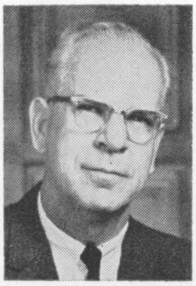
HIGHLIGHTS

of agricultural research
VOL. 18, NO. 2/SUMMER 1971

Agricultural Experiment Station
AUBURN UNIVERSITY

DIRECTOR'S COMMENTS



E. V. Smith

ECOLOGY was one of my favorite subjects when I taught during the 1930's and 1940's. As Congressman Bill Nichols and a few of his contemporary ag graduates will remember, however, few students were interested in ecology.

How times have changed! Today everyone seems to consider himself an ecologist with solutions to such environmental problems as air and water pollution. Concern often approaches hysteria. Under such conditions, over-action and over-response tend to occur.

Alabama was still a rural state during the depression years of the thirties. Animals provided power for farming. Fertilizer nitrogen was expensive and sparingly used. Organic pesticides had not been perfected. Practically no commercial livestock or poultry industry existed.

There were few large towns and few cities. There was little concentration of industry and comparatively small demand for electric power. There were relatively few cars and probably no diesel trucks. Greater concern was expressed for population decline than for growth.

Today the larger towns have become cities. Statistically, Alabama is urban. Large concentrations of energy-demanding industry exist. Mammoth fossil-fuel electric plants have been built and nuclear plants are under construction. Superhighways are clogged with cars and diesel trucks.

Most farming operations are mechanized. As labor has become scarce, labor-saving methods have been adopted. Organic pesticides are used to control insects, diseases, and weeds. Increased production is sought to offset the cost-price squeeze. For example, heavy applications of relatively cheap fertilizer nitrogen are commonplace. Livestock and poultry are more important than crops. Poultry is produced in confinement and confinement practices are expanding to dairy, swine, and beef production.

There was little cause for concern for environmental pollution during the 1930's. It is a sad commentary that the social, economic, and structural changes that have since occurred in our society making America the envy of the world have also been responsible for the deterioration of the quality of the environment. Some say "too many people, too much affluence."

Who are the polluters? The housewife, student, municipality, industrialist, farmer – everyone is. Is there hope for the future? Yes, despite doomsday prophets, few environmental reactions are irreversible although admittedly the time element is often critical.

look for these articles

may we introduce . . .

Dr. Robert T. Gudauskas, author of the article on page 3, is a member of the research and teaching faculty of the Department of Botany and Microbiology. His story on overwintering of the corn blight fungus reports findings of one phase of his research efforts directed toward solutions to the serious problem from the Southern corn leaf blight that developed last year in Alabama. He is also involved in research on diseases of small grains and other grasses, as well as a project concerning biological control of arthropod pests, particularly by viruses.

A native of Georgetown, Illinois, Gudauskas came to Auburn University in 1960 following doctoral study at University of Illinois. He did undergraduate study at East Illinois State College and received M.S. and Ph.D. degrees from University of Illinois.

Promoted to associate professor in 1963 and professor in 1969, he is a member of the Graduate Faculty and Graduate Council and the University Nuclear Science Committee. Membership in Gamma Sigma Delta and Sigma Xi recognize his agricultural and scientific accomplishments.

HIGHLIGHTS of Agricultural Research

SUMMER 1971 VOL. 18, NO. 2

A quarterly report of research published by the Agricultural Experiment Station of Auburn University, Auburn, Alabama.

E. V. SMITH .... *Director*
R. D. ROUSE .... *Associate Director*
CHAS. F. SIMMONS .... *Assistant Director*
T. E. CORLEY .... *Assistant Director*
E. L. MCGRAW .... *Editor*
R. E. STEVENSON .... *Associate Editor*
J. D. HARWOOD .... *Assistant Editor*

Editorial Advisory Committee: R. D. ROUSE; MORRIS WHITE, *Professor of Agricultural Economics;* ROBERT N. BREWER, *Assistant Professor of Poultry Science;* C. C. KING, JR., *Associate Professor of Agronomy and Soils;* AND E. L. MCGRAW.

ON THE COVER. Southern corn leaf blight developed on susceptible plants following infection with spores that overwintered in plant residue (see story on page 3).

CORN BLIGHT FUNGUS
Overwintered in Alabama

ROBERT T. GUDAUSKAS, THOMAS L. WHATLEY, and WAI NAM TO
Department of Botany and Microbiology
DAVID H. TEEM, *Department of Agronomy and Soils*

CORN BLIGHT has become almost a household term since last year's devastating outbreak of Southern corn leaf blight. The disease developed to epidemic proportions, first in the southern coastal regions and eventually on into the Midwest. Losses were heavy nationwide, and percentage losses in Alabama were among the highest in the Nation.

Southern corn leaf blight is caused by a fungus, *Helminthosporium maydis*. Prior to 1970 it was considered a minor disease. The 1970 outbreak was caused by a new race of the fungus, which probably had been present for 8 to 10 years and gradually increasing. The new race was designated Race T because of its ability to attack corn hybrids containing the Texas source of male sterile cytoplasm (Tcms).

Incorporation of Tcms into breeding lines permits control of crossing and development of hybrids without the laborious and costly operation of detasseling. Hybrids produced by detasseling and open-pollinated varieties contain "normal" (N) cytoplasm and are much less affected by *H. maydis* Race T.

Some N cytoplasm corn was grown in 1970, but 70 to 90% of the hybrids planted in Alabama and the Nation contained Tcms. Thus, corn susceptible to Race T was available in abundance. This, coupled with environmental conditions favorable for development of the fungus and the disease and for spread of spores from blighted to healthy corn, provided the necessary ingredients for the corn blight explosion of 1970.

TOTAL AND VIABLE SPORES OF THE BLIGHT FUNGUS FROM CORN RESIDUE COLLECTED IN MARCH, NINE ALABAMA LOCATIONS

Location	Low winter temp.	Spores/gram of residue: Total	Spores/gram of residue: Viable
	Deg. F	*No.*	*No.*
Substations			
Gulf Coast	19	1,120	1,120
Lower Coastal Plain	9	2,640	1,760
Sand Mountain	8	400	320
Tennessee Valley	8	2,080	1,440
Upper Coastal Plain	7	5,440	3,040
Wiregrass	15	8,960	6,880
Main Station, Auburn	15	400[1]	240
		160[2]	80
Experiment fields			
Brewton	18	320	160
Monroeville	---	1,280	640

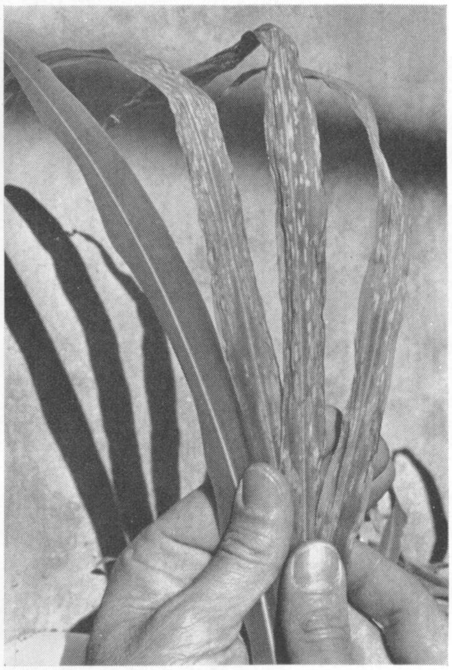
[1] Standing stalks.
[2] Ground litter.

Spread of *H. maydis* last year occurred by spores that were continually produced and blown northward throughout the summer. In addition to attacking living tissue, the fungus can also live on corn residue. Thus, the potential for earlier occurrence of the disease in 1971 loomed large if the fungus lived through the winter on blighted debris. It was strongly suspected that it would thus survive the winter in Alabama because of some evidence that *H. maydis* and closely related fungi could overwinter in northern areas of the United States. Tests were begun by Auburn University Agricultural Experiment Station to determine if and to what extent Race T did overwinter in the State.

During July and August 1970, samples of blighted corn leaves, ears, and stalks were collected at selected Alabama locations (listed in the table). Samples were placed in nylon-mesh bags anchored near the point of collection at each location. Beginning in November, portions of the sample at each location were removed monthly and sent to Auburn for analysis of total spores, viable spores, and pathogenicity (ability to infect) of *H. maydis*.

For spore determinations, samples of residue in water suspension were placed on a block of water agar, which was incubated for 24 hours. Total and viable *H. maydis* spores were counted using a 90-power dissecting microscope.

A spore was considered viable if a germ tube was apparent. Average spore numbers for several samples were determined and multiplied by the appropriate factor to estimate spore numbers per gram of residue. Pathogenicity tests on each residue were made by dusting finely ground residue into whorls of healthy, but susceptible, corn seedlings (Tcms) in the greenhouse. Seedlings were covered with plastic bags for 24 hours to maintain moisture for development of infections. Bags were then removed and plants kept on greenhouse benches for observations and counting of blight lesions.

