HIGHLIGHTS

of agricultural research

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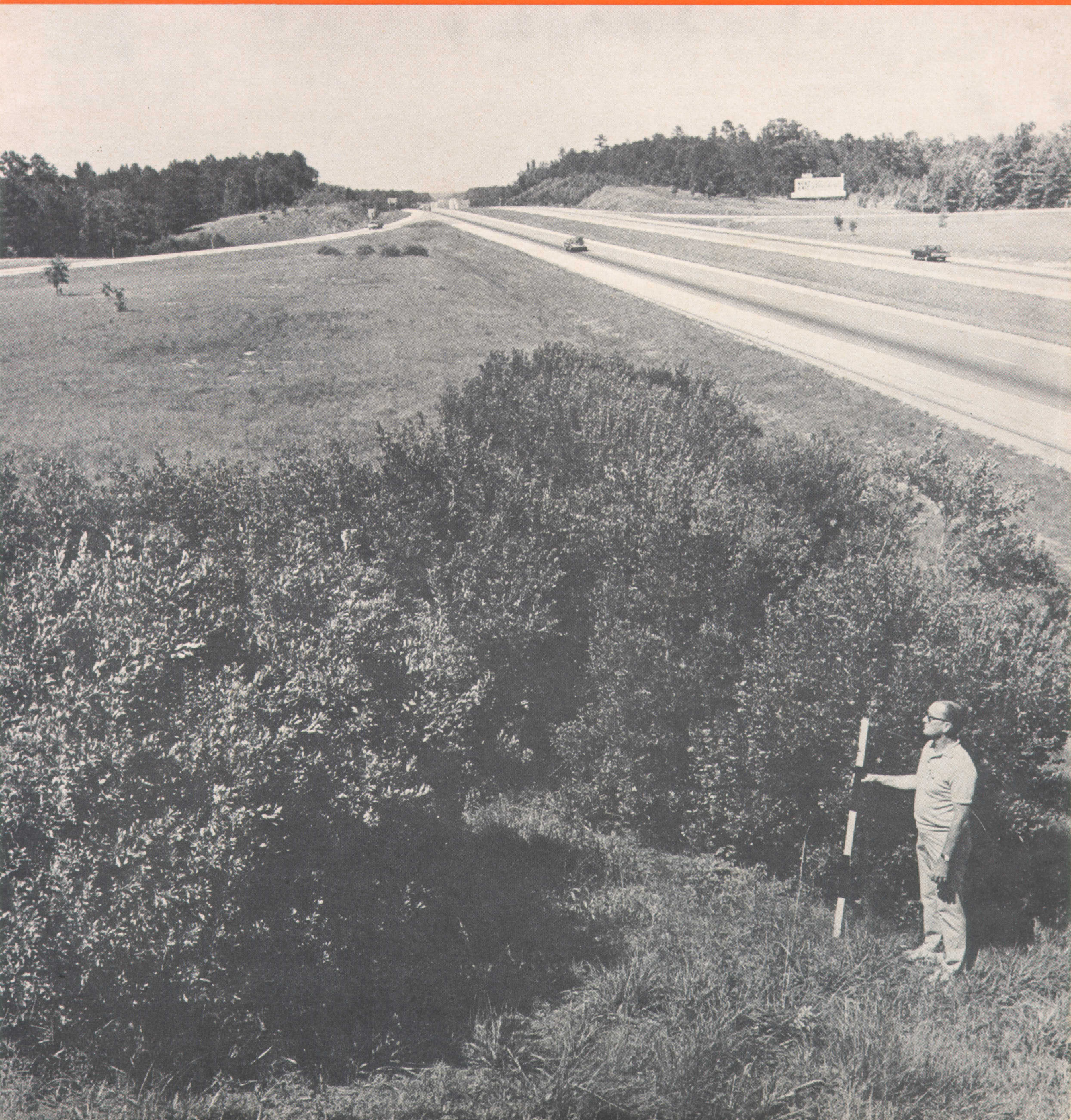
AUBURN UNIVERSITY



DIRECTOR'S COMMENTS

E. V. Smith

IN THE JARGON of his profession, K. B. Roy wrote "30" to an illustrious career in agricultural journalism when he retired as Head of the Experiment Station's Publications Department at the end of June. "Ken," as he is known to his associates at Auburn and to newsmen, is a master craftsman. Working in association with agricultural scientists, he stressed accurate reporting based on supportable facts.

Mr. Roy was Station Editor when the quarterly publication, HIGHLIGHTS OF AGRICULTURAL RESEARCH, was established. He has worked unceasingly to make it a truly outstanding quarterly report of current research in the broad field of agriculture. The fact that this issue, the first that hasn't carried his name as Editor, meets the established standard is proof that he built well.

Mr. Roy expected the same high standard of performance from his associates that he demanded of himself. Despite this fact, he has had only four assistants during his quarter of a century at Auburn, two of whom are still in the department. The senior from the standpoint of service, E. L. McGraw, succeeded him as Editor and Head of the Department on July 1.

June 30 marked the retirement of another outstanding member of the Auburn faculty. As an agronomist, Dr. D. G. Sturkie made many contributions to science during his 45 years of research.

Interested in pastures, Dr. Sturkie long ago initiated a test to compare grasses from various parts of the world in an effort to find improved grasses for pastures. He noted one in his tests that obviously wasn't good for grazing but seemed to have possibilities for other uses. A less observant scientist might have discarded it. Dr. Sturkie's discerning eye suggested that he give the newcomer a trial as a lawn grass. If you have guessed that this new grass was zoysia matrella, you are correct.

From a relatively simple experiment came a new grass for the lawns of Eastern America and a new agricultural enterprise for many Alabamians. The introduction of zoysia is but one example of the many scientific contributions that Dr. Sturkie has made to the agricultural economy and cultural development of his State.

Important as his research results have been, Dr. Sturkie will be remembered longest for his teaching. Brilliant, witty, often sarcastic, and always demanding, Dr. Sturkie is affectionately known as "Doc" to thousands of Auburn Alumni.

Ken Roy and Doc Sturkie are symbolic of the spirit of the Land-Grant University. Other researchers, other teachers, and other writers will follow to do the jobs of research, of teaching, and of reporting that are needed.

look for these articles

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may we introduce . . .

To kick-off this new feature of HIGHLIGHTS, we introduce E. L. McGraw, the new Agricultural Experiment Station Editor, who is responsible for this and all other published research reports of the Experiment Station.

McGraw moved into his new position July 1, after serving 11 years as associate editor in Publications Department. He fills the position created by retirement of K. B. Roy, Station Editor who originated HIGHLIGHTS.

The new department head has been on the Auburn University staff for more than 23 years, working as subject matter specialist in agricultural education in addition to editorial duties for both Experiment Station and Extension Service. He also taught vocational agriculture for 4 years. His B.S. and M.S. degrees are from Auburn, and he did additional graduate work at Auburn and University of Kentucky.

Each quarter this column will introduce an additional member of the Auburn research staff that regularly reports its findings to readers of HIGHLIGHTS.

HIGHLIGHTS of Agricultural Research

FALL 1968 VOL. 15, NO. 3

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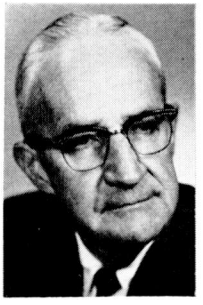
COVER PHOTO. Southern waxmyrtle adds a touch of beauty while conserving soil on slope of I-85 interchange near Auburn.

AN ERA ENDS

Kenneth B. Roy—originating editor of HIGHLIGHTS—joins retired ranks



Kenneth B. Roy

By R. E. STEVENSON
Department of Publications

MORE THAN 14 years have passed since the first issue of HIGHLIGHTS OF AGRICULTURAL RESEARCH rolled off the presses. That original issue was the brain-child of Kenneth B. Roy, Agricultural Experiment Station Editor, and each succeeding issue has had the "Roy Touch"—a style characterized by timely topics, accurate and readable copy, and attractive layouts. This publication style put results of complicated scientific research into understandable and interesting form, and had much to do with the quarterly's acceptance by Alabama farmers and professional agriculturists.

But the "Roy Era" has ended. Retirement on June 30 removed his name from the editor's spot on the masthead, making the current issue the first ever printed without his personal supervision. Nevertheless, the pattern he set through the years is evident throughout this issue.

HIGHLIGHTS began as an 8-page magazine with 8,000 circulation. Its objective, as stated in the first issue, was to "present the highlights of our broad agricultural research program." It grew into a 16-page book as more and more research information became available and as researchers recognized the magazine as an effective way to get research information to those who could use it.

Although Mr. Roy probably got more satisfaction from HIGHLIGHTS than from any other phase of his work, it was just one of many accomplishments since he came to Auburn in 1943. The technological revolution that has occurred on Alabama farms during his years at Auburn has relied on scientific information, and his efforts in disseminating new and usable research results played an important role in acceptance of modern methods.

