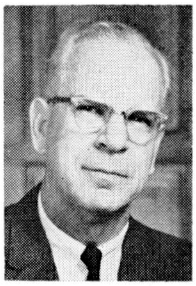
HIGHLIGHTS

of agricultural research

VOL. 16, NO. 4/WINTER 1969

Agricultural Experiment Station
AUBURN UNIVERSITY

DIRECTOR'S COMMENTS



E. V. Smith

DURING THE 1950's AND EARLY 1960's, research became a magic word throughout the world and especially in America. It was generally conceded that research in nuclear physics and subsequent development of the atomic bomb hastened the end of World War II. Medical research essentially conquered infantile paralysis. Research and development enabled man to break the space barrier.

Achievements in space captured man's imagination. Members of the Congress of the United States were no exception. New Federal research agencies were created and the budgets of many of these agencies grew rapidly. Similarly, the budgets of some of the older Federal agencies were vastly expanded. Many of these agencies were extended granting authority and authorized to make grants in their general fields of interest to support research by university faculty members. Actually, some of the more prestigious institutions came to rely heavily on Federal grants and contracts for much of their total support.

As the Viet Nam War drain on the Nation's financial resources has become heavier each year and as the demands of the cities have become more insistent, the Congress has begun to show greater restraint in the appropriation of research funds. Some Federal agencies have actually suffered budget cuts and others have seen their appropriations apparently stabilized.

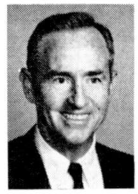
More than 100 years ago, the National Government recognized support for research on agricultural problems to be a public responsibility. The establishment of the United States Department of Agriculture during the 1860's and of the Agricultural Experiment Stations by the Hatch Act of 1872 provided a mechanism for Federal-State cooperation in financing and conducting agricultural research.

Federal expenditures for all research were modest prior to World War II with a major portion dedicated to agricultural research. As total Federal funds for research were expanded tremendously after the War, actual appropriations for agricultural research rose modestly but they constituted a smaller portion of the public research and development budget. These are facts that need to be understood clearly by farm leaders.

look for these articles

may we introduce . . .

Dr. Kenneth M. Autrey in the story on page 11 traces the progress of the dairy industry in Alabama and the history of the Department of Dairy Science of which he became head in 1947.



A native of Louisiana, he did his undergraduate work at Louisiana State University and received both the M.S. and Ph.D. from Iowa State University.

From a program of instruction in dairy husbandry in 1920, the Department has grown to the present program of instruction in all areas of dairying including dairy processing and dairy food technology plus research in production, nutrition, and microbiological problems. One of the first three milking parlors in Alabama was constructed as a part of the dairy research unit at Auburn.

Dr. Autrey is a member of Alpha Zeta and Gamma Sigma Delta. At present he is on leave for 18 months to work with the graduate dean of the National University of the Institute of Colombian Agriculture.

HIGHLIGHTS of Agricultural Research

WINTER 1969 VOL. 16, NO. 4

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

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COVER PHOTO. Research dealing with soybeans—production, costs, and returns—is covered in stories on pages 3 and 6.

FERTILIZER NITROGEN –

Is It Needed for Soybeans?

D. L. THURLOW and HOWARD T. ROGERS
Department of Agronomy and Soils

ALABAMA FARMERS put about a half million dollars worth of commercial nitrogen on soybeans in 1969. About half of the nearly 700,000 acres grown received some fertilizer N.

Some so-called "success" stories in high yield soybean contests might indicate, at first glance, that putting on N is a profitable practice. Carefully conducted research in Alabama and other states fails to show yield increases from fertilizer nitrogen when beans are properly inoculated and planted in moist soil.

At 10 of 12 research locations in central and southern Alabama over several years, addition of nitrogen did not affect yields significantly, see table. The only definite yield increase from nitrogen was in a farmer's field in Macon County where there was a complete inoculation failure on land not previously planted to this crop. Examination of soybean plants over a large area of this field showed no root nodules, such as those shown in the title photograph.