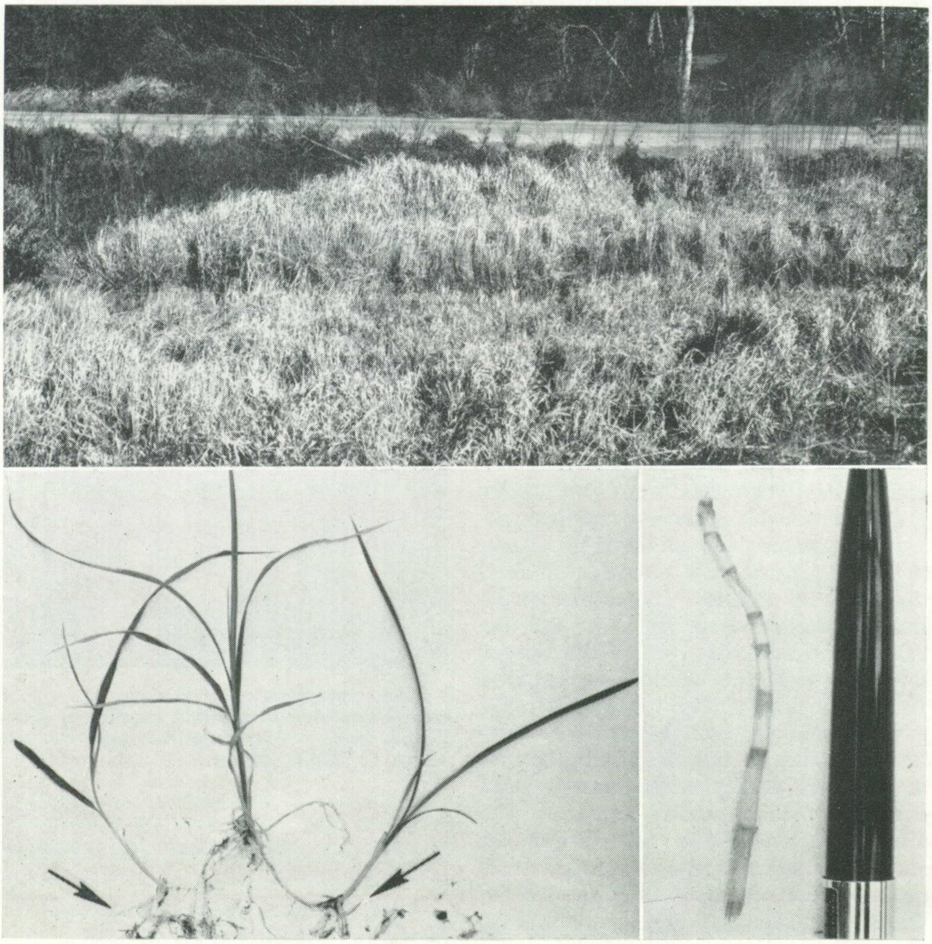


Typical appearance of blighted corn leaf from inoculated susceptible seedling is illustrated here. Nonsusceptible leaf at left shows no blight lesions.

Analyses have been completed for November-March collections from nine locations. Numbers of total and viable spores varied from month to month and location to location, but the fungus apparently survived at all locations. As shown by data in the table, viable spores were found at all locations in the March residue, despite sub-freezing winter temperatures.

In addition to spore counts, pathogenicity tests with March residues indicated survival of infective *H. maydis*. Numerous blight lesions developed on corn seedlings inoculated with residue from each location. A typical reaction is shown in the photo.

The probability of an outbreak of Southern corn leaf blight in 1971 depends on three variables – weather, host, and pathogen. Since *H. maydis* Race T survived the winter throughout Alabama, the potential for more and earlier appearing inoculum is great. Extended periods of warm, moist weather favor rapid reproduction of the fungus. If such weather occurs, then the host plant remains the principal variable. Because of regulations prohibiting sale of Tcms corn in Alabama, it was anticipated that most or all of the 1971 corn crop was planted with the less susceptible N cytoplasm seed.



Typical isolated infestation of cogongrass along a roadside near Mobile (top) crowded out all other plant species. Reasons for fast spread of the grass is illustrated by close up of a rhizome (bottom right) with its closely spaced nodes and 8-week-old plant (bottom left) with two daughter plants showing emerging rhizomes (arrows).

OLD WEED IN A NEW HOME— That's Cogongrass

RAY DICKENS and GALE A. BUCHANAN
Dept. of Agronomy and Soils

WHETHER YOU KNOW it as "lalang," as it is called in Nigeria, or by its southwestern Alabama name of "japgrass," cogongrass is a real pest.

This species of grass (*Imperata cylindrica* (L.) Beauv.) is widely distributed in tropical and subtropical lands, including Africa, India, China, Japan, and the Philippines. More recently it invaded the United States, and Alabama has its share.

Cogongrass isn't choosy about habitat, growing in such widely varying sites as dry sand at sea level or mile-high mountains. Authorities have judged this species to be one of the world's 10 worst weed species.

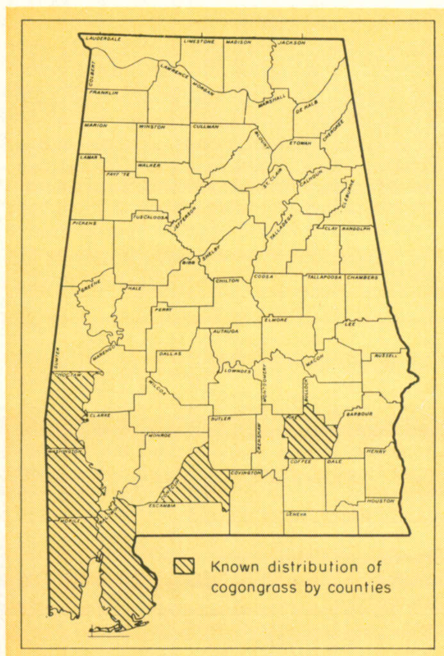
It is a perennial and spreads rapidly by long, many-noded rhizomes. Height of the grass in Alabama varies between 1 and 4 ft., but in other areas of the world it may exceed 9 ft. Its very short internodes and compact growth of rhizomes allow it to crowd out most other vegetation. This pest is favored by frequent fires, because fire tends to destroy other plants without seriously damaging cogongrass' extensive rhizome system.

Cogongrass was introduced into the Southeastern U.S. from the Philippines about 1920 and evaluated in Mississippi, Alabama (Auburn), and Florida during the 1930's and 1940's. It was found to have potential for erosion control but no promise as a forage crop. The Auburn plots of this grass were destroyed in the early 1940's when its pest potential became evident.

Unauthorized introduction by cattlemen into northwestern Florida resulted in an estimated 1,000 acres of cogongrass in that state by 1945. As early as 1948, people familiar with the grass were recommending its eradication. However, no coordinated action was taken and now, according to one Florida agricultural worker, there are isolated patches of cogongrass over the entire state.

Cogongrass now infests an estimated 10,000 acres in Mobile County, Alabama, where it is a major pest in pecan orchards, ornamental nurseries, pastures, home lawns, pine plantations, and highway rights-of-way. Original infestations were thought to be in the Grand Bay area, but now it is found in all areas of Mobile County and in neighboring counties.

In January 1970 the Agricultural Experiment Station received a cogongrass study grant from the Bureau of Public Roads and State Highway Department. Agronomy and Soils Department research was begun to learn reproductive habits of cogongrass and to develop methods of controlling or eradicating it from highway rights-of-way. Results show that viable seed are produced, but not in large quantities. Some promising results were obtained with herbicidal control, but at this time there are no definite conclusions about control practices.



How Far do Horse Flies and Deer Flies Fly?

A. R. THORNHILL, JEANNINE P. GILBERT, and KIRBY L. HAYS
Department of Zoology-Entomology

HORSE FLIES AND DEER FLIES (Diptera: Tabanidae) are among the most annoying blood-sucking insects attacking man and his livestock. Attacks of these insects on cattle interrupt their grazing and cause a significant blood loss. There is evidence that these tabanids may be vectors of anaplasmosis, anthrax, encephalomyelitis, equine infectious anemia, and tularemia.

Most animals need to disperse as a normal part of their lives. The necessity of dispersal among tabanids is readily apparent because they must move around in order to locate hosts, mates, and a place to lay their eggs. A knowledge of the flight activities of tabanids is important in both insect and disease control programs, but very few workers have reported on this aspect of tabanid biology.

Studies in U.S. salt marshes and the adjacent ocean have indicated that some tabanids may fly as far as 8 miles out to sea. In Africa, the movements of the deer flies transmitting *Loa loa* have been investigated. But neither of these reports apply to the conditions normally encountered in the southeastern U.S.

Deer Fly (*Chrysops* sp.) **Movements**

During the summer deer flies (mostly *Chrysops vittatus* Weid.) were collected in the Chewacla Creek swamp, Macon Co., Alabama. The flies were collected with a standard insect net and were marked with a spot of model airplane dope on the dorsum of the thorax. Different colored paints were used for each release. Two hundred to 400 marked flies were collected for each release.

Transects were laid out to the south, east, and north. Collecting stations were located at the release point and each 100 meters along each transect. U.S. Highway 80 crossed the north transect between stations 1 and 2, and Chewacla Creek crossed the east transect between the release point and station 1. Releases were made on June 18, June 24, July 2, and July 9.

Upon release, the marked deer flies flew upward toward the forest canopy. As soon as all the flies had left the holding tent attempts were made to recapture flies with an insect net. At least one attempt to capture marked flies was made each day thereafter. Flies were collected at the release point 1 minute after release and were present there the remainder of the day. In 25 minutes marked flies had crossed the creek 50 meters from the release point. In 1 hour they had crossed the highway and had moved 200 meters north. Twenty-four hours after release all marked flies collected were taken between the release point and points 200-300 meters away. Subsequent collections did not reveal marked deer flies at greater distances from the release point. During collections 35% of the marked flies were recaptured. The greatest number of days that a marked fly was known to live after the original collection was 18.

Horse Fly (*Tabanus* sp.) **Movements**

Horse flies were collected in Chewacla Creek swamp in Malaise traps. These flies were marked with a spot of model airplane dope on the dorsum of the thorax, and placed in ½-gal. mason jars in chests of crushed ice. The cool atmosphere inside the jars prevented the flies from flying and damaging their wings by contact with the jar. The cooled flies were transported to the Piedmont Substation, Camp Hill, Alabama, and released the day of collection.

The point of release was in the center of several semi-circles of sticky traps, Fig. 1. In 1969, 14 of these traps were set in semi-circles at ⅛, ¼, ⅜, and ½ mile from the release point. In 1970, 29 traps were utilized and the trapping range was increased in ⅛ mile semi-circles to 1 mile from the release point. A total of 1,063 horse flies was marked and released in 1969 and 2,931 were marked and released in 1970. Eleven released flies were recollected in 1969 and 103 were recollected in 1970.