Known as a perfectionist, Mr. Roy never spared himself in his quest for accuracy and completeness in reporting research, whether in Experiment Station publications or in news or feature stories. He was responsible for publishing more than 400 bulletins, circulars, leaflets, progress reports, and special publications during his tenure at Auburn's Agricultural Experiment Station. In addition, he aided researchers in reporting their results in technical publications, fulfilling his responsibility of editing all reports originating at the Experiment Station.

Mr. Roy's journalism training and newspaper background proved invaluable in the news dissemination portion of his work as Station Editor. He retained the viewpoint of the working newspaperman, and regularly supplied newspapers with information they termed "news" rather than publicity. Because of this emphasis on furnishing news and his close working relationship with newspapers and farm magazines, these news media regularly devoted space to results of timely Auburn research. His detailed knowledge of printing made for pleasant relations with printers and contributed to the excellent printing that characterized Station publications.

Mr. Roy is a native of Wisconsin, but he adopted the South following his graduation from University of Missouri in 1923. He spent several years with weekly and daily newspapers and wire services before shifting allegiance to the field of agricultural journalism.

After 16 years as agricultural editor at University of Arkansas, where he developed one of the nation's outstanding Extension information programs, he came to Auburn in 1943 as the first full-time Experiment Station editor. He was named head of the Publications Department when it was formed in 1947, and retained this post until retirement. Much of the work of the department, now staffed by three editorial workers, reflects Mr. Roy's philosophy of service to the overall agricultural research program.

Establishment and Maintenance of

LADINO WHITE CLOVER

in the Black Belt

C. COOPER KING, JR., *Dept. of Agronomy and Soils*

L. A. SMITH and H. W. GRIMES, *Black Belt Substation*

Ladino white clover field at the Black Belt Substation. Proper establishment and maintenance practices were followed on this high-producing field.

WHITE CLOVER has excellent nutritive value and high palatability, produces well, and supplies nitrogen to grasses.

To learn how to better manage white clover in the area, a 3-year test was begun in 1964 on a Houston soil at the Black Belt Substation. The test compared the following factors: method of land preparation; soil treatment with fungicide; soil treatment with insecticide; and irrigation. The factors were tested at two levels and in all possible combinations.

Breaking and disking an established dallisgrass sod was compared with spraying the sod with 5 lb. of dalapon per acre. A fungicide treatment of 1:1 mixture of captan and terraclor broadcast at the rate of 10 lb. of technical material per acre was compared with no treatment. These two treatments were performed at the start of the experiment only.

Half of the plots were irrigated at seeding and as needed during subsequent seasons to encourage the clover to persist as a perennial. An insecticide was applied to one-half of the plots at seeding and in early fall of later years.

All plots were fertilized according to soil test. On September 10, 1964, Regal ladino clover was broadcast seeded at the rate of 4 lb. per acre.

Treatments that were irrigated and received insecticide gave good performance regardless of method used for land preparation or whether or not the fungicide was applied. The only successful treatment not receiving insecticide was irrigated, had complete land preparation, and received fungicide. The only successful unirrigated treatment was sprayed with dalapon and received fungicide and insecticide, Table 1.

TABLE 1. EFFECT OF IRRIGATION, INSECTICIDE, SOIL PREPARATION, AND FUNGICIDE ON YIELDS OF LADINO CLOVER, 1965-1967

Soil prep.	Insecticide	Fungicide	Yield of dry forage per acre
Irrigated treatments			*Lb.*
Complete	No	No	2,060
Dalapon	No	No	1,935
Complete	No	Yes	2,638
Dalapon	No	Yes	1,995
Complete	Yes	No	3,115
Dalapon	Yes	No	3,323
Complete	Yes	Yes	2,781
Dalapon	Yes	Yes	2,883
Nonirrigated treatments			
Complete	No	No	779
Dalapon	No	No	854
Complete	No	Yes	1,437
Dalapon	No	Yes	1,565
Complete	Yes	No	2,045
Dalapon	Yes	No	2,318
Complete	Yes	Yes	2,227
Dalapon	Yes	Yes	2,787

Irrigation at seeding and as needed during later years resulted in a 48% yield increase of ladino clover over the 3-year period. The effect of irrigation was particularly pronounced during the first season, with yields being more than twice those of unirrigated plots, Table 2.

Insecticide applications made to protect the young clover seedlings from the striped field cricket had a marked effect on yields. Over the 3-year period, 62% more clover was harvested from plots receiving the annual fall application of insecticide than from the plots receiving none. Other large-scale tests have shown that the crickets cause little damage on thoroughly prepared soil that has no plant residue to provide cover for them.

Complete land preparation gave no better results than did spraying with dalapon. There was a slight but consistent advantage from having used the fungicide treatment at planting.

Conclusions

1. The most practical aid to getting and keeping stands of ladino clover was the use of insecticide. Diazanon spray or granules at ½ lb. per acre applied at planting gives good control of the striped field cricket (*Highlights of Agr. Res.* Vol. 13, No. 2, 1966).

2. Irrigation also helped obtain and maintain stands of ladino clover, but present costs limit use of this practice.

3. When other factors were favorable, treatment of an established dallisgrass sod with a herbicide that destroyed most of the grass was as effective as complete soil preparation in establishing ladino clover.

TABLE 2. MAIN EFFECTS OF IRRIGATION, INSECTICIDE, SOIL PREPARATION, AND FUNGICIDE ON YIELDS OF LADINO CLOVER

Treatment	Yield dry forage per acre			
	1965	1966	1967	Average
	Lb.	*Lb.*	*Lb.*	*Lb.*
Irrig.	2,369	3,170	2,233	2,591
Not irrig.	1,055	2,227	1,971	1,751
Insecticide	2,186	3,444	2,424	2,685
No insect.	1,239	1,954	1,781	1,658
Complete	1,849	2,704	1,853	2,135
Dalapon	1,576	2,694	2,351	2,207
Fungicide	1,789	2,837	2,242	2,289
No fung.	1,637	2,562	1,963	2,054

Upper left—bank planting of native shrubs in exposed location along interstate highway; upper right—regeneration of smooth sumac on roadside shows promise of this native shrub; lower right—Alabama croton (Croton alabamenis) is native only to Alabama.

NATIVE PLANTS PROMISING FOR ROADSIDE LANDSCAPING

HENRY P. ORR and HARRISON BRYCE
Department of Horticulture

CONSERVATION . . . SAFETY . . . BEAUTY . . . These are the end products being sought in plantings of shrubs, small trees, and standard trees in roadside landscapes.

Alabama is blessed with a wealth of native plants that could possibly fill the bill for multiple-purpose plantings along roadsides. Many species are beginning to regenerate in the graded areas near seed plants. Others might volunteer if areas near seed sources were left unmowed.

For several years the Agricultural Experiment Station has been working with the Alabama State Highway Department to identify trees, shrubs, and vines that are adaptable for use on Alabama highways. Main emphasis since 1966 has been on native plant material in efforts to make full use of the wide variety of native plants.

A part of the current study had been to evaluate established plantings on portions of the interstate system in Alabama now open to the public. Three areas of the State were selected for study: I-65 in Escambia, Conecuh, and Butler counties; I-65 in Jefferson, Blount, and Cullman counties; and I-59 in DeKalb County.

Each research area was visited in spring 1967, with numerous plants of several species observed in one or more locations. Sample plants were tagged, measured for height and width (or caliper for trees), and rated. The same areas were visited again in the fall, with plants remeasured to determine the year's growth and given another rating.

Native standard trees considered satisfactory in the southern part of Alabama included sycamore, tuliptree, southern magnolia, bald cypress, red maple, and laurel oak. Evaluated and found lacking in some characteristics desired for low-maintenance plantings were eastern red cedar, American holly, sweet gum, and scarlet oak.

Of the four native small trees planted in the area, flowering crabapple and eastern redbud were rated as satisfactory. Flowering dogwood varied considerably from site to site. Trees planted on well drained slopes made slightly more growth and showed better vigor, on the average, than those planted in level, moist areas. White fringe tree was considered poor.

Relatively few species of native shrubs were planted in southern Alabama. Southern waxmyrtle was rated best of the seven used. It also proved excellent in the Cullman area, where it survived well and made excellent growth.

Seven species of small native trees were used in the two northern areas. Only flowering crabapple was rated good out of this group that included white fringe tree, persimmon, eastern redbud, flowering dogwood, and common smoketree. Washington hawthorn was satisfactory in the Fort Payne area.

Showing promise in the Cullman and Fort Payne areas were red maple, bald cypress, sycamore, cottonwood, loblolly pine, and slash pine. They were among the 18 standard trees evaluated in these test areas.

In a continuing effort to identify native material suitable for roadside use, 24 species of native trees, shrubs, and vines were planted in plots along both sides of I-85 near Auburn in March 1967. These sites included dry, open, undisturbed locations; damp, low sites; exposed bank locations; and shady areas.

Where possible, two different sizes of each species were used to give a comparison of survival and growth rate.