Two tests were put out in this Macon County field when the beans were in early bloom stage. One test was on an area low in soil nitrogen and the other where plants obviously were getting considerable nitrogen from the soil. It is believed that death of the inoculum was responsible for the failure of the plants to get inoculated. The seed were planted in hot, dry soil in June and did not germinate until 2 weeks later after a rain.

Applying nitrogen fertilizer to soils not previously planted to soybeans frequently has produced greener foliage and more vigorous early growth of the plants, **but without increasing seed yield.** This was very striking the first year of an experiment at the Lower Coastal Plain Substation, see photograph. Experiments are underway to determine if this early growth stimulation is of practical importance in weed control.

It has been speculated that soybeans might respond to commercial nitrogen under certain special situations, such as lands not planted previously to the crop, low pH soils, coarse-textured soils low in organic matter, poorly drained soils, and where all other growth factors will permit unusually high yields. Several of these situations are represented in the data reported in the table.

Four of the tests were on new lands for soybeans (No. 9, 10, 11, and 12). Test No. 1 was on a soil with pH 5.1. Soil textures ranged from sandy loam to clay loam. In several experiments by the Station, during the unusually good season of 1967 (not reported here), yields of 60 bushels or more per acre were made without application of nitrogen.

Although more evidence is needed on this point, it has been shown that protein content of soybean seed may be reduced by substituting commercial N for symbiotic nitrogen fixed by bacteria on the roots. This occurred in tests 9, 10, and 11, but the practical importance of this observation is not fully established.

It is concluded from these findings that, under most Alabama conditions, soybean fertilizer funds can be spent more profitably for plant nutrients other than nitrogen, and for lime where needed. However, the importance of proper inoculation and planting in soil with sufficient moisture to germinate the seed and sustain seedling growth is stressed.

This comparison at the Lower Coastal Plain Substation shows results of applying nitrogen to soybeans growing on land not previously planted to the crop. The larger plant at right came from the treatment that got 50 lb. N per acre, whereas the smaller one at left was on an area that got no nitrogen. Despite the early growth difference, there was no yield difference.

EFFECTS OF FERTILIZER NITROGEN ON SOYBEAN YIELDS

Test No.	Location, years of experiment, and soil class[1]	Nitrogen per acre	Per acre yield: Without N	Per acre yield: Difference with N
		Lb.	*Bu.*	*Bu.*
1	Gulf Coast Substation (1954-57), fsl	25	34	–2
		50[2]	34	+1
2	Gulf Coast Substation (1958-65), fsl	25	33	+1
		50[2]	33	+2
3	Gulf Coast Substation (1968), fsl	63	34	–1
4	Brewton Experiment Field (1954-58), sl	25	26	+1
		50[2]	26	+1
5	Brewton Experiment Field (1962-67), sl	25	33	0
6	Plant Breeding Unit (1967), fsl	50[3]	47	–3
7	Plant Breeding Unit (1968), fsl	50[3]	18	+2
8	Agronomy Farm, Auburn (1965-66), sl	67	28	0
9	Johnson Bros. Farm, Macon County (1967), vfsl	120[4]	6	+19
10	Johnson Bros. Farm, Macon County (1967), vfsl	120[4]	34	+11
11	Faulkner Farm, Perry County (1967), cl	80	44	0
12	Lower Coastal Plain Substation (1967-68), sl	50	26	0

[1] Abbreviations: fsl = fine sandy loam; sl = sandy loam; vfsl = very fine sandy loam; and cl = clay loam.

[2] Split application, 25 lb. nitrogen at planting and the same amount as sidedressing at last cultivation.

[3] Soybeans after rye seed crop, which left about 2 tons of straw per acre.

[4] These tests were conducted at different locations in one field. Bean plant roots had **no nodules** on them.