Totals of 12,555 and 17,919 horse flies were collected on the sticky traps in 1969 and 1970, respectively. Comparisons of the numbers captured east and west of the release point and the numbers in open and wooded areas indicated that horse flies were equally distributed over the research area. Analysis of the trap catch data indicated that there was no preference by the flies for any of these areas.

Six species of marked flies were recaptured; these were: *Tabanus fulvulus, T. lineola, T. melanocerus, T. nigripes, T. pallidescens,* and *T. petiolatus.* Distance from the release point appeared to influence the number of recaptured flies at any trap. Seventy per cent of the recaptures were made within ½ mile of the release point, and 28% were taken within ⅛ mile of the release. The amount of wooded terrain between the release point and the trap had no effect on the numbers collected. Flies were recaptured as long as 23 days after release.

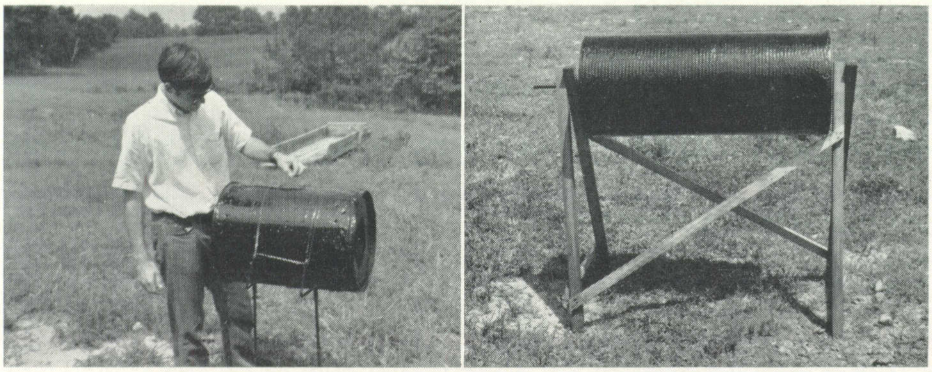


FIG. 1. Two of the sticky traps used to recapture marked horse flies. The trap at left is made from an empty oil drum and the trap at right is a commercially produced model.

Sorghum Silage in Growing Rations for Yearling Beef Steers

R. R. HARRIS, *Department of Animal and Dairy Sciences*

V. L. BROWN, *Lower Coastal Plain Sub.*

W. B. ANTHONY, *Department of Animal and Dairy Sciences*

ACCEPTING SORGHUM as a silage crop is a little like saying "I do" at a marriage ceremony – you take it for better and for worse. And it is both.

On the minus side, sorghum silage gives consistently poorer gain of yearling cattle as compared with corn silage, according to results of Auburn studies. But there are advantages, too. Sorghum is more drought tolerant than corn, it is not susceptible to Southern leaf blight, it is adapted to a wide range of soil types, and its yields are comparable to corn.

The big need, then, is to find better ways to utilize the nutrients in sorghum silage when fed to young cattle. This is the aim of a project that was begun in 1964 at the Lower Coastal Plain Substation.

An intermediate type hybrid forage sorghum (NK-300) was used in all experiments. Various additives were used at ensiling in efforts to improve animal utilization and performance. The forage as ensiled averaged 33% dry matter and 43% grain, dry matter basis. Yields ranged from 12 to 24 tons per acre, and averaged 15.5 tons.

Adding 100 lb. ground shelled corn per ton of green material at ensiling has consistently increased rate of gain by yearling steers fed silage rations (1.67 vs. 1.43 lb.), see table. Feed required per unit of gain and feed cost of gain were similar for steers on growing rations consisting primarily of either untreated or corn-enriched sorghum silage.

Digestible dry matter content of silage was increased 19% by adding the corn. This apparently was a result of corn's high digestibility, rather than to an improved utilization of silage. Digestibility of cellulose increased slightly when corn was added. Crude protein content of silage was the same with or without corn – 7.78%, dry matter basis. There were no acidity differences.

Non-protein nitrogen compounds like urea can be utilized by rumen microbes to synthesize protein. Such protein is often cheaper than common supplements, so urea was included in the silage (10 lb. per ton) and less protein supplement was fed.

Steers fed sorghum silage without additive gained an average of 1.46 lb. daily, not significantly different from 1.39 lb. daily by those on silage containing urea. Steers on urea silage consumed 7% less than those on silage without additive. Untreated silage had pH of 4.4 and the urea silage 5.4, so acidity is not a likely reason for intake differences. Feed conversion, digestible dry matter content, and feed cost per unit of gain were similar between treatments.

Crude protein (dry matter basis) averaged 8.2% for silage without additive and 9.2% with urea added. However, analyzed protein content of the urea silage was only 75% of calculated content. No explanation for this discrepancy was found.

Starch is the ideal carbohydrate for microbial synthesis of protein from non-protein nitrogen. Thus, a combination of 100 lb. of corn and 10 lb. of urea was used in two experiments. Results were disappointing in that no advantage was shown over silage without additive. The intake problem already noted did not occur when the corn-urea combination was used, but there was a discrepancy in the protein content of urea containing silage.

Again, animal performance favored the silage containing ground shelled corn. Small variations in digestible dry matter, cellulose digestibility, crude protein, and pH did not account for differences in performance of cattle on the two silages.

Ground limestone ($CaCO_3$) is sometimes used in combination with urea to control fermentation during the ensiling process. The usual rate, 20 lb. per ton of green material, was used in the research.

During a 1968-69 test, steers averaged 1.65, 1.72, 1.64, and 1.40 lb. daily gain on sorghum without additive, $CaCO_3$ additive, urea additive, and $CaCO_3$ plus urea, respectively. Calcium carbonate in combination with urea reduced silage dry matter consumption 19%, whereas $CaCO_3$ alone reduced it only 7%. Urea alone had a strong effect on dry matter consumption, reducing it 20%.

Potential improved utilization of sorghum silages by use of additives is revealed in results reported. Adding ground shelled corn improved performance of steers on silage, and proved much more valuable as an additive than urea or $CaCO_3$. In fact, there was a reduction in dry matter intake of silage containing urea and calcium carbonate.

Dry matter intake essentially accounted for differences between predicted and observed animal response. Level of silage intake appears to be satisfactory for predicting animal performance.

ANIMAL PERFORMANCE ON NK-300 SORGHUM SILAGE WITH THREE ADDITIVES, LOWER COASTAL PLAIN SUBSTATION, 1965-70

Performance measure	Corn additive/ton		Urea additive/ton		Corn and urea additive/ton		
	None	100 lb. corn	None	10 lb. urea	None	100 lb. corn	100 lb. corn + 10 lb. urea
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Initial weight	515	516	506	505	560	561	560
Final weight	799	837	796	781	884	908	866
Total gain	284	321	290	276	324	347	306
Av. daily gain	1.43	1.67	1.46	1.39	1.51	1.73	1.52
Feed/cwt. gain							
Corn	240	201	259	269	232	200	225
Protein supplement	108	90	107	85	100	86	66
Silage	2,410	2,007	2,294	2,265	2,692	2,241	2,320
Daily feed intake/steer							
Corn	3.3	3.3	3.6	3.6	3.5	3.5	3.5
Protein supplement	1.5	1.5	1.5	1.2	1.5	1.5	1.0
Silage	32.1	33.5	33.1	30.7	35.5	38.8	35.0
Feed cost/cwt. gain[1]	$16.34	$16.70	$14.91	$15.10	$17.24	$17.56	$18.68

[1] Cost of producing, harvesting, and storing sorghum silage ranged from $5.70 to $7.25 per ton; protein supplement averaged $85 per ton; and ground ear corn varied from $35 to $45 per ton.

What Is RURAL DEVELOPMENT?

J. H. YEAGER, *Department of Agricultural Economics and Rural Sociology*

RURAL DEVELOPMENT is discussed almost as frequently as the weather. And there is a reason – urban and rural development now go together.

Some of the present problems of cities possibly could have been avoided, or at least not have become as serious, if greater efforts and resources had been placed on rural development.

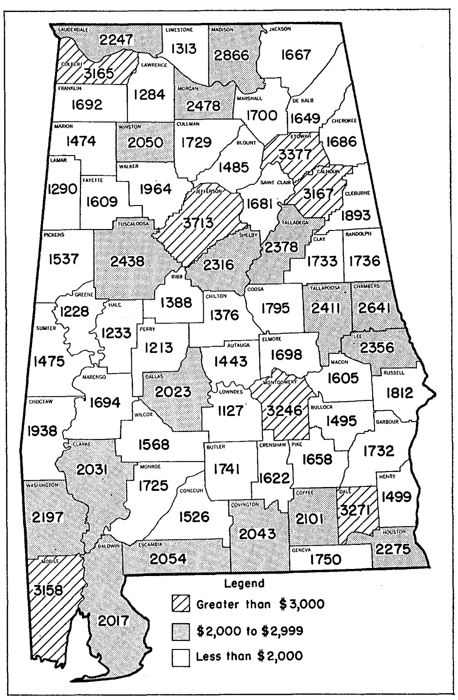
Population Concentration

Historically, growth and development of America has meant increased concentration of people in cities. The first U.S. census, in 1790, showed only 1 of 20 Americans lived in an urban area. Today 14 of 20 Americans live in urban centers – core cities or suburbia. These 70% of the people live on 1% of the land.

When cities reach a size so that the cost to provide services increases out of proportion to the population increase, then trouble ensues. Social and personal problems may also result from impersonal relationships of concentrating people in cities.

Many people residing in cities came originally from rural areas. In view of migration and movement of people between geographic areas, urban and rural development cannot be divorced.

Rural development is associated with a number of other terms. These include rural community development, economic resource development, natural resource development, and human resource development.



The above map shows the estimated per capita income in Alabama by counties in 1969.

Per Capita Income

The degree of development is sometimes measured by the level of personal income. When comparing population relative to total income, per capita personal income is used. The map of Alabama indicates 1969 estimated per capita income by counties. Jefferson County had the highest average per capita income ($3,713) while Lowndes had the lowest ($1,127). The State average was $2,582 compared with the U.S. average of $3,687 in 1969. If average per capita income is accepted as an overall measure of development in terms of personal income generated, it is obvious that most rural counties were below the State average. Apparently they have not experienced the degree of development as have many other counties.

