[1] indicated that each dollar of sales of livestock products created $2.49 in income in the form of wages and salaries, proprietor and rental income. Each $1 sale of crops created $2.75 in the above kinds of income in the economy.

Tremendous opportunities exist for further growth and development of Alabama's agriculture. Generally, population and per capita incomes are increasing in the South. Land and water resources are favorable for continued expansion if used wisely. However, farmers must be able to continue to be effective users of research and technology and responsive to continuing educational assistance. Public research and educational programs must be adequately supported. Research shows returns on these programs to be two to five times the average returns of private investment.

[1]Curtis, W. C. 1972. The Structure of the Alabama Economy, An Input-Output Analysis. Alabama Agricultural Experiment Station Bulletin 429.

Other Factors

Besides the significance of the inputs and outputs of agriculture and their role and effects on the economy of the State, the Southeast, and the nation, there are other factors of importance in Alabama agriculture.

Land in farms accounts for about 12 million acres of total land in the State. This acreage has declined as population increased and nonfarm demands for land grew. No doubt in the future, further needs will be expressed for farm land to be converted to nonfarm uses. This will point up the necessity for greater productivity and efficiency on the land remaining in farms. It will be a challenge in the years ahead to preserve the best farm land for agricultural uses and to provide sound overall land use to meet a changing and developing State.

One of the keys in the development of our agricultural production and efficiency has been the free enterprise system. Farmers have had the incentive to use new knowledge from research quickly to improve their operations. They owned a major portion of their resources. By making improvements, farmers operating in a competitive market passed on to consumers the benefits of new technology. In addition, farm families encouraged the development of desirable communities in which to live. A major challenge to farmers and rural people is to maintain and to improve the rural environment and to make it an even better place to work and live and to rear the children who will be our future leaders.

TABLE 2. CHANGES IN ALABAMA CASH FARM RECEIPTS, 1960-1978

Year	Alabama cash farm receipts	
	Current dollars	1966-68 dollars
	Mil.	*Mil.*
1960	530.3	519.9
1965	646.3	639.9
1970	766.8	716.6
1975	1,338.5	778.2
1976	1,618.1	889.1
1977	1,541.7	842.4
1978	1,895.3	915.6

Predicting Irrigation Uniformity of Travelers

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Department of Agricultural Engineering

CABLE AND HOSE TOW TRAVELER irrigation systems have advantages of (1) flexibility for use on irregularly shaped fields, and (2) portability between field locations.

Both systems utilize high volume sprinklers by towing them through the field along a travel lane. Therefore, the amount and distribution of water applied by each is generally similar even though their towing techniques are different. Factors such as lane spacing, sprinkler type and size, water pressure at the sprinkler, and travel speed determine the resulting water distribution. A poor selection of one or more of these can cause too much water to be applied at some locations and not enough at others.

One technique being developed at the Auburn University Agricultural Experiment Station for evaluating the various design choices is a computer simulation. This simulation uses information about the sprinkler characteristics and predicts the amount of water applied in a field at various lane spacings and travel speeds. For example, a typical high volume sprinkler has been tested and found to apply water as shown in figure 1. The test was conducted with the sprinkler mounted at a stationary location and with the part-circle attachment engaged to leave a 45-degree dry arc. The traveler simulation takes these and other data and calculates the amount of water applied at various locations in the field. Such problems as end effects and variation in travel speed can also be determined and evaluated.

Consider the sprinkler in figure 1 utilized on a moving traveler with the 45-degree dry arc placed to the front: General guidelines call for lane spacing from 80 to 50% of the sprinkler's wetting diameter, depending on expected wind conditions (no wind to greater than 10 m.p.h.). Since the wetting diameter of the sprinkler in figure 1 is 420 ft., the resulting lane spacing could be from 210 to 335 ft., depending on the choice of design wind condition. Of course, the wider lane spacings are generally more desirable if application uniformity can be maintained.

At this point, the simulation can provide an analysis on which to make a decision. Selection of a 2 ft. per minute travel speed and a lane spacing of 250 ft. results in the predicted wetting pattern shown in figure 2 for "no wind" conditions. This spacing is recommended for 10 m.p.h. winds and results in too much water applied midway between lanes when there is no wind. The average application is 1.3 in., but the range is from a low of 0.7 in. to a high of 2.0 in.