Marketing Heavier Hogs Shows No Producer Advantage

B. G. RUFFIN, *Dept. of Animal Science*
R. A. MOORE, JR., *Upper Coastal Plain Substation*

Hogs weighing 200 to 220 lb. have been preferred by the industry for several years. Producers have been advised against feeding to heavier weights, on the assumption that larger hogs require more feed per unit of gain. In addition, a national effort was directed toward production of meatier, less fat carcasses. And lighter pigs were preferred because they were thought to be leaner.

This situation seems to be changing somewhat now. Heavier hogs are being processed by certain packers with little or no market penalty. The packers realize a labor advantage from processing heavier carcasses and there are indications that modern meat type hogs will maintain a favorable rate of gain and feed conversion to heavier weights.

Despite the change in attitude about heavier weight hogs, there appears to be little advantage to producers. This was learned in a study at the Upper Coastal Plain Substation, Winfield, that measured feed requirements, average daily gain, and carcass composition of pigs marketed at 200, 230, and 260 lb.

Five trials involving 200 pigs were done from March 1968 to April 1969. Weanling pigs from Substation sows were assigned at random to three treatments, balancing weight, age, sex, and litter and breed composition.

A basic corn-soybean meal ration with added vitamins and minerals was fed, with protein content varied as follows: 16% ration from weaning to 125 lb.; 14% from 125 to 200 lb.; and 12% protein from 200 lb. to slaughter weight.

The pigs were fed in confinement on concrete floored pens. Individual weights and feed conversion per pen were recorded for each trial. At specified slaughter weights, the hogs were hauled to the Meats Laboratory at Auburn University Agricultural Experiment Station where carcass information was obtained.

A summary of performance data for all trials is presented in the table.

There was a slight reduction in average daily gain in the 260-lb. market hogs as compared with the 200- and 230-lb. groups, but differences were not statistically significant.

Sore feet presented a problem in the 230- and 260-lb. groups, causing 10% and 28%, respectively, to be removed before reaching the desired final weight. Pigs that suffered sore feet showed a decrease in rate of gain and an increase in number of days on feed.

After reaching 200 lb., an additional 17 and 38 days on feed were required for 230- and 260-lb. market weights.

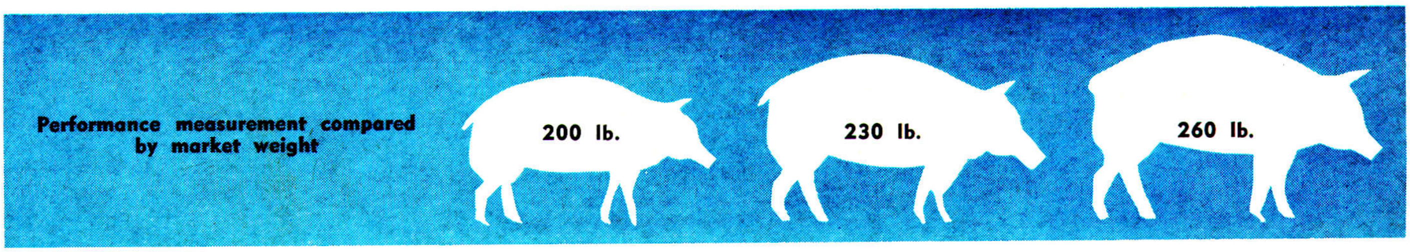
Pigs fed to 200 pounds required less feed per 100 lb. gain than those continued to 230 and 260 lb. For each increase in market weight there was a corresponding increase in feed required per unit of gain.

Carcass weight per day of age was practically the same for the three weights studied, as shown by carcass data in the table. Dressing percentage increased with the heavier hogs, but only slightly. Body length and loin eye area increased with each increase in slaughter weight.

Backfat thickness increased 9% between 200- and 230-lb. weights, and 18% between 200- and 260-lb. The 200-lb. hogs also showed superiority in grading, with a marked increase in USDA grade for each increase in market weight. (Higher numbers indicate poorer grades.)