Although development can be considered from several standpoints, such as level of income, all development involves change. In economic development, change may be in terms of increased employment opportunities and higher incomes. In community development, change may involve a new water system or other community facilities. Natural resource development may include development of a lake or stream for recreational purposes. Human resource development may come in the form of institutional developments for training or retraining people in skills and arts demanded by society. In any of these forms there may be a change in beliefs, attitudes, and values of the people affected.

Objectives

The ultimate objective of development is that people benefit. Therefore, one can define rural development as anything that contributes to the economic and social improvement of the quality of life for rural people. Although rural people benefit directly, urban residents also receive benefits.

From the report of The President's Task Force on Rural Development titled, "A New Life for the Country," the following statement gives a summary insight to rural development:

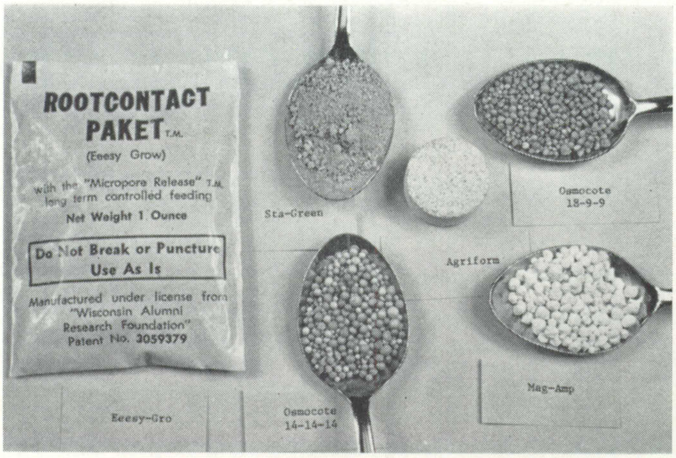
"The purpose of rural development is to create job opportunities, community services, a better quality of living, and an improved social and physical environment in the small cities, towns, villages, and farm communities in rural America."

Rural development concerns two broad groups of people directly – farm and rural nonfarm. Although total farm population has declined in the U.S. in the past several years, further development of farms and all of American agriculture cannot be overlooked.

In some areas rural nonfarm population has increased in recent years. Modern transportation, communication, and service systems have made it possible for people to live in less congested places in rural areas while working in cities. It is likely that this trend in place to live relative to place of work may increase in the future. Separation of residence and place of work poses additional challenges to development in rural areas.

Although rural development can be defined in several ways, the means of achieving development are more varied. Authorities do not agree on ways of accomplishing rural development. It is not just a case of programs or funds. One of the primary keys is the people – their motivation, interest, organization, and leadership.

Rural development will help create a nation of expanded opportunities, deeper satisfactions, and greater beauty. By development of rural areas we can provide a better life for country people and a better society for all.



LONG LASTING FERTILIZERS FOR ORNAMENTALS

KENNETH C. SANDERSON
Department of Horticulture

PLANT IT and forget it!

This is no longer a dream as far as fertilization of ornamentals is concerned. New long lasting fertilizers can now provide adequate plant nutrition for 9 months to 5 years from a single application, according to manufacturer's reports.

Most long lasting fertilizers are manufactured. Unlike the old organics (from plant or animal materials or their refuse), they are uniform, easy to handle and obtain, clean, odorless, and non-caustic. Some are non-burning and can be applied directly into the root zone. Their slow release minimizes leaching loss and salt buildup.

Auburn University Agricultural Experiment Station research has compared the growth of plants fertilized with conventional inorganic dry and liquid fertilizers with several long lasting fertilizers. The new forms tried (trade names) were Agriform tablets, Eeesy-Gro packets, Mag-Amp, Osmocote, and Sta-Green.

Agriform tablets are premeasured (1.5 to 25 g.), tightly compressed pills of various fertilizer formulations for container and landscape plantings, made to last up to 2 years.

The Eeesy-Gro packet is a perforated plastic envelope containing 10 g. to 4 oz. of water soluble fertilizer. Water vapor enters the packet through tiny holes, dissolves the fertilizer, and causes it to seep out into the root zone for 1 to 5 years.

Mag-Amp is an inorganic, nearly insoluble combination of magnesium ammonium phosphate and magnesium potassium phosphate. Lasting up to 2 years, its release is based on granule size.

Osmocote is plastic coated, granular, inorganic fertilizer of various analyses. Water penetrates the coating and dissolves the fertilizer. An increase in osmotic pressure within the granule meters the liquid nutrients for 3 to 9 months. Rate of nutrient diffusion is controlled by type and thickness of the coating.

Sta-Green is a 12-6-6 organic fertilizer. Nitrogen is supplied primarily by urea and urea formaldehyde, although cottonseed meal and ammonium nitrate are also sources.

Four experiments were done with Yellow Mandalay pot chrysanthemums during 1968-69. Osmocote 18-9-9 produced plants with the most flowers, and plant height was only slightly less than from constant fertilization at each watering, as shown below:

Treatment	*Height, in.*	*Flowers per plant number*
Constant fertilization, 200 p.p.m. NPK	12.9	3.4
12 g. Agriform tablet, 14-4-6	11.3	3.5
10 g. Eeesy-Gro packet, 16-8-16	11.0	3.5
¾ lb./bu. Mag-Amp, 7-40-6	10.7	3.5
¾ lb./bu. Osmocote, 18-9-9	12.0	3.8
¾ lb./bu. Osmocote, 14-14-14	11.3	3.7
¾ lb./bu. Sta-Green, 12-6-6	9.9	3.7

Plants getting constant fertilization and Osmocote 18-9-9 had the best leaf color and Eeesy-Gro plants had the poorest.

Potted liners of *Ilex cornuta Burfordi, Thuja occidentalis,* and *Viburnum Burkwoodi* were transplanted into Lerio cans for an experiment during 1968-69. Fertilizer treatments were applied at potting and in spring 1969. Data taken in fall 1969 revealed that constant fertilization again produced the tallest plants, as shown here:

Treatment	*Plant height, in.*		
	Thuja	*Viburnum*	*Ilex*
Constant fertilization, 200 p.p.m. NPK	15.0	18.0	20.6
12 g. Agriform	14.9	15.5	19.6
28 g. Eeesy-Gro, 16-8-16	14.6	17.9	17.6
¾ lb./bu. Mag-Amp, 7-40-6	12.7	12.7	16.3
¾ lb./bu. Osmocote, 18-9-9	14.9	17.0	20.4
¾ lb./bu. Osmocote, 14-14-4	14.4	15.6	18.4
¾ lb./bu. 8-8-8	13.9	11.5	14.9
¾ lb./bu. Sta-Green, 12-6-6	14.0	12.9	16.5

Agriform tablets and Osmocote 18-9-9 produced Thuja plants almost equal to the constantly fertilized plants. Eeesy-Gro was the second best treatment on Viburnum. Osmocote 18-9-9 yielded the tallest Ilex plants of any slow-release fertilizer. Mag-Amp was the poorest treatment on Thuja and 8-8-8 gave poorest results with Viburnum and Ilex.

Fertilization, Crop Rotation, and Nematode Populations

R. J. COLLINS and R. RODRIGUEZ-KABANA
Dept. of Botany and Microbiology
E. M. EVANS
Dept. of Agronomy and Soils

NUMBER AND KINDS of plant parasitic nematodes in field soils are affected by the kind of crop present and by the type and relative balance of nutrients in the fertilizer formula applied.

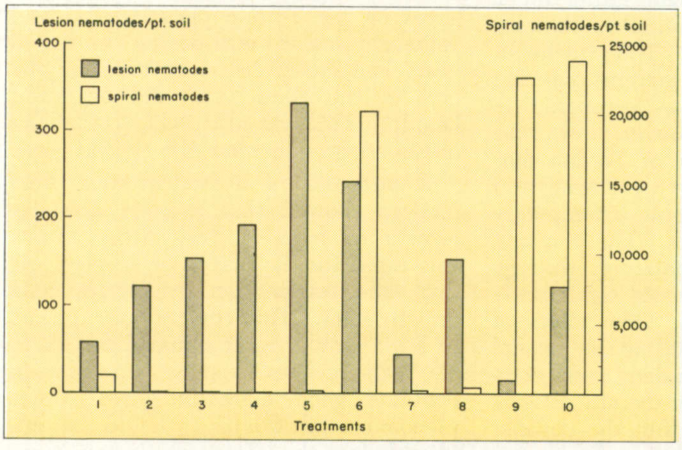
A comprehensive 3-year field study on the subject was begun at the Auburn University Agricultural Experiment Station. Plots studied were under the following rotation sequence: corn, winter wheat, soybeans, fallow, cotton, and in some plots winter legume (crimson clover + vetch) as green manure. The experiment consisted of three blocks rotating every year to Fla-200A corn, Bragg soybeans, and Auburn 56 cotton. Ten plots in each block received a different fertilizer treatment with combinations ranging from a complete formula (N, P, K, lime, minor elements) to treatments deficient in one or more of the components. Each plot had received essentially the same treatment continuously for at least 10 years.

Soil samples were collected monthly or bimonthly from each of the plots. Nematode populations were determined in both the soil and the roots.

The number and types of nematodes varied considerably among plots. Of the agriculturally important nematodes, lesion nematodes (*Pratylenchus scribneri*), spiral nematodes (*Helicotylenchus dihystera*), stubby root nematodes (*Trichodorus* sp.), and root knot nematodes (*Meloidogyne incognita*) were found in highest numbers. Dagger (*Xiphinema*) and other less important plant parasitic nematodes occurred in lower numbers.