Figure 3 shows the pattern from the same sprinkler operating with 300-ft. lanes and traveling slower to provide the same average application. The range of application has been improved with a low of 0.8 and a high of 1.8 in. The approximate ideal spacing for "no wind" conditions is shown in figure 4. The minimum and maximum amounts are now 0.9 and 1.5 in., respectively. A further increase in lane spacing would cause a drier area halfway between the lanes.

These simulations tend to confirm the "no wind" recommendations for this situation. Additional studies would be required to determine the effects of wind and to provide a spacing selection best suited for various wind conditions. Additional factors, such as varying the part-circle dry angle, could improve uniformity and can be evaluated by the simulation.

Although the simulation is still being developed, it is already providing information to improve water application uniformity and thus reduce water and energy consumption.

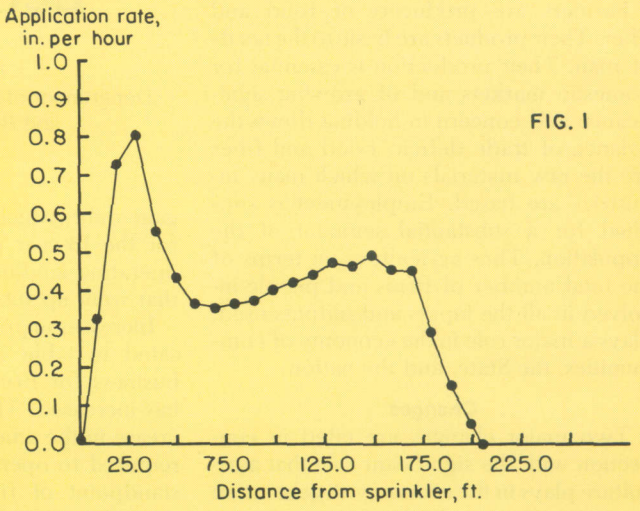

FIG. 1

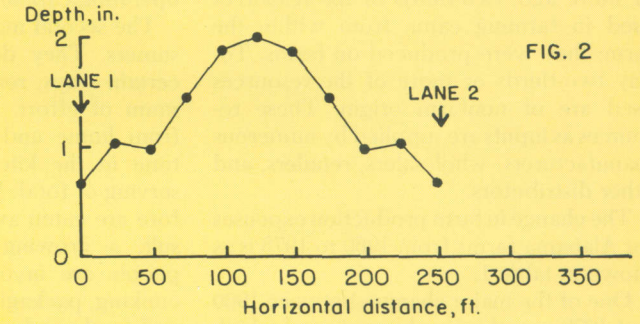

FIG. 2

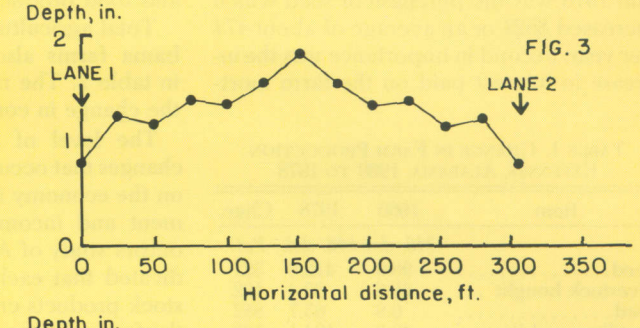

FIG. 3

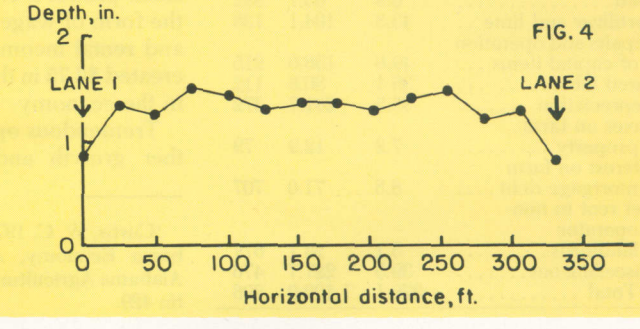

FIG. 4

FIG. 1. Wetting pattern of typical sprinkler. FIG. 2. Water application between two travel lanes spaced 250 ft. apart. FIG. 3. Water application between two travel lanes spaced 300 ft. apart. FIG. 4. Water application between two travel lanes spaced 325 ft. apart.