Several native species not in use on Alabama highways at present looked good in first-year evaluation and may be useful and attractive in selected sites. These include ninebark, devils walking-stick, American bittersweet, grey dogwood, and vernal witchhazel.

MARKETING FACILITIES for ALABAMA SOYBEANS

JAMES R. HURST, *Department of Agricultural Economics and Rural Sociology*

RECENT DRAMATIC INCREASES in soybean production in Alabama have raised questions about the adequacy of marketing facilities.

To help answer these questions a statewide survey of grain marketing facility needs was made in 1965 by the Auburn University Agricultural Experiment Station. Results indicated that the existing market structure in northern and southern Alabama could be expanded to meet increased needs but that new facilities would be needed to accommodate increased soybean production in central Alabama.

Shifts in Production

A more detailed study is now being conducted in 14 Black Belt counties that have experienced the greatest proportional increase in soybean production in recent years. State production increased from 4.5 to 12.9 million bu. from 1964 to 1967 but central Alabama's production rose from 197,100 to 3,349,000 bu. to account for 26% of the total, see map.

Markets

In 1964, approximately three-fourths of the State's soybean production was from southern Alabama – the majority being marketed at local elevators that shipped to ports on the Gulf of Mexico. Northern Alabama produced 23% of the total, marketed primarily at local elevators to be shipped to a State processing plant.

Since 1964 an additional processing plant has been built in Georgia with another to be completed soon. Because of this indications are that additional Alabama produced beans will be shipped to Georgia. Preliminary results of the intensive study in the Black Belt indicate that a majority of the 1967 crop from this area was shipped to Mobile for export. More than three-fourths of central Alabama's 1967 production was shipped to Mobile.

Transportation

The structure of the Alabama grain market, which also normally handles soybeans, is equipped primarily to receive large volumes of feed grains from Midwestern States by water and rail. The exception to this has been local elevators, in the Gulf Coast area of the State, where locally produced soybeans, wheat, and corn were received from farmers. The proximity of this area to the export elevator at Mobile made it feasible to depend largely on truck transportation. The greater distance from central Alabama elevators to processing plants and central markets makes them dependent on water and rail transportation that afford lower rates with larger volume shipments.

In 1967 about 55% of the central Alabama soybeans were shipped by water, more than 36% by rail, and 9% by truck. More than three-fourths of the beans went to Mobile for export and a fourth went primarily to processing plants in northern Alabama and Georgia.

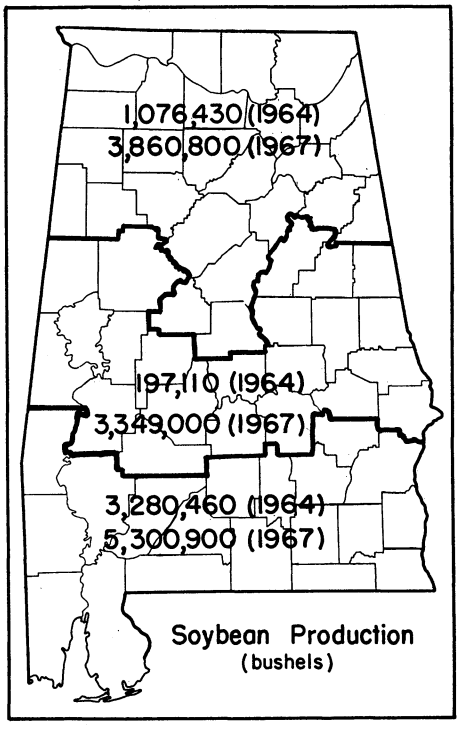
The major facilities that have been built in the central Alabama area since 1964 have access to water transportation. This indicates that the export market at Mobile will continue to be an important market for soybeans produced in the area because these waterways are not connected with other major markets. However, with increased volumes to be shipped more competitive rail rates (using large capacity cars and multi-car shipments) can be obtained, increasing the possibility of shipping to processing plants in Georgia and northern Alabama.

Outlook

In 1964 Alabama produced about one-fourth of its soybean needs and more than one-half in 1967, yet a majority of soybeans was shipped out of the State and soybean meal was shipped into the State. This has raised the question of the feasibility of more processing capacity within the State.

The probability of locating more processing capacity in the State is enhanced by the poultry producing area of northern Alabama where soybean meal utilization is high. If world and domestic prices remain the same, the accessibility of the Port of Mobile to central and southern Alabama will continue to make the export market a major competitor for the majority of beans produced in this area.

Alabama soybean producers have a competitive advantage in marketing by being near large export facilities and areas of high domestic utilization. Local elevators indicated ability to handle projected increases in production with increased turnover and moderate increases in capacity in the Black Belt study area. The marketing structure has generally kept pace with increases in production and should continue to do so with adequate on-farm storage, length of harvest season, and available railroad cars and barges.

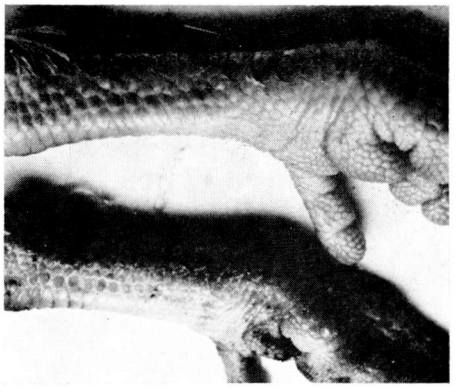


This map shows soybean production by sections in 1964 and 1967. Production in number of bushels is given.

EFFECT of CONTINUOUS FEEDING of AFLATOXIN to CHICKENS

G. J. COTTIER and C. H. MOORE, *Dept. of Poultry Science*

U. L. DIENER and N. D. DAVIS, *Dept. of Botany and Plant Pathology*



Shanks from 6-week-old broilers show effects of aflatoxin in feed. Shank at bottom is from bird that was on the high level of aflatoxin and shank at top is from bird that was in control group.

THE INCREASING PROBLEM of moldy feed ingredients, especially corn, and moldy feed in bins or feed troughs is of great economical importance to certain segments of the poultry industry.

Broiler and turkey producers have had more serious trouble with mycotoxins than have commercial egg producers. Turkeys are more susceptible than chickens to aflatoxin and mycotoxicosis so the mortality problem is greater with this species. With chickens there is some indication that the amount of aflatoxin required to produce symptoms increases with age.

Tested at Auburn

In experiments at Auburn University, four groups of Pilch strain White Rocks were fed commercial rations continuously from 1 day of age through the first 9 weeks of laying. A starting ration was fed for 8 weeks, a complete growing ration from 8 to 24 weeks, and a complete laying ration during the 9-week laying period. Ground corn meal on which *Aspergillus flavus* had been grown was added to the ration fed three groups to supply an equivalent aflatoxin B_1 content of approximately 308, 610, and 1,834 p.p.b. The fourth group served as a control.

The chickens were raised in batteries for the first 6 weeks and then moved to floor pens. At 9 weeks, the number was reduced to approximately 5 males and 40 females per pen because of space shortage. Data were obtained on growth, mortality, age at first egg, egg size, and egg production.

EFFECT OF AFLATOXIN ON CHICKEN MORTALITY

Eqv. afla. B_1 level	Mortality		
	0-9 wk.	9-24 wk.	24-33 wk.
	Pct.	*Pct.*	*Pct.*
Control	5.26	17.77	5.40
308 p.p.b.	8.00	21.05	3.23
610 p.p.b.	11.00	31.58	19.23
1,834 p.p.b.	47.00	35.48	25.00

Affected Broiler Weights

At 9 weeks, broilers receiving the low and middle levels of aflatoxin were as large as those in the control group. At the same age, those broilers on the highest level of aflatoxin were smaller and weighed 1 lb. less than control birds. The birds on the highest level were unable to overcome the growth retardation and at 24 weeks were still approximately 1 lb. lighter.

The highest level of aflatoxin delayed maturity and the pullets receiving this ration were 171 days of age at the time of the first egg. This was 12 days older than the control birds. The other two levels of aflatoxin had no effect on maturity.

Mortality of the chickens on the middle and highest levels of aflatoxin was very high compared to those on the lowest level and control ration. Chickens on the highest level had a mortality of 47% for the broiler period, 35.48% for the growing period, and 25% for the laying period. Mortality for those on the middle level was 11, 31.58, and 19.23%, respectively, for the three periods. At the lowest level, mortality was higher during the first two periods than for those on the control ration, but it was lower during the laying period. Mortality was figured for each age group for each treatment and not from the number of chicks started.

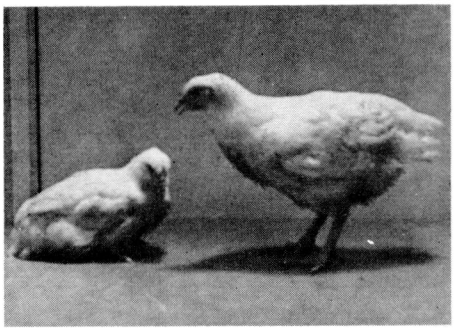
Egg Production Lowered

Egg weights were taken for 36 consecutive days starting at 187 days. Egg size was similar for all treatments. Egg production records were kept for approximately 9 weeks. Egg production, figured on a hen-day basis, was considerably lower for the group receiving the highest level of aflatoxin.