Spiral nematodes were most numerous during growth of corn, followed by cotton and soybeans in decreasing order. These nematodes occurred in high numbers only in soil and roots from plots receiving all major elements, lime, and a winter legume. The figure illustrates a typical pattern obtained for this nematode in a sampling performed in October, 1970. Application of N in the form of winter legume resulted in higher spiral nematode population in all crops than when inorganic N was used. With the exception of plots with cotton, numbers of spiral nematodes were higher in plots deficient in P than in those lacking K. Omission of lime restricted spiral nematode numbers in all crops. When spiral nematode numbers in the figure are compared with plot yields in the table, the distribution pattern seems to coincide with the general fertility of the plots.

The pattern obtained for the lesion nematode contrasted markedly with that for the spiral nematode. Populations of the lesion nematode were higher in soybean and cotton plots receiving no fertilization and no winter legume than in plots receiving all major elements, lime, and winter legume; the reverse was true in corn plots. The form in which N was supplied affected lesion nematode populations. Plots deriving N from green manuring only had consistently lower numbers of lesion nematodes than plots receiving no N at all; this effect was more distinct in plots with corn than with soybeans or cotton. Soybean and corn plots receiving N only in the form of a winter legume supported lower numbers of nematodes than those receiving inorganic N. This difference was not apparent with cotton.



Populations of lesion and spiral nematodes in soil receiving different fertilizer treatments. Treatments are fully identified in the Table.

YIELD OF MAJOR CROPS FROM PLOTS RECEIVING VARIOUS FERTILIZER TREATMENTS, 1969

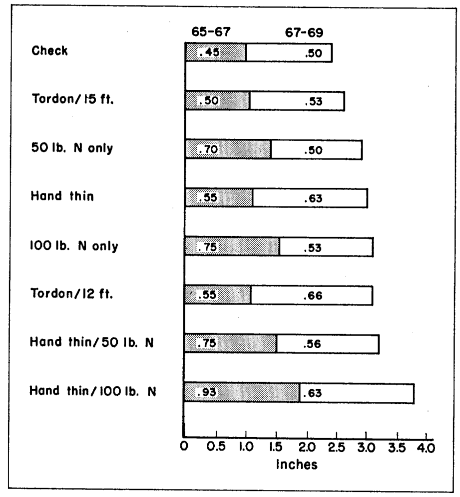
Treatment	Yields: Corn	Soybeans	Cotton
	Bu./A.	*Bu./A.*	*Lb./A.*
1. PK, lime, green man.	46.7	39.3	1,785
2. PK, lime	9.4	40.1	901
3. Check	1.6	11.8	59
4. NPK, lime	64.5	34.4	1,647
5. NK, lime, green man.	34.5	14.0	459
6. NPK, lime, green man.	88.9	41.0	1,409
7. NP, lime, green man.	12.4	11.2	46
8. NPK, green man.	52.0	14.7	653
9. NPK(-S), lime, green man.	92.1	44.6	1,472
10. NPK, lime, green man., minor elements	85.7	46.7	1,868

Omission of P or K in the fertilizer scheme decreased yields of the three major crops. However, numbers of lesion nematodes were higher in P-deficient plots than in plots receiving complete fertilization. In plots lacking P, numbers of lesion nematodes were highest in corn, followed by soybeans and cotton in decreasing order. Application of P in the form of triple superphosphate resulted in low sulfur availability and generally resulted in lower number of lesion nematodes than when superphosphate was used. Deficiency of K did not significantly affect lesion nematode populations. Omission of lime resulted in higher populations of lesion nematodes in cotton and soybean plots but did not have the same effect on corn plots.

In this study, spiral nematodes occurred at levels high enough to cause crop damage. Their occurrence in highest numbers in the more fertile plots probably reflects a greater number of fine rootlets in these plots. Lesion nematodes also occurred in numbers sufficient to cause damage to roots directly or in association with other soil-borne pathogens. The fact that their numbers increased with the use of deficient fertilizer combinations has practical significance. Thus, this study, which is still in progress, indicates that the use of properly balanced fertilizers will help to maintain lesion nematode numbers within tolerable levels.

Precommercial Thinning in Natural Pine Stands

S. D. WHIPPLE, *Dept. of Forestry*



Diameter increase of dominant and codominant trees by treatment and years. Figures within bars are average yearly growths.

MANY PINE SITES of the Upper Coastal Plain of Alabama tend to be poor. Loblolly pine quite frequently reseeds such sites abundantly, resulting in semi-stagnated overcrowded stands. These dense stands of pine (12,000 to 22,000 stems/A.) approaching age 20 have trees only 1 to 2 in. in diameter. Little diameter growth is possible under these conditions. The result is that many natural stands can not be commercially thinned for 8 to 15 years later than plantations of the same age.

In April 1965, several overstocked 18-year-old stands of natural loblolly pine on ridge areas in the Fayette Experiment Forest were selected to receive thinning treatments. A randomized block design consisting of 8 treatments with 4 replications was used. Treatments were 1) Check-no treatment; 2) hand thinning to 800 stems/A.; 3) Hand thinning as in "2" plus N at 50 lb./A.; 4) Hand thinning as in "2" plus N at 100 lb./A.; 5) Only N at 50 lb./A.; 6) Only N at 100 lb./A.; 7) Spreading a soil sterilant (Tordon) in narrow bands 12 ft. apart; and 8) Spreading a soil sterilant in narrow bands 15 ft. apart.

THINNING EFFECTS OF TREATMENTS AFTER 1 AND 5 YEARS

Treatment	Original stem count	Reduction 1 yr.	Reduction 5 yr.
	No.	*Pct.*	*Pct.*
1	11,200	4	42
2	13,720	78	79
3	19,640	85	89
4	17,360	83	83
5	22,200	15	49
6	21,360	17	59
7[1]	19,160	64	73
8[1]	14,040	46	54

[1] Soil sterilant used was Tordon 10K pellets at 104 g. per 100 lineal ft.

As shown in the table, great variation was observed in natural stocking prior to the treatments. Because of this variation a comparison of the effects of treatments was based on the per cent of reduction in number of living trees per acre for each treatment. Data showed that, 1 year after treatment, differences in reduction percentage appeared among treatments. The three hand thinnings resulted in a comparatively satisfactory condition of 800 stems/A. and thinning ranged from 78 to 85% of the original. The two Tordon treatments showed strong thinning the first year but not to the level desired. Even the fertilized treatments resulted in a greater reduction in stocking than the check for the first year after application.

The relative differences among these thinning treatments were reduced by the fifth year. Differences in the degree of thinning were evident only between the 3 hand thinnings and Tordon at 12 ft. and the check. Practically no mortality occurred on the hand-thinned plots after the first year. However, the killing effect of the soil sterilant lasted for 2 years with very little mortality showing after the second year. This treatment killed trees of all sizes thereby reducing the average diameter as compared to other treatments. However, even the residuals showed effects of Tordon during the first 2 years with a yellowing and shortening of needles plus a temporary curling of the terminals. The thinning effects of fertilizers continued through the fifth year but were not significantly greater than the check. The effect of fertilization was assumed to be related to the dominant trees making more complete use of the nitrogen thereby causing increased competition for the smaller trees. The unthinned checks began rapid self thinning at about age 21.

Average diameter growth per tree of dominant and codominant trees varied by treatment and years after treatment. During the first 2 years the check and the Tordon plots had the least growth. The limited growth of the hand-thinned-only plots could not be explained. However, the plots that were fertilized had greater growth the first 2 years than those not fertilized. The hand thinning plus 100 lb. N treatment showed greater growth than the other fertilized plots. No differences were obvious among the other fertilized treatments.

Average diameter growth per tree varied considerably from the end of the second year to the fifth year. The yearly average growth of all fertilized plots decreased after the second year but still was as good or better than the check. The hand thinning plus the 100 lb. N produced the greatest 5 year growths, averaging 3.8 in. The 100 lb. of fertilizer rates consistently produced greater increases in growth than the 50 lb. rates. Trees on the Tordon plots that showed yellowing and tip curl during the first 2 years had completely recovered by the end of the third year and appeared healthy. This was also indicated by the increased growth after the second year.

Examination of individual stem cross sections showed that average diameter growth of trees in very dense stands was rapid for the first 7 to 8 years. At this time competition greatly reduced growth rates. This competition appears to keep growth rates reduced for 12 to 15 years in these stands. In order to continue good diameter growth rates precommercial thinning should be applied before the effects of stagnation are evident or before the stand is 8 years old.

BEEF COW-CALF GRAZING SYSTEM vs. TWO CONFINEMENT SYSTEMS

SIDNEY C. BELL and ELLEN VAUGHN
Department of Agricultural Economics and Rural Sociology

HIGHEST YIELDING forage crops are not utilized at maximum efficiency by grazing. Thus, some system other than grazing must be used to get maximum benefits of improved crops by beef brood herds.

A 5-year research project (1963-68) comparing two confinement systems of utilizing forages in producing beef calves vs. a conventional grazing system was conducted at the Lower Coastal Plain Substation. A group of 45 cows was divided into three comparable groups and fed as follows:

Group I. Conventional system. Fifteen cows were allowed to graze on 15 acres of nitrated Coastal bermudagrass pasture from April until November. From November 1 to March 31, they received Coastal bermudagrass hay and protein supplement. Calves did not receive any creep feed.

Group II. Confined silage. Fifteen cows were confined to a 3-acre paddock and were fed sorghum silage (NK-300 type) year-round, supplemented with 1 lb. per day per cow of 65% protein supplement when the cows were dry and 1.5 lb. per day during lactation. Calves were given a blended creep mixture.

Group III. Confined hay. Fifteen cows were confined to a 3-acre paddock on a year-round basis and were fed Coastal bermudagrass hay daily. They also received 1 lb. per day per cow of 65% protein supplement during lactation. These calves also received a blended creep mixture.

Forage yields and animal input-output data were determined from the experimental data. Prices of resources used in production were obtained from experimental data, equipment dealers, and previous publications. These prices were used to develop costs and returns for the three different feeding systems. Actual sale value of calves was used. The price per pound varied from year to year and for each system, but was approximately $0.25 per lb.

All feeding systems had a negative return to land, labor, and management, see table. To determine how these systems might compare in the next 5 to 10 years, a set of projected prices was used to determine net returns.