Breeding Tall Fescue and Orchardgrass for Resistance to Grass Tetany

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GRASS TETANY IS A PROBLEM that challenges plant breeders. This disease causes death of lactating cows grazing tall fescue, orchardgrass, and other cool season grasses in most temperate climates. A metabolic disorder, grass tetany is also known as hypomagnesemia because it is caused by a low level of blood serum magnesium (Mg).

Occurs in Cool, Wet Weather

The disease most often occurs in cool, wet weather. This may be due to depressed mineral uptake of plants that occurs on soils having poor aeration. Plants that contain less than 0.2% Mg in the forage are considered tetany prone. The normal range of Mg in forage grasses is 0.2 to 0.5%.

The challenge facing plant breeders is to develop varieties of tall fescue and orchardgrass that will be less conducive to grass tetany. Thousands of plants must be evaluated for their ability to take up Mg in both normal and poorly aerated soils. High Mg plants must be synthesized into new varieties and evaluated for forage yield potential at several locations in the South. The final test will be grazing trials that will measure animal performance on the new varieties in comparison with existing varieties. With new varieties like those being sought, grass tetany should not occur even on soils with poor aeration.

Resistant Varieties Sought

Current work at the Auburn University Agricultural Experiment Station is concentrating on development of tall fescue and orchardgrass varieties having the desired resistance to grass tetany. Special equipment to evaluate germplasm of the two grasses for mineral uptake has been designed by the Experiment Station in cooperation with USDA-SEA Soil and Water Research Unit, figure 1.

Seedlings can be grown in either flooded or nonflooded conditions to determine the efficiency of Mg uptake under low soil aeration. Fortunately there are tall fescue and orchardgrass genotypes that take up sufficient levels of Mg when grown in either soil oxygen level, see table. Such genotypes are valuable in a breeding program because research has established that Mg uptake is an inherited trait. Plants containing high amounts of Mg can be intercrossed to combine genes for high Mg uptake, figure 2. These populations of plants will serve as the basis for grass varieties that will not produce grass tetany.

[1]Coop., SEA, Federal Research, USDA.

UPTAKE OF MAGNESIUM BY TALL FESCUE AND ORCHARDGRASS[1]

Selection	Fescue		Selection	Orchardgrass	
	Normal soil oxygen	Low soil oxygen		Normal soil oxygen	Low soil oxygen
	Pct. mg	*Pct. mg*		*Pct. mg*	*Pct. mg*
1.....	0.60	0.35	1.....	0.30	0.22
2.....	.41	.27	2.....	.30	.26
3.....	.39	.28	3.....	.30	.26
4.....	.36	.23	4.....	.28	.24
5.....	.36	.22	5.....	.28	.25

[1]Selections above 0.20% Mg should not cause grass tetany.

FIG. 1 (top). Determining mineral uptake of grasses with specially designed equipment. FIG. 2 (bottom). Intercrossing combines genes to provide for high Mg uptake of tall fescue and orchardgrass.

POPULATION TURNAROUND & ALABAMA'S RURAL COUNTIES

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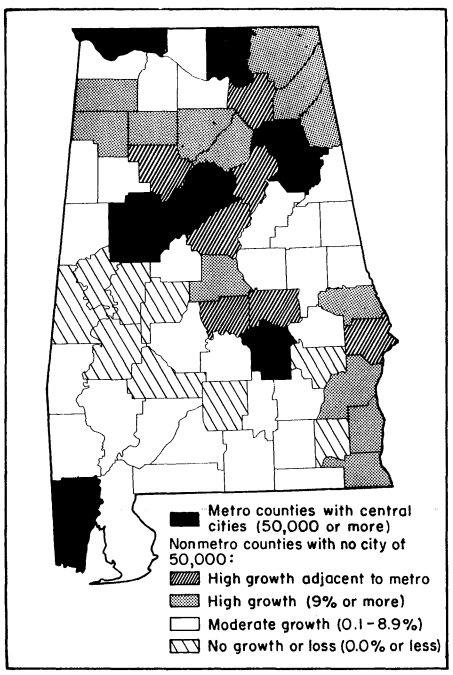
ONE IMPORTANT CHANGE that occurred in rural America during the 1970's was the reversal of long-time patterns of population decline. Nationwide, nearly 60 million people live in the open country or in villages or towns. More than one-fourth of all Americans reside in counties that have no urban center larger than 50,000 in population.