Symptoms and post-mortem findings varied greatly in chickens fed aflatoxin, indicating individual differences in susceptibility. The main symptoms were depression, paleness of comb and shanks, and mortality. Early symptoms of the chickens on the highest level were depressed appetite and some cannibalism, which was transitory. Post-mortem findings were mottled, hemorrhagic livers, mottled and congested kidney and spleen, increased fluid around the heart, and in many cases pale, hemorrhagic muscles.

Results

Results of these experiments show that even relatively low levels of aflatoxin in poultry rations can cause serious problems. High levels depress body weight, delay maturity, and cause high mortality.



Broilers at 9 weeks showing effects of aflatoxin. Bird at left received high level, and bird at right was in control group.

EFFICIENT GROWTH MADE BY CALVES ON RYE-RYEGRASS PASTURES

R. R. HARRIS, *Dept. of Animal Science*
J. K. BOSECK, *Tennessce Valley Substation*
W. B. ANTHONY, *Dept. of Animal Science*

GETTING SOME LOW-COST growth gain on young cattle can make a big difference in profits from a beef herd. One practical method of putting on about 300 lb. per stocker calf is to use high quality small grain pastures for a winter grazing season.

Efficiency of stocker calves (about 450 lb. at beginning of grazing) in using rye-ryegrass pastures has been established in research at the Tennessee Valley Substation, Belle Mina. Based on the 4-year findings, such a pasture program is recommended in a system for growing-finishing slaughter cattle.

An effective procedure for growing the cool-season crops was worked out in the Substation trials. Land was plowed in June or July and fallowed during summer, which was necessary to ensure good stands for early grazing (October). Usually the crop was planted the last week in August or first week in September.

A complete fertilizer, 14-14-14 or 10-10-10, was broadcast before planting at a rate to provide at least 40 lb. each of N, P, and K per acre. Two additional nitrogen applications of 40 lb. each were made in January and May.

Explorer rye was seeded at a rate of 1.5 bu. per acre and common ryegrass at 15 lb. per acre.

Steer calves grazed the pasture, with stocking rate usually two per acre except when forage supply was low or bad weather prevented grazing. When removed from grazing the cattle were barn fed corn silage plus a supplement of 1 lb. cottonseed meal and 1.5 lb. ground snapped corn per head daily. Cattle were weighed every 28 days, or whenever there was a major change in feed or forage.

As shown by performance data in the table, the calves grazed an average of 162 days per season. However, there were 50 days that they were off grazing and had to be fed. Thus, some form of harvested feed must be provided because the cattle cannot graze continuously. Corn silage properly supplemented is excellent for this purpose, but hay or a blended high-roughage mixture can be used.

The test calves gained an average of 286 lb. per animal. This amounted to 562 lb. of beef per acre, including that credited to the harvested feed.

The reported daily gain (1.35 lb.) may appear low, but the calves gained at this rate throughout the entire 212-day period (October-June). Results from other Alabama grazing tests with rye-ryegrass indicate that daily gains of about 1.6 lb. can be expected for the cool-season grazing period.

Alabama cattlemen are predominantly cow-calf producers, but many could profitably shift to producing feeder steers weighing 750 lb. instead of selling 400-lb. stocker calves. This system could increase their return per cow and per unit of land. As shown by the Belle Mina results, cool-season grazing on rye-ryegrass is an excellent basis for such a growing-out program.

PERFORMANCE OF STOCKER CATTLE ON RYE-RYEGRASS PASTURES, TENNESSEE VALLEY SUBSTATION, 1963-66

Performance item	Yearly and average results				
	1963-64	1964-65	1965-66	1966-67	4-year av.
Days grazed	104	109	201	235	162
Days off grazing-barn fed	65	60	45	31	50
Initial weight, lb.	481	429	368	484	440
Weight off grazing, lb.	722	628	713	839	726
Total gain per head, lb.	241	199	345	355	286
Average daily gain, lb.	1.43	1.18	1.40	1.44	1.35
Beef gain per acre, lb.[1]	362	398	779	710	562
Feed per steer, lb.					
Snapped corn	138	130	90	[2]	.....
Cottonseed meal	104	98	66	[2]	.....
Corn silage	1,786	2,184	1,238	[2]	.....
Date on initially	11/13	10/19	10/11	10/10	.....
Date grazing ended	4/19	4/6	6/13	6/12	.....

[1] Includes gain made while off grazing and fed harvested feed.
[2] Calves were off test pasture 31 days but grazed other forage and did not get any harvested feed.

Can Herbicides Be Used Safely Every Year?

A. E. HILTBOLD and G. A. BUCHANAN, *Department of Agronomy and Soils*

HERBICIDES ARE HERE to stay. They have proved their worth, and few farmers would consider cropping without them.

Occasional injury of crops has raised a question of herbicides staying too long after application. Small grains and winter legumes following cotton appear most susceptible, according to results of research by Auburn University Agricultural Experiment Station. However, several effective chemical weed killers have been used on a sustained basis at recommended rates without build-up of herbicide in soil.

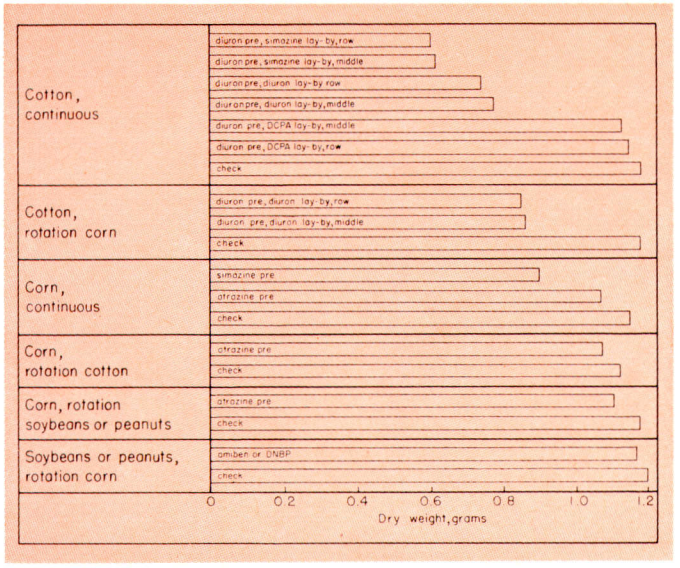
Studies on herbicide persistence were begun in 1962 on Dothan loamy sand, Wiregrass Substation, Headland; Hartsells fine sandy loam, Sand Mountain Substation, Crossville; and Decatur clay loam, Tennessee Valley Substation, Belle Mina. Certain herbicides were applied every year with continuous corn or cotton. Rotating corn with cotton and with soybeans and peanuts provided for alternating use of herbicides.

Atrazine and simazine were broadcast preemergence to corn at 2 lb. active material[1] per acre on sandy soil and 3 lb. on the clay loam. Diuron was applied preemergence to cotton on a 12-in. band over the row, using 0.8 or 1.1 lb. per acre. Lay-by herbicides for cotton (1 lb. diuron, 1.5 lb. simazine, or 4 lb. DCPA) were broadcast in July following the last cultivation.

Peanuts were treated at cracking time with 1.5 lb. DNBP. Amiben at 3 lb. was used for preemergence application to soybeans. Cultivated crops getting no herbicides provided a comparison.

Residual effects of herbicides in soil were evaluated each fall by measuring growth of oats, a sensitive plant, planted in soil from the upper 3 in. of each test plot. Dry weight of oats was determined after 4 weeks growth under controlled conditions.

[1] All rates are pounds active material per acre based on area actually sprayed.



Growth of oats in soil samples from herbicide persistence plots are shown as averages of three soil types in the 1964 experiment.

Soybeans, cotton, and corn in these plots at the Tennessee Valley Substation are used in determining herbicide persistence.

Persistence of certain herbicides was apparent in all soils even with first-year application. Cotton lay-by treatment with diuron and simazine injured oats that followed in the fall. Where DCPA was used at lay-by there were no injurious residues from either DCPA in the middles or preemergence diuron in the drill. These results emphasize the importance of time between applying diuron and simazine and planting of a sensitive crop like oats. April applications essentially disappeared, but that put out in July was still toxic in November.

Residues of diuron after 6 treatment years were no more prominent than after the first year. Apparently the diuron residue problem is mainly from the current-year, lay-by application, since residues after each treatment in the rotations were of the same intensity as in continuous cotton.

Atrazine applied preemergence to corn did not persist into the fall at any location. Oats grew as well in soil from atrazine plots as in check plots, and there was no evidence that atrazine accumulated with repeated use.

Recent work has shown that atrazine activity in the test soils is reduced by half each month after application. While leaching with rainfall moves atrazine into the soil, the principal loss is from inactivation by chemical and microbiological processes. Atrazine does not pose the problem of carryover in Alabama that has been observed in the North and Midwest where higher rates are used and the growing season is cooler and shorter.