As suggested by these findings, there is no advantage to the producer from feeding hogs to heavier weights. There was no improvement in rate of gain at heavier weights, and feed conversion was better for lighter hogs.

A significant increase in amount of fat in the heavier carcasses explains some of the reduced efficiency of feed utilization. The longer feeding period required for heavier weights resulted in more leg problems, which could adversely affect performance. Heavier hogs were fatter, and their carcasses graded poorer and probably yielded less desirable cuts of pork.



	200 lb.	230 lb.	260 lb.
Pig performance			
Number of pigs	66	67	67
Initial weight, lb.	34	34	34
Final weight, lb.	205	229	258
Days fed	111	128	149
Average daily gain, lb.	1.51	1.52	1.48
Feed per cwt. gain, lb.	357	368	386
Carcass data			
Carcass weight per day of age, lb.	0.88	0.90	0.90
Dressing percentage	73.7	74.3	74.7
Length, in.	30.1	30.9	31.9
Loin eye area, sq. in.	4.43	4.48	4.83
Backfat thickness, in.	1.27	1.41	1.50
USDA grade	1.56	1.93	2.13

TOP-PRUNING of HARDWOOD SEEDLINGS BEFORE PLANTING

HARRY S. LARSEN and SHERMAN D. WHIPPLE
Department of Forestry

LARGE, HEALTHY SEEDLINGS are essential for good performance of hardwood plantations, even under favorable planting conditions. The most reliable measure of seedling vigor is diameter of the stem at the ground. When raised to a desirable diameter, however, seedlings of two of our most popular species, yellow-poplar and American sycamore, are commonly 2-3 ft. or more in height. Such long stems increase handling and shipping costs and make machine planting impossible. Top-pruning, either in the nursery or just before planting, would control height without limiting seedling diameter.

In spring of 1966, test plantings were made to check the effects of pruning on early growth and survival of these species. Each species was planted on an upland site in the Upper Coastal Plain, but at widely separated locations with different soils. Both sites were disked before planting but received no later treatment.

The yellow-poplar and sycamore seedlings averaged 2.0 ft. and 2.1 ft. in height respectively, before pruning. Two degrees of pruning, one-half and three-fourths of total stem length, were tested. Growth and survival were measured for the next 3 years, and forking caused by pruning was checked after the second and third years.

For both species growth increased roughly in proportion to the degree of pruning, and total heights were essentially equal after 3 years regardless of treatment. The greater growth of pruned seedlings probably resulted from a better balance between the seedling tops and root systems. The maximum size of the root system of lifted seedlings is largely fixed by the necessity for undercutting the root systems at a moderate depth to make lifting economical.

PERFORMANCE OF PRUNED AND UNPRUNED SEEDLINGS OF YELLOW-POPLAR AND AMERICAN SYCAMORE

Treatment Spring 1966	Average growth			Av. ht. Fall 1968	Survival Fall 1968
	1966	1967	1968		
	Ft.	*Ft.*	*Ft.*	*Ft.*	*Pct.*
Yellow-poplar[1]					
No prun.	0.5	0.7	1.0	3.9	100
½ prun.	0.7	0.9	1.3	3.8	97
¾ prun.	1.1	1.2	1.3	3.9	99
American sycamore[2]					
No prun.	0.8	2.1	2.6	7.6	85
½ prun.	1.3	2.0	2.8	7.0	89
¾ prun.	1.5	2.4	2.9	7.3	88

[1] Plantation contained 128 seedlings in each treatment.
[2] Plantation contained 112 seedlings in each treatment.

Average survival was high for both species and was not reduced by pruning. About 18% of the pruned yellow-poplar seedlings were clearly forked after 2 years. However, after 3 years more than half of the forked seedlings were judged to be developing single stems. Pruning caused almost no forking in sycamore.