When projected prices (calf price of $0.32 per lb.) were used, the conventional system was the most profitable. Net returns from projected prices for 1971 showed $270 returns for conventional systems; $–21.55 for confined silage and $–421.19 for confined hay.

FIVE-YEAR AVERAGE SUMMARY OF TOTAL RECEIPTS AND EXPENSES BY TYPE OF FEEDING SYSTEM, CONFINED BEEF COW STUDY, LOWER COASTAL PLAIN SUBSTATION, ALABAMA 1963-68

Item	Type of feeding system (15 cows each)		
	Conventional	Confined silage	Confined hay
	Dol.	*Dol.*	*Dol.*
Receipts			
Calves	1,448.55	1,712.35	1,471.17
Excess forage	72.53	58.57	5.41
½ bull @ 1,600 lb.	60.00	60.00	60.00
Average total receipts	1,581.08	1,830.92	1,536.58
Average cash expenses			
Protein supplement	169.32	314.95	131.05
Forage purchased	53.68	46.21	75.07
Calf creep feed	0	565.60	576.74
Veterinary expense	15.00	15.00	15.00
Building & fence repair	16.50	16.50	16.50
Tractor operation expense	159.30	167.88	170.00
Fertilizer, lime, and seed	417.30	222.24	352.48
Labor	75.00	106.80	80.00
Interest on operating capital	35.60	50.35	48.48
Marketing expense	45.33	53.17	45.20
Average noncash expenses			
Noncash machinery cost	119.10[1]	253.68[2]	127.12[3]
½ bull	105.00	105.00	105.00
Fixed expenses	318.00[4]	278.09[4]	422.74[4]
Establishment cost	57.00	0	30.40
Average total cost of production	1,586.13	2,195.47	2,195.78
Average returns to operator's land, labor, & management	–5.05	–364.55	–659.20

[1] Noncash machinery cost was $7.94 per acre for 15 acres.
[2] Noncash machinery cost was $21.14 per acre for 12 acres necessary to furnish silage for this group.
[3] Noncash machinery cost was $15.89 per acre for 8 acres necessary to furnish hay for this group.
[4] Fixed expenses included interest, depreciation, taxes, and insurance on the cattle, barn, and fencing.

Increasing land value increases total cost of producing calves considerably in the conventional system. To determine the effect of higher land values, the net returns and land requirements of the respective feeding systems were compared. Use of an estimated break-even value of land indicated at present production, the price of land had to be exceedingly high, $844 per acre, before any consideration would be given to a confinement feeding system. As the yield of silage and Coastal bermuda hay increased, the break-even value of land decreased. With an increase in the yield of silage from 20 to 30 tons per acre, the break-even value of land decreased from $844 to $473 per acre. One ton per acre increase in Coastal bermudagrass hay in the confined Coastal bermudagrass hay system resulted in a decrease in the break-even value of land from $1,418 to $1,276. This depicts the increased competitiveness of the confinement system with the conventional system as forage yields increase.

Cows from both confinement systems consistently weaned heavier calves than the conventional system. This extra weight was attributed to the use of calf creep feed in the confinement system. The silage system had an additional cost of $0.44 per lb. and the confined hay system an added cost of $0.88 per lb. as a result of using calf creep feed.

RURAL ALABAMIANS MOVE -- WHERE?

CALVIN VANLANDINGHAM
Department of Agricultural Economics and Rural Sociology

MIGRATION OF PEOPLE is a phenomenon about which little is known. Although data on the numbers of migrants by race, sex, and age are available, knowledge of individual migrants is generally lacking. Alabama, as well as the South, has experienced a considerable amount of out-migration. For example, between 1950 and 1960, Alabama lost 368,000 people as a result of out-migration; that is, 368,000 more people moved out than moved in. During the 1960 to 1970 decade, Alabama continued to lose; however, the South, for the first time in a century, gained more migrants than it lost.

Southern Regional Projects S-44 and S-61 provide some information on migrants. Both studies are concerned with the adjustment and change in households located in low-income, rural areas. The Alabama portion of the study contains 278 households in four counties. Both heads and homemakers were first interviewed in 1960 (S-44 Project) and reinterviewed in 1966 (S-61 Project). In the restudy, interviews were completed in 155 of the original 278 households.

A part of the interview schedule was designed to obtain information on all members of the household, including those who had left. Such information as the age at which the individual left the household, sex, occupation, and address at the time of interview was included. The information on residence provides the data for this report.

A total of 679 individuals had left these 278 households prior to the 1960 interview – approximately 2.4 persons per household. Another 63 individuals had migrated from the 155 households recontacted in 1966. Thus, 742 former members of these rural households were residing elsewhere. Information on some individuals is not available as the homemakers either didn't know or failed to provide such information.

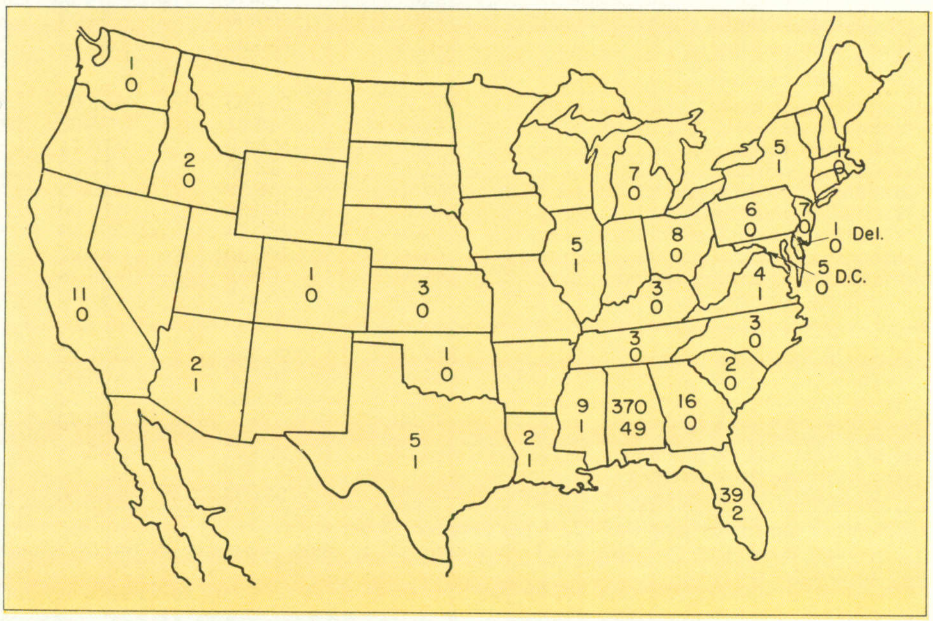
The map shows, on a state basis, the location of migrants from these Alabama households. The top figure in each state is the number of Alabama migrants who resided in that state as determined from the 1960 study. The lower figure is the number of Alabama migrants from the 1966 restudy. As indicated, most of the migrants were living within Alabama at the time of the interviews – less than 30% were outside the State.

Research has demonstrated that most moves are relatively short ones. This appears to be true in this study. For example, about 20% were living in the same community and another 25% were living in the same county. One rather surprising finding was that a majority of the migrants who resided in Alabama had remained in rural areas. Although about half lived in urban areas, only 15% were in Alabama's largest cities. On the other hand, of those who left the State, almost all (95%) were living in urban areas, with approximately 50% in cities of 100,000 or more population. This may partially explain the slow rate of growth of Alabama's large cities.

Most of the migrants outside the State were in the Southern Region. Florida, as might be expected, had 41 former Alabama residents living within its borders. Georgia was next with a total of 16. Two states with 10 or more migrants were California and Mississippi. States with between 5 and 10 were Texas, Illinois, Michigan, Ohio, Pennsylvania, New York, and New Jersey.

Comparisons between those migrants who remained in Alabama and those who resided elsewhere can be made. As previously noted, those moving within Alabama tended to stay in the rural areas, while those who moved out almost totally went to urban areas. Migrants outside Alabama had completed more years of school than those within; however, the differences were slight. Migrants residing in Alabama were more recent movers than those living outside the State. This finding together with the fact that a higher percentage of the migrants in the restudy were living within Alabama suggest that many individuals move within state as a first step to moving out of the State. However, it may be that Alabama will begin to retain more of its rural people.

Although a complete picture is not possible and generalizations are limited, the analysis provides new information on rural Alabama migrants. A majority of the migrants were living in the State. Of those who lived outside Alabama, most were in large urban areas of the Southern States. Florida and Georgia led all states in the number gained. Most migrants within the State resided in rural areas or small towns – a positive factor for the future of rural Alabama.



Location of migrants from Alabama households contacted in this study. The top figure in each state was determined by the 1960 study and the bottom by the 1966 restudy.

The Morningglories—Serious Weeds of Cotton

GALE A. BUCHANAN and EARL R. BURNS[1], *Department of Agronomy and Soils*

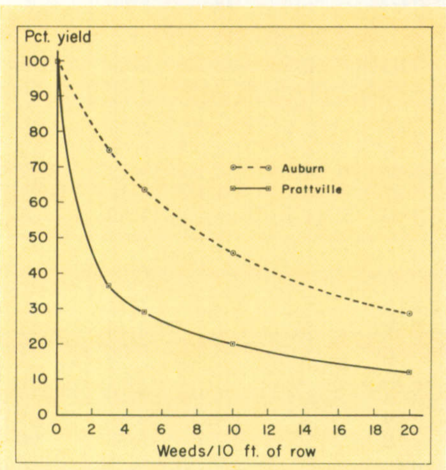
MORNINGGLORIES ARE some of our prettiest plants. Some are even cultivated as flowers. But they are also among the most serious weeds in cotton and other crops in Alabama.

More than 15 morningglories occur in crops in various regions of the United States. The major problem ones in Alabama are tall (*Ipomoea purpurea* (L.) Roth), ivyleaf (*I. hederacea* (L.) Jacq.), and smallflower morningglory (*Jacquemontia tamnifolia* (L.) Griseb). Cypressvine morningglory (I. *quamoclit* L.) also occurs in southeastern Alabama. It may be locally serious but is not widespread. These morningglories cause serious reductions in yield and, in some instances, lower the quality of corn, cotton, peanuts, and soybeans.