Historically, rural areas have exported people to metropolitan centers. The high rate of out-migration has been highly selective of the young and better educated segments of the population. Some of the problems of economic decline and the depressed quality of life in rural areas have been magnified by this out-migration of human resources. Solutions to many problems associated with rural America have focused on stemming the tide of out-migration through industrial and rural development.

During the decade of the 1960's, the rate of rural to urban out-migration began to slow; however, not until the 1970's did a widespread reversal of the trend occur. For the period 1970 to 1975, the country grew by 10 million persons for a rate of 4.8%. Rural areas gained more than 2 million residents. The rural turnaround in population affected counties nationwide but was obscured somewhat in the South and West by the fact that 85% of the national growth occurred in these two regions. The growth rate was more than 8% for the South. Both urban and rural counties in the South grew from interregional migration.



Population change in Alabama: 1970-1975.

Turnaround and the South

The population of Alabama was estimated to be 3,615,000 as of July 1, 1975. This represented a growth of 4.9% since 1970. The striking thing about the increase is that Alabama has not shared in the accelerated growth characteristic of the South. Only two Southern States—West Virginia (3.1%) and Louisiana (4.4%)—grew more slowly. All Southern States except Florida, which grew by 21.8%, had percentage increases in the range of 5 to 10%.

Population turnaround is only a part of this Southern pattern. Not all of the 15 Southern States experienced declining populations in counties containing cities of 50,000 or more. Instead, the general pattern was for both metropolitan and nonmetropolitan (rural) counties to experience population increases. Every state experienced rural population growth. This reversed the out-migration trends established in recent decades. Rural population growth ranged from 2.2 and 3.2% for Louisiana and Mississippi to 8.6 and 27.5% for Virginia and Florida.

Alabama Turnaround Weak

In Alabama, the growth of rural counties between 1970 and 1975 was 5.5% compared to the State rate of 4.9%. This compared favorably with the lower rate of growth (2.8%) registered by the eight metropolitan counties in the State containing cities of 50,000 population or larger. Nevertheless, the highest growth rates were found in those primarily rural counties located adjacent to a county containing a large city. The growth rate was 11.4% for these counties. It is these adjacent counties that are experiencing the most immediate impact from the exodus of urban people to towns and the open country, see figure. The major growth counties in this category are Shelby (25.9%), St. Clair (19.1%), Elmore (18.2%), Autauga (16.9%), Walker (14.0%), and Baldwin (13.7%).

Thirteen rural counties had high growth rates of 9% or more. These tend to cluster in two areas of the State. Four counties are in the Southeast bordering Georgia. Except for Chilton County, the other seven high growth rural counties are in north Alabama but not in the Tennessee Valley. Comparatively, the no growth or declining population counties are located solely in the Black Belt with the exception of Dale County which is effected primarily by the fortunes of the Fort Rucker military installation. The declining population pattern of these nine counties represents a continuing but slowing trend of out-migration. Perry and Wilcox counties suffered the most severe population loss with rates in excess of 9%.

Although some Alabama rural counties have experienced a population turnaround, 27 counties are still sending more residents to urban areas than they are receiving. For many years, these counties have experienced high rates of natural increase (excess of births over deaths) and a shortage of employment opportunities, creating a surplus of people to fill a relatively stable number of local jobs.

In summary, it is worth noting some of the potential consequences of rural population growth. For many rural residents this trend will mean improved social and economic conditions. Operators of businesses and landowners may benefit directly from expanding demand. On the other hand, the local labor force may experience competition from better qualified urban migrants for available jobs. Also, new residents from urban backgrounds may expect and press for additional community and governmental services which often result in higher costs of living and increased taxes.

Shredded Pine Cones Valuable as Amendment for Growing Media

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PINE CONES MAY REPRESENT more than just the seeds of tomorrow's trees. Shredded pine cones also contain valuable nutrients and organic material that may be used in media to grow tomorrow's seeds, plants, and trees.