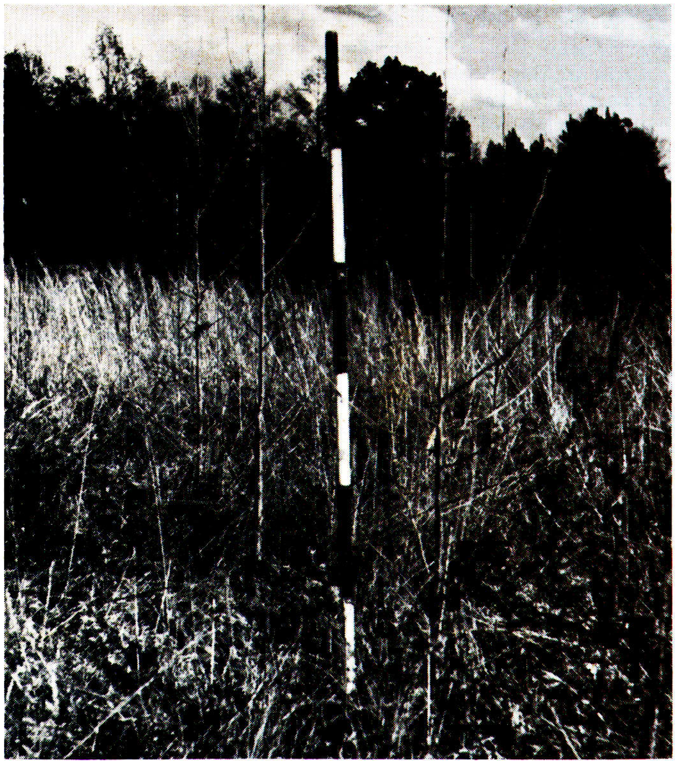
Provided planting is done on properly prepared sites, pruning up to three-fourths of the original stem apparently does not appreciably harm the performance of yellow-poplar and sycamore seedlings. Forking induced in yellow-poplar is probably largely temporary. Permanently forked trees could be removed in the first thinning without a loss of revenue.

It is possible that pruned seedlings may not perform as well because of early overtopping on sites where initial control of woody competition is poor. However, competition from annual weeds on both planting sites, and from grass on the sycamore site, was fairly heavy in this study.

The practical benefits of pruning would be greatest if it were applied in the nursery before lifting. In addition, forest nursery managers would be encouraged to produce larger, more vigorous seedlings if the height problem were eliminated. All seedlings in each nursery bed could, of course, be pruned to an arbitrary, desirable height in a single operation.

Some of the difficulty in achieving successful planting of hardwoods, particularly when machine-planted, can be traced to the large size of root systems. Despite undercutting, large hardwood seedlings tend to have a bulky root system with long lateral roots. This suggests the desirability of combining top-pruning and lateral root-pruning before lifting.

A commercial paper company had tested the growth of hand top-pruned and root-pruned sycamore seedlings in Alabama with favorable results. Experiments have recently been conducted by Auburn to test the effects of lateral root-pruning of row-sown yellow-poplar seedlings once or twice during the growing season. These attempts to develop seedlings with more compact root systems have thus far not proved to increase growth or survival. However, they have demonstrated the feasibility of mechanical pruning. They also indicate that lateral root-pruning prior to lifting should not be harmful if accompanied by top-pruning and could be beneficial. A study is planned to test this possibility.



Half-pruned American sycamore seedling after 3 years.

SOYBEAN PRODUCTION COSTS and RETURNS in ALABAMA

SIDNEY C. BELL and BRUCE WARD
Dept. of Agricultural Economics and Rural Sociology

IN RECENT YEARS SOYBEANS have become an important cash crop in Alabama. Total value of the crop has increased from $4.9 million in 1958 to $30.7 million in 1967, an increase of more than 500%. In 1967 corn was the only Alabama row crop planted to more acres than soybeans. However, in that same year cash receipts from soybeans exceeded that of any other crop.