Residues of simazine applied preemergence to corn have persisted into the fall, particularly in Decatur clay loam getting 3 lb. per acre. There was little indication that simazine accumulated with continuous use. None of the herbicides persisted into the spring following the treatment year.

It is concluded from results reported that these herbicides can be used year after year at recommended rates without damage to continued crop production. Late season application of diuron and simazine, however, may injure fall crops, such as oats.

FUSIFORM RUST in SOUTHERN PINES

TERRY C. DAVIS and JAMES GOGGANS

Department of Forestry

SOUTHERN FUSIFORM RUST is the most important disease considered in the selection of parent Southern pine trees in the Alabama Tree Improvement Program.

This rust disease, caused by the fungus *Cronartium fusiforme*, produces cankers that girdle and kill Southern pine seedlings and saplings. The primary infection symptom usually expressed by pine seedlings is an inconspicuous spindle-shaped swelling of the main stem. Older seedlings may exhibit these swellings on small limbs, and excessive branching (witches' brooming) frequently occurs from the swollen area. Such early limb infections can result in stem infections and death of the seedling. Infected trees that survive exhibit stem cankers or galls, or both.

Trees selected as parent (plus) trees must not show evidence of damage by fusiform rust. This does not indicate a definite resistance to the disease, however, because some trees escape infection or do not show evidence of past infection. Also, seed from these plus trees are a result of open pollination and susceptibility could be inherited through male parents. This study was undertaken to determine whether progeny of loblolly pine plus trees show differences in susceptibility to fusiform rust.

Seeds were collected from 18 loblolly plus pine, soaked in 3% H_2O_2 for 24 hours, and planted in greenhouse flats during May 1966. Cotyledonary stage seedlings were inoculated by placing the flats in an incubator (22°C and high humidity) and suspending water oak leaves bearing germinating teliospores of *C. fusiforme* above the seedlings for 24 hours. Flats were returned to the greenhouse following inoculation.

Spindle-shaped gall on the main stem of a loblolly pine seedling infected with fusiform rust.

Inoculated seedlings were inspected weekly for 6 months and those with galls were removed. Some seedlings formed small galls within 9 weeks after inoculation. After 6 months, remaining seedlings were regrouped according to seed source and transplanted into nursery beds at the Auburn Forest Nursery. Periodic examinations were continued and seedlings exhibiting galls were eliminated.

After 4 months, approximately 70% of the seedlings from all groups had been eliminated. As shown in the table, sources F and O exhibited the greatest resistance and sources U and M exhibited the least resistance. After 15 months, approximately 90% of the seedlings from all groups had been eliminated. At this time, sources D and R exhibited the greatest resistance and sources U and N exhibited the least resistance.

It was planned initially to remove diseased seedlings on the basis of evidence of needle infection. Because a very large percentage of all groups showed about the same amount of needle spotting following inoculation, the experiment was changed to eliminate seedlings on the basis of gall formation.

Many of the spotted needles became necrotic and were shed. In other cases, spots darkened and finally disappeared. The dying and shedding of diseased needles may be a mechanism of resistance, and the disappearance of needle spots also may be indicative of a resistance mechanism.

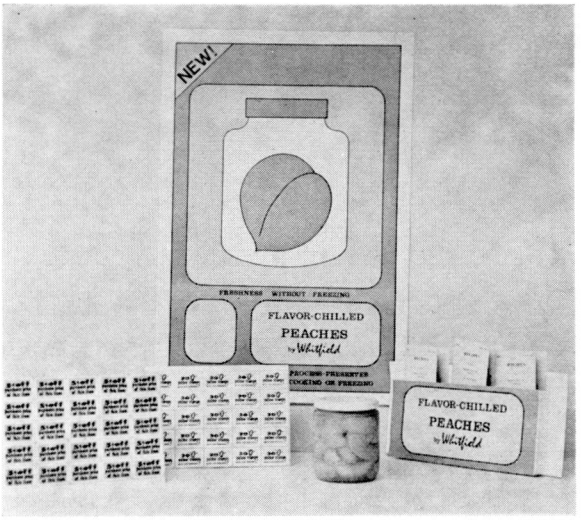
Seedlings from five sources exhibited less infection during the observation period than did the others. The different and changing percentages that occurred after various time intervals is interpreted to indicate that a definite amount of time is required for gall formation to take place within a given source. Additional natural infections possibly occurred in the transplanted seedlings during spring of 1967, and some of these additional infections probably are reflected in the last column of the table. The evidence of this study and the experience gained from several years of general observations lead the authors to conclude that field testing of seedlings planted in areas of high rust incidence may yield more valuable results than artificial inoculation of very young seedlings. The results suggest that considerable variation in resistance to fusiform rust does occur in seedlings from different seed sources.

NON-INFECTED LOBLOLLY PINE SEEDLINGS FROM 18 PLUS TREES 4 AND 15 MONTHS FOLLOWING INOCULATION

Seed source and no. of seedlings used in test	Non-infected seedlings remaining			
	Oct. 1966		Sept. 1967	
	No.	*Pct.*	*No.*	*Pct.*
A, 286	43	15.0	13	4.5
B, 290	79	27.2	27	9.3
C, 287	59	20.6	14	4.9
D, 284	82	28.9	54	19.0
E, 281	127	45.2	48	17.1
F, 284	166	58.5	48	16.9
G, 288	136	47.2	27	9.4
H, 284	52	18.3	8	2.8
I, 287	55	19.2	21	7.3
J, 285	76	26.7	11	3.9
K, 289	74	25.6	15	5.2
L, 281	97	34.5	20	7.1
M, 288	41	14.2	9	3.1
N, 288	46	16.0	4	1.4
O, 283	162	57.2	41	14.5
P, 289	93	32.2	19	6.6
R, 286	99	34.6	53	18.5
U, 236	27	11.4	1	0.4
Average	84	29.6	24	8.4

Effects of ADVERTISING Pasteurized-Refrigerated PEACHES

BILL R. MILLER and CHARLES E. STRAIN
Department of Agricultural Economics and Rural Sociology



Three types of promotion were used in introducing the pasteurized-refrigerated peach in a number of selected chain stores. Those used included the 5¢ off, trading stamps, and poster with free recipe folders.

ADVERTISING is a very important tool in introducing new products to the American society.

A research project was begun by Auburn University Agricultural Experiment Station in the fall of 1967 to determine effects of several types of advertising and promotion on the demand for pasteurized-refrigerated peaches.

The types of advertising considered were newspaper, coupons offering 5¢-off, coupons offering 20 trading stamps, and posters with free peach recipes, see figure. A sales test was conducted and is continuing in 24 supermarkets of a chain located in Alabama. Stores were classified as small, medium, and large with eight stores in each classification. Types of advertising were assigned to the stores at random.

The first newspaper ad during the week of October 20 was a ½-in. by 2-in. column insert featuring 16-oz. jars of pasteurized-refrigerated peaches at 39¢ each. The same size ad the last week of February featured 16-oz. jars of pasteurized-refrigerated peaches 3 for $1. Simultaneous with the first ad, 5¢-off coupons were attached to the stock in one group of stores, 20 trading stamps were attached in a second, and in a third group both 5¢-off and 20 trading stamps were attached. Stamps and coupons remained on 3 weeks before removal. The week following the second ad the same procedure of adding stamps and coupons was followed and this time they were removed after 4 weeks.

Short-run effects of some of the advertising now available are presented comparing small and large stores. Twenty trading stamps were found to be the most important method of promotion in these stores. Trading stamps was the only method that obtained a response greater than that of newspaper advertising alone, see table. Sales increased by more than 50% in stores offering 20 trading stamps over sales in stores affected only by newspaper advertising.