A major factor that contributes to morningglories' success as weeds is their large seed size. This enables them to germinate deep in the soil, often below the effective zone of applied herbicides, and probably contributes to the often erratic control by herbicides.

Early growth of morningglories is rapid, and this factor alone would make them severe competitors of crops. Coupled with rapid growth, however, is another factor that makes them serious pests – their viny type of growth. This growth habit enables the pest plants to climb to the top of most crops so they compete not only for nutrients and moisture but also for light.

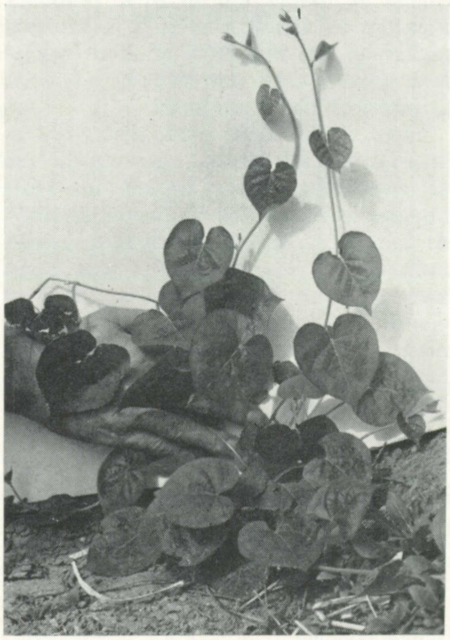
[1] Now with Cooperative Extension Service, Auburn University.



Morningglories provided more severe competition in cotton at Prattville than at Auburn, but yields at both locations dropped as population of morningglories increased.

Effect of specific densities of morningglory on cotton was studied by Auburn University Agricultural Experiment Station. These experiments were at both Auburn and the Prattville Experiment Field.

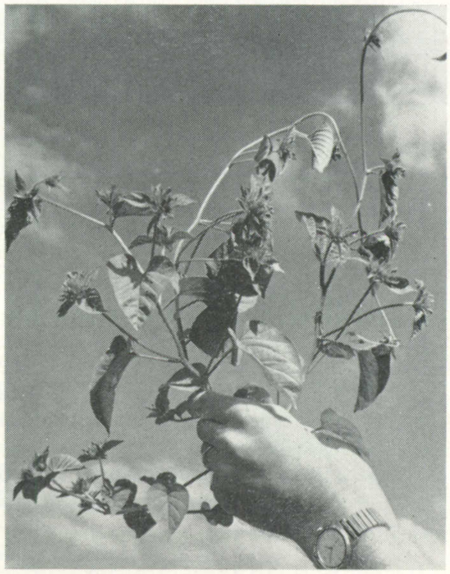
Tall morningglory seed were planted 20 to 30 seed per ft. of row when cotton was planted. After cotton and morningglories had germinated, the morningglories were thinned to the desired density, ranging from 1 per 3 ft. of row to 1 per 6 in. of row. Cotton was thinned to a uniform stand of 6 to 10 plants per ft. All yields were by hand harvest.



Tall morningglory is one of the major species of this pest that occurs in Alabama to provide serious competition for crops.

As shown by data in the table, even the lowest weed density reduced yield of cotton at both locations every year except one. There were no yield reductions at any density in 1969, probably because of a heavy (mid-season) infestation of white mold disease that severely injured morningglory. In other years, yields were reduced 15 to 40% at Auburn and 53 to 75% at Prattville from the low density weed infestations.

Higher densities caused still greater reductions. At the highest density studied (2 morningglories per ft. of row) cotton yields were reduced 69 to 73% at Auburn and 85 to 88% at Prattville.



Smallflower morningglory isn't a true morningglory, but it has similar growth characteristics and is a major weed pest in cotton and other crops in Alabama.

EFFECT OF DENSITY OF TALL MORNINGGLORY PLANTS ON YIELD OF SEED COTTON

Weed density	Yield reduction[1]					
	Auburn				Prattville	
	1966	1967	1968	1969	1967	1968
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
1 weed/3 ft. of row	40	21	15	0	53	75
1 weed/2 ft. of row	47	24	37	0	65	77
1 weed/ft. of row	58	41	63	0	77	83
1 weed/6 in. of row	69	—	73	0	85	88

[1] Yields of weed-free cotton average 2,160 lb. at Auburn and 2,650 lb. per acre at Prattville.

Greater competition of morningglory at Prattville is clearly shown in the graph.

Length of the main cotton stalk, stem diameter at the soil surface, and boll and seed weight were reduced by morningglories, but not nearly as much as was yield. Lint and fiber properties were not affected to any measurable extent. However, these data represent cotton produced (hand harvested yields) and do not consider harvesting difficulty. The green viny growth of morningglories would severely interfere with mechanical harvest and drastically reduce picker efficiency. Additionally, it would cause added trash and stains that could reduce grade of the lint.

INCOME as Related to Consumer MILK PURCHASES

RUTH A. HAMMETT, *Department of Agricltural Economics and Rural Sociology*

SURVEYS OF DAILY FOOD INTAKE by Americans have shown that diets at all income levels may be deficient in certain essential nutrients. Some of these deficiencies, such as calcium and the B vitamins, could be supplied by increased use of milk products.

A total of 925 urban families from three Alabama cities sampled by a researcher in the Department of Agricultural Economics and Rural Sociology provided an opportunity to study effects of income on weekly food costs and use of milk products. White families in the sample had average incomes of $10,000, and per capita incomes of $3,000. Negro families had average incomes of $4,300, and per capita income of $1,342.

In both races, with each increase in income range, a smaller proportion of the total budget was spent for food. The average white family spent 17% of income for food, and the average Negro family spent 22%. The proportions in an individual family would depend on many factors, such as size of family, age and sex of family members, purchased and guest meals, or tastes and preferences.

Data showed that decreasing amounts were spent for food per person as family size increased. Larger amounts were spent for food per person with increases in age of the homemaker, age of the youngest family member, per capita income, or per capita meal cost. With greater food costs per person, larger amounts were spent for dairy products, but these products accounted for a smaller proportion of food expenditures. In each race, 15% of the average food dollar went for dairy products.

These facts indicated that more was spent for food per person in families of two or three adults, usually in the ages when all children are grown, or beyond the age of 45 years. The same or greater income is divided among fewer persons, which allows more freedom in food choices. Because of package sizes, dislike of monotony, or spoilage because of overbuying, food costs in small families are 10 to 15% higher than for families of 3 or 4 persons.

To evaluate milk use from a nutritional standpoint, dairy products by each family were reduced to calcium content in terms of fresh whole milk and grouped into six equivalent classes: Sweetmilk, buttermilk, cheese, dry milk, evaporated milk, and ice cream. The amount of milk equivalent recommended for each family member was calculated by age and sex, and adjusted to total meals eaten at home.

The recommended nutritional standard of 5 qt. of milk equivalent per week for children, 7 qt. for teenagers, and 3.5 qt. for adults was used to measure adequacy of family use of milk products. Families in which sweetmilk equivalent makes up less than 50% of total equivalent seldom used nutritionally adequate amounts of dairy products.

Data in the table show that with increased annual income, per capita use of sweetmilk nearly tripled in white families and doubled in Negro families. At any range except the lowest, sweetmilk use by Negro families was about half that of white families. Use of cheese and total equivalent nearly doubled with increased income in white families, but there was little change in Negro families.

Per capita weekly food costs increased much more rapidly with greater income in Negro than in white families. Milk expenditures doubled with increased income in white families. Negro families never exceeded the amount spent for milk products by the lowest income group in white families, regardless of their income.

All white families, except the lowest income group, used 85% or more of milk equivalent regarded as necessary for adequate nutrition. In each income range, the ratio of sweetmilk equivalent was more than 50%. Only Negro families in the highest income range approached this level of dairy product use.

Per capita use of ice cream equivalent was the same in both races. A greater percentage of Negro families used equal or larger amounts of buttermilk, dry milk, and evaporated milk than white families. Consumption of processed milk products did not offset low use of sweetmilk equivalent in most Negro families. The average Negro family was using 59% of the amount of milk products considered nutritionally necessary.

One of the greatest potential markets for beverage-type milk products is in Negro families with younger children. Activities such as Headstart, School Lunch Programs, and the Expanded Food and Nutrition Programs can reach special groups. If milk products are to become a full member of the Basic Four food groups in Negro families, a vigorous nutrition program is necessary.

PER CAPITA USE OF MILK EQUIVALENT AND FOOD COST PER WEEK, BY ANNUAL FAMILY INCOME, 801 WHITE AND 124 NEGRO FAMILIES, THREE ALABAMA CITIES, SPRING 1968

Annual family income, dollars	Family		Per capita milk equivalent used				Per capita	
	Distribution	Average size	Sweetmilk	All cheese	ME used	ME[1] recc.	Food cost[2]	Milk cost
	Pct.	*No.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Dol.*	*Dol.*
White families								
Under 1,500	1	2.5	0.9	0.5	2.5	3.7	6.20	0.74
1,500-2,999	2	2.6	1.9	.3	3.6	3.9	7.12	.98
3,000-4,499	7	3.2	1.9	.4	3.4	3.8	6.15	.99
4,500-5,999	9	3.7	1.9	.5	3.4	4.0	6.64	1.03
6,000-7,999	15	3.7	2.2	.6	4.0	4.0	6.90	1.11
8,000-9,999	16	3.6	2.5	.7	4.1	4.1	8.12	1.17
10,000-12,999	22	4.0	2.5	.7	4.1	4.1	8.11	1.26
13,000 and over	28	3.9	2.5	.9	4.4	4.1	8.82	1.35
Average		3.8	2.4	0.7	4.0	4.1	7.74	1.17
Negro families								
Under 1,500	12	3.9	0.8	0.3	2.4	4.4	3.16	0.69
1,500-2,999	24	3.6	.5	.3	2.0	4.3	4.40	.54
3,000-4,499	30	3.3	1.0	.6	3.0	4.3	5.04	.74
4,500-5,999	15	4.8	1.0	.2	2.1	4.3	4.65	.60
6,000-7,999	9	4.4	.9	.4	2.4	4.1	5.16	.71
8,000-9,999	8	4.4	1.3	.4	3.0	4.0	5.64	.82
10,000-12,999	2	3.5	1.6	.2	2.7	2.4	8.86	.90
13,000 and over	0	0	0	0	0	0	0	0
Average		3.9	1.0	0.4	2.5	4.2	4.69	0.67

[1] Recommended Dietary Allowances, Sixth Revised Edition, 1964. National Academy of Science. National Research Council Pub. 1146.
[2] Includes milk product expenditures.