Shredded pine cones have been investigated as a media amendment in the production of ornamental plants at the Auburn University Agricultural Experiment Station since 1974. Poinsettias and snapdragons have been successfully grown in media containing the shredded pine cones.

Commercial Product Tested

The shredded pine cones used were provided by a commercial media manufacturer. Shredding produced a coarse product ranging in size from 12.5 to less than 1 mm. Proportion of particle sizes were: 12.5 mm—5%; 5 mm—37%; 3 mm—19%; 2 mm—20%; 1 mm—6%; and less than 1 mm —13%.

Use of the large particles in media made it difficult to insert cuttings and small seedlings. A dibble was required to make the opening in the media for cuttings and plants. Further grinding or screening is suggested to produce a more uniform product with no particles larger than ¼ in. (6.3 mm). This would facilitate manual transplanting and the use of potting machinery.

The pH (6.2) and soluble salts (0.11 millemhos per cm, at 1.2 dilution) of shredded pine cones are satisfactory for most ornamental crops. Micro-kjeldahl analysis revealed that shredded pine cones contain a small amount of nitrogen, but additional nitrogen fertilization would be necessary for growing plants. High analysis water soluble liquid fertilizer was used in the Auburn study.

Trace Amounts of Plant Nutrients

Spectrographic analysis showed the presence of trace amounts of manganese, iron, boron, copper, zinc, phosphorus, and calcium in the shredded pine cones. Potassium and magnesium concentrations might be expected to make some contributions to a plant's nutrition if available. Nutrient concentration was as follows:

Element	*Concentration*
Nitrogen	0.740%
Phosphorus	.036%
Potassium	.479%
Calcium	.121%
Magnesium	.914%
Manganese	83 p.p.m.
Iron	636 p.p.m.
Boron	25 p.p.m.
Copper	63 p.p.m.
Zinc	76 p.p.m.

Cuttings of poinsettia (Annette Hegg Supreme) were directly propagated and grown in the three media combinations used in the poinsettia study. Height of poinsettia plants grown in shredded pine cone media exceeded that of plants grown in sphagnum peat moss, table 1. The most desirable height for poinsettia depends on their use. With the exception of plants grown in soil, sphagnum peat moss, and perlite, poinsettia plants grown in shredded pine cone-amended media had the largest flowering bract diameters.

TABLE 1. GROWTH COMPARISONS OF ANNETTE HEGG SUPREME POINSETTIAS GROWN IN SPHAGNUM PEAT MOSS AND SHREDDED PINE CONE MEDIA

Media, by volume	Plant height	Flowering bract diameter
	In.	*In.*
1:1 soil-peat moss	11.1	12.7
1:1 soil-pine cones	11.8	13.2
1:1 sand-peat moss	8.2	12.6
1:1 sand-pine cones	8.9	13.3
1:1:1 soil-peat-perlite	12.3	13.0
1:1:1 soil-pine cones-perlite	12.4	12.0

Most Value in Sand Based Media

The value of shredded pine cones as a media amendment was best shown in the sand-based medium. It produced the largest flowering bract diameter and one of the greatest differences over sphagnum peat moss in height. Two plants were grown per 6-in. pot with 16 pots per treatment.

In the snapdragon test, plants grown in shredded pine cone-amended medium had much greater growth than those grown in a medium containing sphagnum moss, table 2. This showed up in all growth measurements—height, weight, size of flowering spikes, and strength of stems.

TABLE 2. GROWTH OF WINCHESTER SNAPDRAGON IN MEDIA AMENDED WITH SPHAGNUM PEAT MOSS AND SHREDDED PINE CONES

Growth measurement	Result, by media (1:1:1) Soil-peat moss-perlite	Soil-pine cones-perlite
Plant height, in.	45.20	49.80
Plant fresh weight, oz.	1.57	1.92
Flower spike length, in.	9.50	9.90
Stem strength, g/cm	.14	.18

Seedlings of the Winchester variety were transplanted into flower beds in the greenhouse on July 25. Plants grown in soil-sphagnum peat moss-perlite flowered September 19-24, as compared with September 24-29 for plants grown in soil-shredded pine cones-perlite. Approximately 140 seedlings were planted per replication (two replications), and 20 plants were selected for data.