AGGREGATE SALES OF PASTEURIZED-REFRIGERATED PEACHES FROM SMALL AND LARGE SUPERMARKETS BY PROMOTIONAL METHOD, OCTOBER 20, 1967-MAY 30, 1968

Method	No. of 16-oz. jars		
	Small	Large	Total
Newspaper	100	68	168
Newspaper and 5-¢off	28	129	157
Newspaper and 20 trading stamps	126	149	275
Newspaper, 5¢-off, and 20 trading stamps	69	77	146
Total	323	423	746

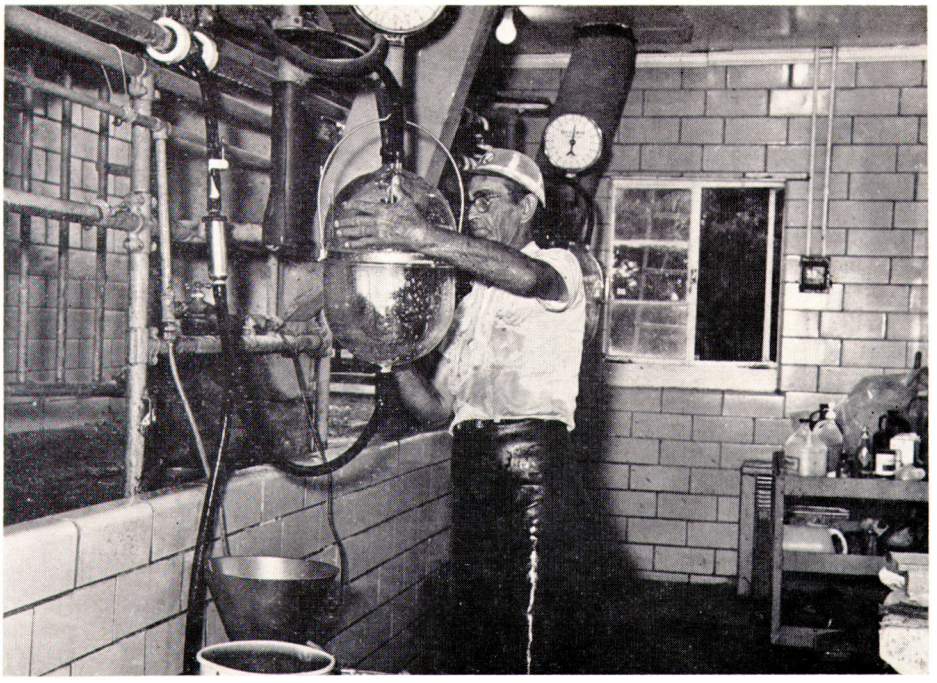
The offer of 5¢-off coupons failed to perform as well as newspaper ads alone and there were significantly decreased sales in stores offering cents-off, trading stamps, and newspaper ads relative to stores offering newspaper ads alone. Advertising and promotion, it appears, can present an inferior product image if too much reduction in value is obtained.

The comparison of 5¢-off coupons with trading stamps suggests savings is not simply the absence of consumption as sometimes suggested. Trading stamps represent purposeful saving with consequences in view while the 5¢-off may not be seen as a decision to save as the consequences may never be known. Twenty trading stamps are equal in promotional cost to 5¢-off when trading stamps are purchased for $25 per 10,000, a fairly common arrangement among small retailers. However, large chain stores may pay less than this depending on the terms of trade between the chain and the stamp company. Twenty stamps have a value of 5¢ to the consumer when a book of 1,200 has a redemption value of $3 in purchase of retail goods.

Estimated cost of trading stamps was $4.53 per additional hundred units sold greater than the amount sold in stores having newspaper ads only. Additional sales above those in stores with newspaper advertising alone was valued at $11.70 per additional hundred units sold, which is the value of a 30% return to the retailer from selling additional units of 16-oz. jars at 39¢ each. Retailer net return to trading stamps for the 30-week period was then $7.17 per additional hundred units sold. Retailer net return is just one example of how returns or costs may be distributed as manufacturers and wholesalers also participate in stamp promotions.

Cents-off and cents-off combined with trading stamps were very costly as promotional devices in this test. However, the conditions of the test must be kept in mind as the test does not cover all of the ways in which cents-off and trading stamps may be used in advertising and promotion. The newspaper ad featuring 3 jars for $1 appeared to be successful and immediately preceded the cents-off promotion. These back-to-back price effects could possibly have reduced the price effect of cents-off.

The final important question, "Did advertising aid in introducing the product?" has not yet been fully answered. Total sales of the product in the test stores were, however, good in relation to chilled citrus products that compete for the same shelf space in the supermarket. In the last 15 weeks of the study period, 99 cases (12/16 oz./case) of pasteurized-refrigerated peaches were ordered from warehouse compared to 38 cases of ambrosia, 51 cases of fruit salad of the same size and 33 cases (12/32 oz./case) of grapefruit slices.



Thorough cleaning of all equipment immediately following milking helps reduce the incidence of psychrophilic bacteria in the raw milk.

RAW MILK QUALITY affects PASTEURIZED MILK

R. Y. CANNON and D. D. ROY, *Dept. of Dairy Science*

With the competition in the food industry and the threat of filled and imitation milk products, the consistent good taste of milk at the time it is consumed becomes an important factor in maintaining sales.

With milk being transported greater distances and being held for longer periods of time before consumption, contamination of the pasteurized product with psychrophilic bacteria and growth of these bacteria may result in a product with an undesirable flavor at the time of consumption.

Raw milk of poor bacterial quality, even though it is within the bacterial count limits for "Grade A Raw Milk for Pasteurization" as specified by the Alabama State Board of Health, has been shown to contribute to the psychrophilic contamination of the pasteurized product. These results came from a study conducted at Auburn University Agricultural Experiment Station. For the study, selected producers of a dairy plant were assigned to one of two groups based on standard plate counts recorded by the health department over the past several years. One group had maintained low counts over the entire period while the other group had counts consistently approaching the maximum allowable for Grade A Raw Milk (100,000).

Samples of raw milk were taken from the bulk tank at each dairy at the time of regular pickup. A portion of each sample was pasteurized at 143° F for 30 minutes shortly after pickup. The remainder was stored raw for 2 additional days at 40° F, then pasteurized. All samples were held at 40° F for 10 days after pasteurization. Bacterial counts were run on all samples immediately before and after pasteurization and after storage for 5 and 10 days.

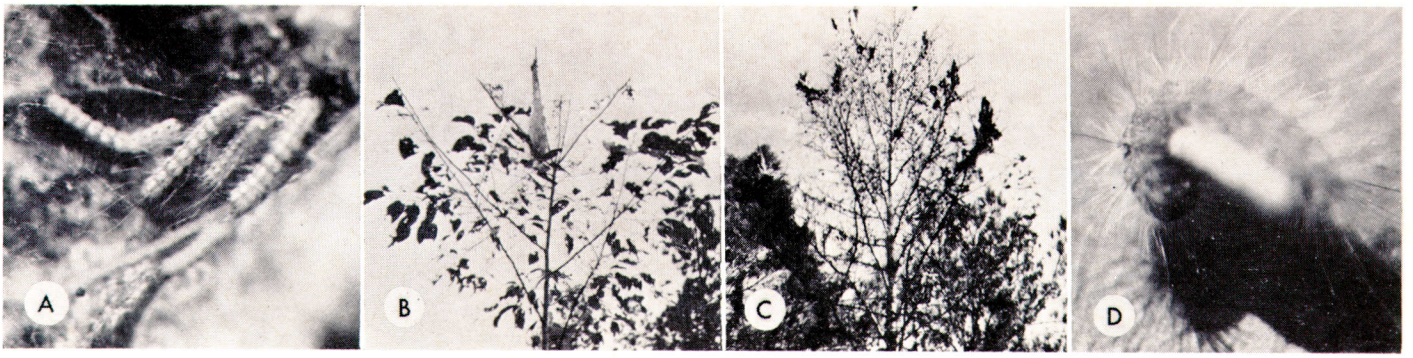
The standard plate count of the raw milk at the time of pickup averaged 16,200 for the low-count group of samples and 63,100 for the high-count group. None of the samples had a count higher than 100,000 per ml. There was a sizable increase in the bacterial counts of the raw milk in both groups during the 2-day storage period. Pasteurization efficiencies as determined by the rate of bacterial kill were the same for both groups. However, because of the higher initial counts, the high-count group also had higher counts in the freshly pasteurized product.

Following pasteurization, the rate of growth of bacteria in the milk from the high-count group was faster than in milk from the low-count group, as determined from changes in the standard plate count and the psychrophilic count. The average generation time (time required to double the population) as calculated from the standard plate counts was 61.45 hours for the low-count group and 32.75 hours for the high-count group. The rate of growth of the psychrophiles, however, is of greater significance in the spoilage of milk. In the samples tested, the generation time as calculated from psychrophilic counts averaged 40 hours for the low-count group and 28 hours for the high-count group.

When raw milk is cooled rapidly to below 40° F and held at that temperature, very little growth of bacteria takes place. High counts in the raw milk, therefore, usually indicate a high rate of contamination, generally from poorly cleaned equipment. Thorough cleaning of all equipment immediately following milking, using good quality detergents and proper cleaning methods, is necessary if milk of good bacterial quality is to be produced.

Bacterial Counts on Raw and Pasteurized Milk from Initial Low-Count and High-Count Groups

Sample	Storage at 40° F		Standard plate count		Psychrophilic count	
	Raw	Pasteurized	Low	High	Low	High
	Days	*Days*	*No.*	*No.*	*No.*	*No.*
Raw	0	0	16,200	63,100	2,760	13,800
Pasteurized	0	0	100	380	20	110
Pasteurized	0	5	200	4,470	150	5,130
Pasteurized	0	10	1,000	58,900	690	58,900
Raw	2	0	126,000	512,000	42,700	178,000
Pasteurized	2	0	800	1,070	120	660
Pasteurized	2	5	1,820	22,400	910	19,500
Pasteurized	2	10	14,100	209,000	11,500	195,000



The fall webworm is responsible for the unsightly webs formed on many tree branches during the summer and fall. A. shows the larvae of the fall webworm, orange race; B. partial defoliation of host by single webworm colony; C. complete defoliation of large host tree by several webworm colonies; and D. parasitized larva with a cocoon formed by emerged parasite.