Soybeans can be grown successfully in most sections of the State and under a wide range of soil types and climatic conditions.

In addition to having suitable soils and climate, a majority of Alabama's farmers already have most of the machinery and equipment necessary to produce soybeans. Therefore, most of the farmers in the State could produce soybeans with a relatively small outlay of capital for purchase of specialized machinery.

Data in this study were collected by personal interview from farmers of four farming areas of Alabama. Areas included were the Southeast Area (Houston, Geneva, and Covington counties); the Southwest Area (Escambia and Baldwin counties); the Black Belt Area (Dallas, Marengo, Hale, and Perry counties); and the Northeast Area (Madison and Jackson counties). The four-area study included about two-thirds of the total 1966 Alabama soybean acreage.

About 50% of the farmers interviewed were planning to increase soybean acreage. The two major areas planning to expand production were the Southeast and the Black Belt. The most common reason given for planning expansion was that soybeans were more profitable than other crops. Other reasons given were soybeans fit in well with a double cropping system, soybeans had a lower labor and capital requirement, and soybeans were not allotted.

There were two factors associated with increased acreage of soybeans. Yields increased an average of about 1 bu. per acre for each 100-acre increase in size of soybean operation in the Southeast and Southwest areas. Also, the larger producers received from 10 to 20 cents per bu. higher price for their soybeans. This was true in all four production areas.

It was found that the number of insecticide applications was highly correlated with the yield. In 3 of the 4 areas, as the number of insecticide applications increased from 0 to 3, yields increased an average of 2 bu. per acre for each additional application.

The producers in each area were divided into three groups based on returns to land, labor, and management. There were two other returns computed, returns to labor and management and returns to management.

When comparing all areas, the Southwest and the Northeast areas had the highest average production for the high group with approximately 37 bu. per acre. The 16 high producers in the Northeast Area had the highest return of any group to management with an average of $70.09. This is return above all cost. The Southeast and Black Belt areas were about the same in return to management with their highs being approximately $52 above all cost.

COSTS AND RETURNS FOR SOYBEAN PRODUCERS, ALABAMA, 1966

Item	All producers	Producer groups[1]		
		Low	Mid	High
Southwest Area				
Number of farms	103	32	35	36
Av. acreage of soybeans/farm	189	152	216	195
Av. yield per acre in bushels	31.2	23.6	31.1	37.5
Per acre		*Dollars*		
Gross returns	89.08	65.50	90.91	108.17
All cost[2]	47.00	50.63	46.73	44.05
Returns to land, labor, & mgt.	60.41	34.40	61.42	81.81
Returns to labor & management	48.16	22.15	59.17	69.56
Returns to management	42.08	14.87	43.54	64.12
Southeast Area				
Number of farms	49	16	17	16
Av. acreage of soybeans/farm	100	60	81	159
Av. yield per acre in bushels	25.8	17.2	25.4	34.7
Per acre		*Dollars*		
Gross returns	72.18	46.74	71.45	98.36
All cost[2]	45.12	43.73	45.79	45.83
Returns to land, labor, & mgt.	41.33	17.01	40.34	66.65
Returns to labor & management	32.07	7.75	31.08	57.39
Returns to management	27.06	3.01	25.66	52.53
Black Belt Area				
Number of farms	33	12	11	10
Av. acreage of soybeans/farm	319.7	253.8	379.8	331.5
Av. yield per acre in bushels	25.7	16.7	27.4	34.6
Per acre		*Dollars*		
Gross returns	68.10	47.32	70.22	90.70
All cost[2]	38.85	37.82	40.76	38.00
Returns to land, labor, & mgt.	41.73	21.41	42.73	65.00
Returns to labor & management	34.07	13.77	35.09	57.36
Returns to management	29.22	6.13	29.46	52.67
Northeast Area				
Number of farms	47	14	17	16
Av. acreage of soybeans/farm	162	121	194	183
Av. yield per acre in bushels	28.7	20.1	28.5	37.4
Per acre		*Dollars*		
Gross returns	82.59	52.07	80.59	115.12
All cost[2]	44.82	46.06	43.37	45.03
Returns to land, labor, & mgt.	56.64	25.04	55.72	89.17
Returns to labor & management	51.57	19.81	51.02	83.89
Returns to management	37.77	6.01	37.22	70.09

[1] Producer groups are based on returns to land, labor, and management.