Results of the Auburn study show that shredded pine cones could be an outstanding media amendment for growing ornamental plants, but shredding should be adjusted to provide a more uniform particle size. Questions about availability and supply remain to be answered.

Force Molting Caged Broiler Breeder Hens

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FORCED MOLTING of various types of poultry has been practiced since 1930. The practice has the economic advantage of increasing the flexibility of production programs and lengthening the productive life of hens. This lengthened productive life reduces hen depreciation and thus reduces costs to the producer and consumer alike.

Greatest use of force molting has been by commercial egg producers who use egg-type Leghorn hens. Recently, however, producers of hatching eggs from meat-type broiler breeder hens have become interested in forced molting to increase their flexibility of operation and reduce costs. Information about proper methodology for forced molting of broiler breeder hens has been limited, so a research program to help fill this information need has been started at the Auburn University Agricultural Experiment Station.

The general forced molting procedure involves reducing the daily hours of light, removing feed approximately 10 days (or when a specific weight is achieved), and removing water for a day. Following this period of feed deprivation, the hens are then fed a high protein molt ration which allows a rapid recovery and renewal of feathers. The males are not molted because certain endocrinological features make the procedure prohibitive. Instead, the males generally are replaced with young roosters in naturally mated populations.

It is well known that feed restriction improves performance of broiler breeder pullets; however, the practice has not been investigated thoroughly in forced molted breeder hens. As demonstrated by results of two Auburn trials, given in the table, feed restriction produced beneficial effects in forced molted breeder hens. These tests compared six different feed intake levels during sustained egg production.

Feed restriction was found to control body weight gain, and a gradual improvement in feed conversion was evident as feed intake decreased from 5½ to 4¾ oz. (173 to 145 g) per hen per day. Further restriction did not improve feed conversion but decreased egg population. Smaller egg size and improved shell quality (specific gravity) were associated with feed restriction below 5¼ oz. (163 g) per hen per day.

Other data suggested a trend toward improved fertility and hatchability associated with smaller body weight gain. Taken together, these and other data indicate that body weight of the broiler breeder female has a profound effect on reproductive efficiency, and that carefully managed feed restriction programs can improve reproductive efficiency.

Removing feed during a forced molt is done to reduce body weight. Final body weight achieved, irrespective of how much weight is lost, is a major factor in a successful program. Thus, the achievement of a specific body mass may be the key to a successful program. The optimum body weight to be achieved may be as low as 6.6 lb. Further experimentation will be needed to determine the exact nature of this response. It must be recognized, however, that in this test birds were kept in individual cages. Floor flocks, with their different social structure, would undoubtedly require modification of the procedure.

To achieve optimum body weight loss, hens must be prevented from eating for several days. This calls for removal of all feed plus removal of nutrients available in litter. Removal of old litter and replacement with wood shavings or other nonedible materials has been found necessary. Such litter materials as rice or peanut hulls are unacceptable. Access to built-up manure under partial slats must be prevented by using wire or wood partitions.

Fewer days off feed generally are required in cold weather than in hot weather to accomplish weight loss. Within large populations of broiler breeders, there are often wide variations in body weight. This requires extra care to avoid getting too many hens at a lower weight than is required to maintain their health.

EFFECT OF VARIOUS LEVELS OF FEED INTAKE ON PRODUCTION FACTORS IN FORCE MOLTED BROILER BREEDER HENS, TWO TRIALS

Production measure	Result[1], by treatment and trial							
	Treatment 1		Treatment 2		Treatment 3		Treatment 4	
	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
Maximum feed intake, g/hen/day	145.3	127.2	154.4	136.2	163.4	145.3	172.5	154.4
Eggs produced/hen	105.6	92.1	107.6	101.5	115.6	110.0	104.1	107.3
Egg weight, g	69.5	69.6	69.4	69.1	70.1	69.9	70.2	71.2
Egg specific gravity	1.0824	1.0830	1.0814	1.0833	1.0803	1.0836	1.0807	1.0827
Feed conversion, kg/doz.	2.8	3.3	2.9	3.2	2.9	3.2	3.5	3.5
Postmolt body weight gain, kg	1.12	.90	1.20	.98	1.35	1.07	1.51	1.23

[1]Conversion factors: 1 oz. = 28 g; 1 kg = 2.205 lb.

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