THE FALL WEBWORM

Are Infestations Limited by Natural Control?

LACY L. HYCHE, *Department of Zoology-Entomology*

THE FALL WEBWORM is the critter responsible for the unsightly webs seen on host tree branches during the summer and fall.

An insect native to North America, these worms are commonly found scattered through the woods, in some orchards, and on certain shade trees in Alabama. During most years only one to a few webs are found per tree and damage is usually insignificant. During these years, infestations are generally confined to only a few species of host trees, although in the United States, the fall webworm is reported to feed on over 100 species of plants. In recent years this caterpillar has been introduced into Europe and Asia. In these areas it has become established as a serious pest, and is reported to attack over 200 species of plants.

Two Races

Tests at Auburn University Agricultural Experiment Station during the past 2 years have established the presence of two races of fall webworm in Alabama — orange and black. Coloration differences are distinct and the races are easily identified in the larval stage. Larvae of the orange race have orange heads and orange tubercles on the bodies. The adults, or moths, of this race are white and without markings. Larvae of the black race have black heads and black tubercles. The adults are white but many have several small black spots on the forewings. The orange race has been much more abundant in Alabama than has the black.

Although these webworm races are currently considered to be one species, there appear to be some differences in behavior. One difference is host preference. Approximately 97% of all orange-race colonies observed were on persimmon and pecan. Other host plants for this race include sweetgum and hickory. Seventy-three per cent of the black-race colonies were collected from sweetgum; other hosts were red mulberry, willow, elderberry, and persimmon.

Parasitism and Natural Control

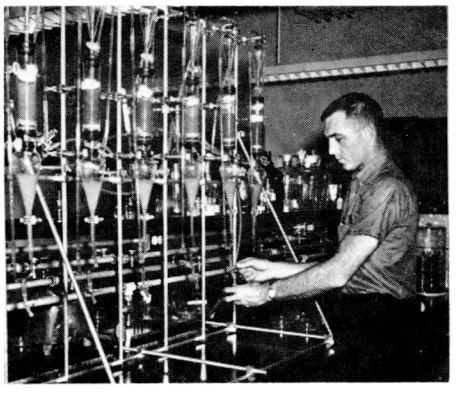
Do natural enemies of the fall webworm play a significant role in maintaining webworm population density below the outbreak level? Results of observations made during the past 2 years indicate that the impact of these natural enemies may be an important factor in regulation of populations. The seriousness of the webworm as a pest in Europe and Asia has been attributed to the lack of native parasites and predators in the areas into which it has been introduced.

In Alabama insect parasitism has been somewhat variable among colonies, but ranged as high as 67% in 1966 and 78% in 1967 in individual colonies. At present 9 to 11 species of parasitic flies and wasps have been reared from fall webworm colonies. The parasitic flies (Diptera: Tachinidae) have been the most abundant, and were responsible for greatest webworm mortality. Parasitism by all species, flies and wasps, results in the death of webworms attacked. In addition to the parasites, several predators have been observed feeding on fall webworm larvae. These include a ground beetle that is predaceous in both the beetle adult and larval stages; species of large wasps; spiders; and birds. A fungus disease, *Beauvaria* sp. has also been found attacking larvae of the webworm.

In general it appears that natural enemies are capable of causing heavy mortality of fall webworm. This may well be an example of nature aiding in the control of a potentially important pest.

CULTURAL PRACTICES INFLUENCE PINE FUNGUS

WALTER D. KELLEY and E. A. CURL
Department of Botany and Plant Pathology



Soil extracts were obtained from glass columns of soil such as these.

In Alabama and the Southeast, the large number of pine plantations established since the advent of the soil-bank program provides an ideal situation for *Fomes annosus* root-rot to become widespread, particularly following thinning operations. Because this fungus also attacks pine seedlings, replanting of clearcut *F. annosus*-infested plantations could result in considerable seedling loss. This would mean added expense to the landowner because he would have to replace the dead seedlings.

It is known that air-borne spores of *F. annosus* germinate on stump surfaces and establish a source of infection for adjacent trees. However, the ability of the fungus to become established in forest litter and soil has not been clarified. Basic information on soil conditions unfavorable for growth or survival of the pathogen may indicate ways of intensifying the suppressive effects and suggest control measures.

The Auburn University Agricultural Experiment Station established a test in a *Fomes*-infected clearcut pine plantation provided by the International Paper Company, Bainbridge, Georgia. Five plots were prepared to create different soil environmental conditions. The treatments were: burned; burned and disked; and burned, disked, and seeded (one plot each) with lupine, oats, or rye. A sixth plot adjacent to the others, and with unmolested natural stand, served as a control.

Beginning 4 months after the plots were established, samples of organic debris and soil were collected at 4-month intervals from each treatment. They were processed or tested in the laboratory by standard and special techniques to determine colonization of organic matter by *F. annosus* or other fungi; soil fungistasis (inhibitory effect of soil on spore germination); microbial populations in the soil and the percentage of these organisms that inhibit growth of *F. annosus;* and effect of filter-sterilized leachates of the soil on growth and spore germination of the parasite on a culture medium. The leachates (water extracts) were obtained by automatically cycling water through glass columns of plot soils after 14 days of incubation.

Soil Fungistasis Results—Germination of Spores on Soil Collected in April

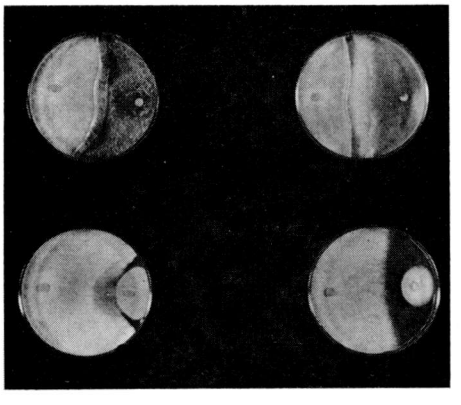
Plot	Germination	
	Sterilized soil	Non-sterilized soil
	Pct.	*Pct.*
Natural	99.3	4.3
Oats	4.2	0.0
Rye	3.6	1.0
Lupine	97.1	1.6
Burn	87.9	0.0
Burn and disk	95.3	0.3

Predominant fungi colonizing organic debris particles were species of *Trichoderma, Penicillium, Aspergillus,* and *Gliocladium.* Failure to find *Fomes* colonizing debris particles anytime during the study may reflect the fact that species of each of the most prevalent fungi are known inhibitors of *F. annosus.*

In the fungistasis tests, spores of *Fomes* did not germinate on non-sterilized soil taken from the plots in January or August, but some germination occurred on the soil taken in April. Germination on the oats plot was totally inhibited and germination on the natural check plot was least inhibited. Spores germinated readily on all soil samples when the soil was sterilized, except those from the oats and rye plots in April. Definite inhibition was observed on these.

Soil microbial populations varied with the sampling date. The highest percentage of antagonistic organisms was normally associated with the oats and rye plots, suggesting some correlation with fungistasis results on non-sterilized soil. Growth of the pathogen was inhibited on agar containing soil extracts from the burned plot and the lupine plot in January, but there was little difference between plots on other sampling dates.

The identity of the spore-inhibiting factor(s) in soil from the oat and rye plots is not known at this time, but probably is a combination of antibiotic effect and absence of required nutritional components for germination. Other research workers also have found beneficial effects of oat culture and oat residues in soil for suppressing the activity of soil-borne plant parasitic fungi.



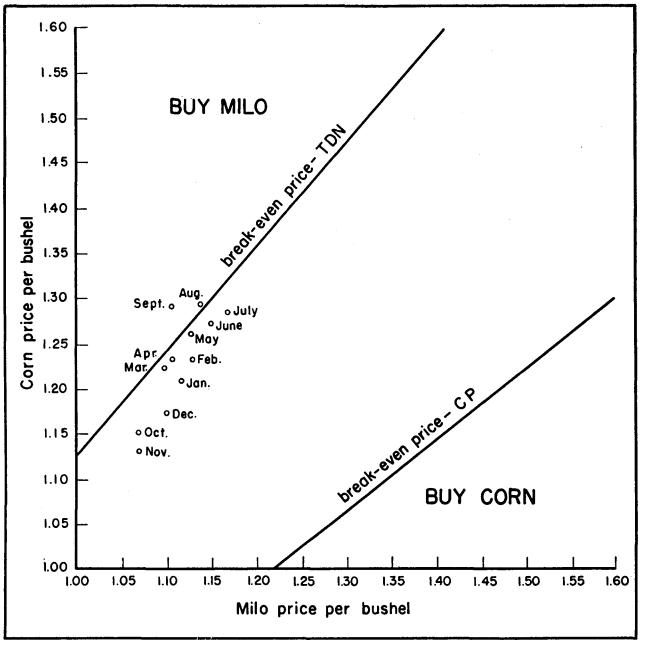
Examples of soil fungi (right side of plates) exhibiting antagonism to F. annosus.