GOOD MANAGEMENT VS. MAREK'S DISEASE

S. A. EDGAR, Y. CHO, and H. WOMACK
Department of Poultry Science

A LOSS OF $200 MILLION by the poultry industry in the United States from leukosis of chickens is the loss estimate prior to 1970. The Marek's type of the leukosis complex is believed to account for 90% of this loss and its incidence has increased steadily during the past decade.

Marek's disease is caused by a herpes virus(es) that causes partial paralysis and lymphoid tumors in various organs of the body. Not all birds that acquire the agent develop the disease. The development of tumors resulting in morbidity and death cause the economic loss. The onset of morbidity and time of death in a flock depends largely on the age exposed and the severity of exposure. Losses chiefly are unthriftiness, death, reduced egg production, and condemnations. The dollar loss from condemnation of broilers rose from 4 to 5 million 10 years ago to 25 to 30 million in 1970. During the past 12 months many company operations have averaged 5 to 10% condemnation losses for months at a time, particularly during winter and early spring.

Marek's disease is now known to be highly infectious through air. The virus is shed in the epithelial cells from the skin, particularly in those from around feather follicles, and chickens shed the agent in greatest amounts about 2 to 3 weeks after becoming infected.

Control

Ways by which producers have or are attempting to reduce losses from this disease are: (1) genetic selection for resistance, (2) protection of chickens from exposure for the first 3 to 6 weeks of their lives by rearing them in clean environments away from older stock, (3) use of chemicals that kill the agent, and (4) immunization. Research has shown that a high degree of resistance can be attained in as few as two generations of selection. Other results have shown that starting chicks in clean isolated quarters reduces the disease. Although numerous investigators have attempted to develop attenuated Marek's vaccines, none has had great success. It was only recently that two groups of scientists (Burmester and colleagues with USDA and Biggs and co-workers in England), working independently, found that a naturally occurring herpes virus of turkeys when injected into chicks resulted in marked protection against the disease.

Recent work at Auburn has dealt with (1) attempts with industry to develop practical procedures for reducing exposure to Marek's disease in commercial poultry operations, (2) testing the relationship of age at the time of exposure to the incidence of the disease and (3) testing the effectiveness of reducing the disease by immunization. Attempts to protect birds by immunization with a Marek's agent were unsuccessful.

Results of some of the field trials by different companies to reduce Marek's by cleaning contaminated premises are summarized in Table 1. In all instances the companies were able to reduce condemnation by 50% or more.

Chicks exposed at 7 days of age were less than 50% as susceptible as those exposed at 1 day and those exposed at 2 weeks about half as susceptible as those exposed at 7 days. By 6 or 9 weeks chickens were only about 10% as susceptible as those exposed at 1 day. These results support work at the University of Georgia where broiler chickens reared and maintained for 3 weeks in clean positive pressure houses and then placed in contaminated quarters suffered less than 10% as much from the disease as hatchmates placed in the same contaminated quarters at 1 day of age.

TABLE 1. INCIDENCE OF LEUKOSIS CONDEMNATIONS AMONG BROILERS BEFORE AND AFTER SANITIZING CHICKEN HOUSES

Company	Incidence of leukosis			
	Before clean out[1]		After clean out	
	Morbidity	With tumors	Morbidity	With tumors
		Pct.		Pct.
A	+	14	None	< 1
B	+	6	Some	< 2
C	+	20	None	< 3
D	+	12	Some	< 5
E	+	12	Some	< 4

[1] Several selected farms with 1 or more houses having history of high leukosis condemnation.

TABLE 2. EFFECT OF AGE OF EXPOSURE ON DEGREE OF MAREK'S DISEASE IN GROWING CHICKENS, TWO EXPERIMENTS[1]

Age when exposed	With tumors	Mortality from Marek's
	Pct.	Pct.
1 day	43.0	25.0
4 days	24.0	19.0
1 week	20.0	15.0
2 weeks	13.0	7.0
3 weeks	8.0	2.5
6 weeks	3.5	3.5
9 weeks	3.5	3.5
Controls	3.5	3.5

[1] More than 3,000 chickens. Tests terminated 12 to 16 weeks after exposure.

Results of several tests to pinpoint the effect of age on susceptibility are summarized in Table 2.

Results of preliminary trials to test the effectiveness of vaccination with a tissue culture turkey herpes virus (THV) vaccine (source of THV-USDA, East Lansing) or with THV- infected whole turkey blood are summarized in Table 3.

TABLE 3. INCIDENCE OF MAREK'S DISEASE IN CHICKENS VACCINATED AT ONE DAY OF AGE WITH THV TISSUE CULTURE (TC) OR THV-INFECTED TURKEY BLOOD

	Strain of bird	Vaccinated with	Morbid signs	Condemned for tumors
A[1]	Layer	None	Yes	15.5
A_1[1]	Layer	Turkey blood[1]	No	1.9
B	Broiler	None	Yes	15.0
B[1]	Broiler	TC	No	3.0
C	Broiler	None	Yes	6.6
C_1	Broiler	TC	No	2.5
D	Broiler	None	Yes	9.1
D_1	Broiler	TC	Some	5.4

[1] Fifty birds of each treatment in each of 4 pens. 100 to 200 PFU's/0.25 ml. dose of turkey blood.

Drought Affects Growth of Cotton Stems

BETTY KLEPPER
Department of Botany and Microbiology

V. DOUGLAS BROWNING
SWCRD, ARS, USDA

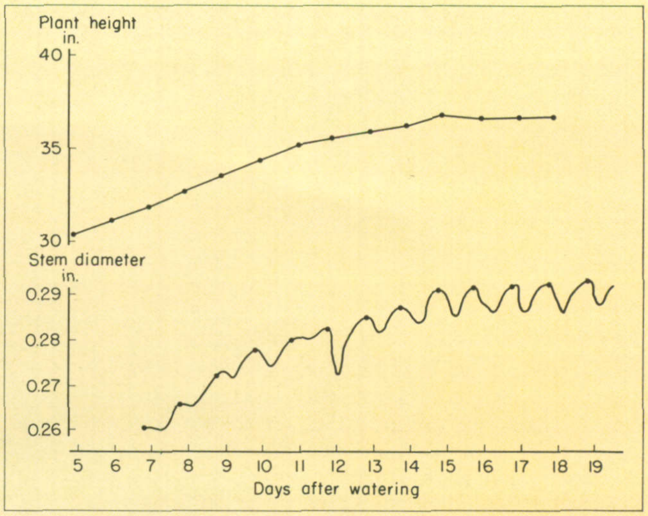


FIG. 2 Comparison of changes in plant height and stem diameter.

PLANTS REQUIRE WATER for growth and very often they will cease growing during a summer drought. Reductions in growth can, and generally do, cause decreased yield. Thus it is important to study in some detail the effects of drought on growth. Since changes in plant height are not easily measured in the field, an instrument has been built at the Auburn University Agricultural Experiment Station to measure stem diameter growth continuously and with a high degree of accuracy.

Some of the instrumentation required for these measurements is shown in the diagram. The apparatus holds a plant stem steady while a movable core is pressed to the side of the stem. The core passes through an electronic sensor, called a linear variable differential transformer (LVDT), which will produce a different voltage depending on how far the core is pushed into the LVDT. When the stem grows in diameter, it pushes the core and the resulting voltage change indicates the expansion of the stem. The voltage is automatically recorded so that when the plant is growing the LVDT is providing information that periodic manual measurements and observations could not provide.

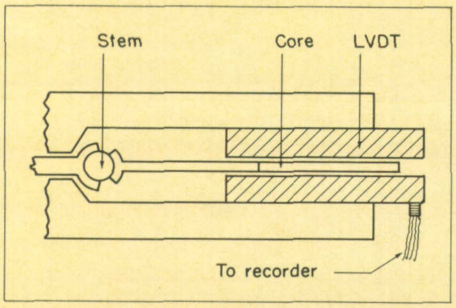


FIG. 1. Apparatus used to continually measure changes in diameter of cotton stems.

One recent experiment, illustrated in the graph, shows effects of drought on the growth of a cotton plant. The experiment was started after the soil had been thoroughly watered; then the soil surface was covered. Plant height was measured daily at 8 a.m. In the graph, the 6 a.m. value of stem diameter is indicated with a dot. The stem grew rapidly in both diameter and height for about 2 weeks before the growth rate slowed down. Notice that stem diameter decreased in the middle of the day even when the plant was in wet soil. This midday shrinkage occurs because the plant loses more water on a warm, sunny day than it can take up from the soil, especially when the root system is stunted or the soil is dry. The midday stem shrinkage became even more marked after 1 week when the soil had become rather dry.

Obviously, this midday shrinkage makes it difficult to measure stem diameter growth without continuous monitoring. In practice, a daily measurement at 6 a.m. determines growth made from one day to another. The graph shows that both stem diameter growth and stem height growth stopped at about the same time during the drought period.

This instrument is being used in detailed studies relating plant growth to the environment and to the extensiveness of the root system.

AGRICULTURAL EXPERIMENT STATION
AUBURN UNIVERSITY
AUBURN, ALABAMA 36830

E. V. Smith, Director

PUBLICATION—Highlights of Agricultural Research 6/71 10M