Price Mapping Determines Grain for Economical Feeding

RELATIVE PRICES OF SUBSTITUTABLE GRAINS IDENTIFIES MOST PROFITABLE RATION INGREDIENTS

JAMES R. HURST and
BILL R. MILLER

Dept. of Agricultural Economics and Rural Sociology



MANUFACTURERS OF poultry and livestock feeds continually strive to produce at lowest possible cost feed balanced for top feed efficiency. As prices of ingredients change, adjustments are made in the combination of ingredients.

Most large manufacturers use an electronic computer and a mathematical process known as "price mapping" to determine the most economical combination with varying prices of substitutable ingredients. In making a price map, ranges of price variations are determined for two feed ingredients that are substitutes. Computing the cost per pound of nutrients at all probable ingredient prices identifies areas of least cost.

Individual farmer-feeders and small feed mill operators can reduce feed costs by using the principles of price mapping without the aid of computers and without complete price mapping of all feed ingredients. Feed grains account for the major cost of most feed rations and are easily substituted, making them subject to price mapping.

Comparing the cost of various grains by price mapping must be on the basis of nutrient content. Total digestible nutrients (TDN) and crude protein (CP) are the more important measures for feed grains and the only ones considered here.

The table lists TDN and CP content of the major feed grains and cost per pound of nutrient at 1961-65 average market prices. These averages show that milo was the cheapest source of CP throughout this period.

Wide variation in prices of a feed grain causes changes in relative costs of TDN and CP. By determining the "break-even" prices (prices at which TDN and CP costs are equal for the two grains), feed manufacturers or farmers can take advantage of price variation to lower nutrient costs in feeds.

Break-even prices plotted in the graph indicate prices of corn and milo at which cost of TDN and CP would be about equal. TDN would cost the same in corn priced at $1.23 per bu. as in milo at $1.12 per bu.

The area of the price map below the two break-even lines indicates relative prices for corn and milo at which corn would be the cheapest source of TDN and CP. That above the lines shows prices at which milo would be cheapest for both nutrients. Between the break-even lines is an area where milo is the cheapest source of CP and corn provides lowest cost TDN.

To illustrate results of price mapping, monthly average prices of corn and milo during 1961-65 are plotted. Only 2 months are in the area where milo was the cheapest source of both TDN and CP. In the other 10 months corn provided lower cost TDN, but not CP. Corn and milo prices tend to increase as the crop year progresses, but corn prices go up more. Thus, as corn and milo prices increase, milo becomes a relatively cheaper source of TDN and CP.

The examples used are simple illustrations, and price mapping and balancing nutritents in feed can be expected to be more complicated. Complex situations arise as the number of possible feed ingredients increase. More than one ingredient substitution is usually possible, making computers increasingly important in choosing ingredients.

One example from Auburn research illustrates changes that can take place in a ration as a result of price mapping. The experimental ration satisfied minimum requirements of 10.5% crude protein, 65% TDN, 0.35% calcium, 0.25% phosphorus, and 0.15% magnesium. When price of shelled corn was high, the ration was made of 28.8% ear corn, 13.9% wheat middlings, 0.8% urea, 51.5% grass hay, and 5.0% fat. As shelled corn becomes cheaper it can replace not only ear corn, but other ingredients as well. One ration formulated by lowering the price of shelled corn while maintaining a constant price of all other ingredients was 56% shelled corn, 37.4% grass hay, 0.7% urea, 0.1% ground limestone, and 5.8% wheat bran.

Computer procedures and price mapping to minimize feed costs were used in an informal beef feeding project at the Lower Coastal Plain Substation in 1966. Preliminary results indicate savings can be made in least cost rations formulated by price mapping.

PRICE AND NUTRIENT CONTENT OF MAJOR FEED GRAINS, UNITED STATES, 1961-65

Feed grain	Nutrient content		Price per bushel		Cost per pound	
	TDN	CP	Range	Average	TDN	CP
	Pct.	*Pct.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
Corn	80	8.9	1.07-1.48	1.23	0.028	0.247
Milo	71	11.0	1.02-1.20	1.12	.028	.182
Barley	78	11.7	1.02-1.38	1.21	.032	.215
Oats	65	11.8	.65- .78	.72	.035	.191

[1] Per cent TDN and CP taken from unpublished research, Auburn University Agricultural Experiment Station.

[2] United States Department of Agriculture. Feed statistics through 1966. Sta. Bul. No. 410, September 1967.

LIQUID GOLD FEEDING SYSTEM

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Liquid gold promises to be the latest feeding system to balance rations for cattle, replacing most of the soybean and cottonseed meal now being fed.

Major reasons for this are that liquid formulas are ideally suited for use of urea; blending liquid mixes is easier than preparing dry mixes; and liquid feeds can be fed with far less labor input than dry mixes. Liquid protein supplement containing preformed protein and urea, minerals, vitamins, and dietary additives has already commanded a significant portion of the beef brood cow winter supplement market.

Research has been conducted at the Auburn University Agricultural Experiment Station on the use of liquid feed to supply a significant portion of the ration for fattening cattle. Two related conditions were found to be especially significant in feed formulas for fattening cattle. A large amount of roughage in mixtures is required to keep animals on a high rate of feed intake and avoid harmful digestion problems. However, grinding, mixing, storing, and feeding fattening mixtures containing a significant amount of forage requires a relatively large investment in equipment. The farm feeder, therefore, often cannot justify the effort to prepare typical dry mixed rations to fatten a few cattle. The liquid feed system introduced at Auburn and given the designation "Liquid Gold Feeding System" (LGFS) was developed to make it possible for the farm feeder to feed any number of cattle with low investment in feed preparation equipment. The system eliminated the necessity of including roughage in the feed mixture and provides a simple and practical means of feeding all-concentrate rations.

In the LGFS liquid feed constitutes one-third or more by weight of the total ration. This large amount of liquid slows down intake of grain and, thereby, prevents overeating and founder frequently encountered when the ration is composed only of grain and supplement. By using a purchased liquid supplement the farm feeder needs only two tanks for liquid, a molasses pump and meter, and grain storage, in addition to conventional cattle pens and feed troughs. Molasses should be purchased in bulk and stored in one tank. The second tank is for storage of a purchased supplement. The purchased supplement normally will contain 30% crude protein and, in addition, minerals, vitamins, and additives. After the supplement is placed in the tank, molasses is pumped into this tank equivalent by weight to the amount of supplement added. The contents are mixed by recirculation using the molasses pump. When feeding grain it is placed in the trough and liquid feed is pumped over it. This system has been used successfully at Auburn in four feeding trials. In the first three the experimental ration was ground ear corn and liquid; in the fourth, the experimental ration was whole shelled corn and liquid. The control ration formula used with slight variation in the first three trials is shown in Table 1. The control ration formula used in the fourth trial is given in Table 2. Yearling cattle were used. In the first trial, the liquid level was initially 50% of the total ration. This proved too much since it induced some scouring. The amount used was lowered to equal one-third of the total ration and this amount proved very satisfactory. On starting cattle on feed in later trials the initial ration was 1:1 liquid and corn, but it was changed within a few days to 1:2. Cattle in all trials were finished and sold for slaughter. Performance data for all four trials are summarized in Table 3.

One serious problem, now under study, exists for the LGFS as in dry mixed, all-concentrate mixtures. Rumen parakeratosis afflicts all animals and there is a high incidence of condemned livers.

Table 1. Control Ration Formula for 3 Trials[1]

Ingredient	Per cent
Ground snapped corn	78.0
Dehydrated alfalfa meal	2.5
Cottonseed hulls	5.0
Cane molasses	10.0
Urea	1.0
CSM (41%)	2.0
Salt	1.0
Defluorinated phosphate	0.5
Vitamin A	2.4 million I. U./ton
Aurofac-10	5.6 gm./ton
Stilbestrol	800 mg./ton

[1] For trial 3 (Wiregrass Substation), the control formula included 20% Coastal hay.

Table 2. Control Ration Formula for Fourth Trial

Ingredient	Per cent
Ground shelled corn	75.5
Soybean meal (50%)	8.0
Dehydrated alfalfa meal	5.0
Cane molasses	10.0
Salt, trace mineralized	1.0
Defluorinated phosphate	0.5
Vitamin A	1000 I. U./lb. of feed
Vitamin D	250 I. U./lb. of feed
Aureomycin	70 mg. per animal daily
Stilbestrol	10 mg. per 25 lb. of feed

Table 3. Performance Data

Trial No. and ration	Animals per pen	Days on feed	Av. daily gain	Feed dry matter per lb. gain
	No.	*Da.*	*Lb.*	*Lb.*
1. Control	12	140	2.55	9.20
LGFS	12	140	2.28	7.85
2. Control	12	112	2.50	8.52
LGFS	12	112	2.25	8.77
3. Control[1]	10	119	2.90	9.40
LGFS	10	119	2.30	8.68
4. Control	12	126	2.42	7.45
LGFS	12	126	2.46	7.01

[1] Fed at the Wiregrass Substation.

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