[2] Includes fixed machinery cost, total variable cost, interest on operating capital, land cost, and labor cost.

SORGHUM SILAGE for BEEF STEERS

R. R. HARRIS and W. B. ANTHONY
Department of Animal Science

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

AUBURN RESEARCH has shown that yearling beef cattle eating sorghum silage consistently gained less than those fed corn silages, 1.25 vs. 1.50 lb. ADG. Because Alabama has fairly large areas of land suitable for production of sorghums but not corn, and since sorghums usually produce reasonably good yields of silage, it seems desirable to improve utilization of sorghum silages by cattle. Research with this major objective was initiated in 1964 and is still active. Certain data from two experiments are reported here.

In 1964 corn (Dixie-18) and sorghum (NK-300) were produced and stored as silage at the Lower Coastal Plain Substation. Corn was harvested when the grain was in hard dough and was stored without an additive. Sorghum was harvested and stored both when the grain was immature and when it was mature. Other variables for sorghum silage were additions of corn and $CaCO_3$ at time of ensiling; limit feeding; and separation, rolling, and recombining the grain.

Each silage was full-fed to one pen of 6 yearling steers that also received 2 lb. of corn and 1.5 lb. cottonseed meal daily per head. Criteria for evaluating treatment differences were silage intake, ration digestibility, and animal weight gain (140 days: November 16, 1964-April 6, 1965). Digestibility was obtained by supplying a known amount of Cr_2O_3 in cottonseed meal and making a total collection of excreta for determining Cr_2O_3 dilution.

In the 1964 experiment, all cattle except those fed $CaCO_3$-ensiled forage and those limit-fed gained 1.5 lb. or better daily, Table 1. The cattle fed silage containing $CaCO_3$ gained somewhat less (1.31 and 1.38 lb., ADG). Some of this difference can be attributed to a depressing effect $CaCO_3$ had upon silage intake, reducing it about 3 lb. daily or approximately 10%. Immature and mature silages were similarly affected. In another test in 1968, $CaCO_3$ depressed silage intake only slightly (1.6%). But $CaCO_3$ in combination with urea caused an 11% reduction. In the 1968 study, urea alone reduced the amount of silage eaten by almost 8%. These data indicate a thorough study should be conducted on the effect of $CaCO_3$ and urea upon silage intake.

Feed conversion, i.e. dry matter/cwt. gain, was most efficient for the basal sorghum silage, Table 1. Cattle on limited amounts of sorghum silage were equally as efficient in converting feed as those full-fed corn silage. The limit-fed cattle received 88% as much silage as did their full-fed counterparts on sorghum silage and gained 85% as well. Thus, restricting silage intake did not improve feed conversion.

Cattle fed the immature (dough) sorghum silage with 100 lb. of ground shelled corn added at ensiling gained the fastest of all groups, (1.61 lb. ADG). This particular treatment has consistently supported the fastest rate of gain during the 5 years it has been tested. The 5-year mean ADG was 1.69 lb. for cattle on corn-enriched sorghum silage compared to 1.51 lb. for cattle on the control sorghum silage. There was no apparent relationship between grain content of the basic silage and differential animal response even though the grain content varied from 28% to 50% of the dry matter during the 5-year period.

Rolling of the grain in NK-300 silage prior to feeding did not improve rate of gain or feed conversion, Table 1, even though the grain was mature when ensiled.

In these studies, animal response was closely associated with digestible dry matter intake, Table 2. All groups gained in direct proportion to digestible dry matter consumed except that cattle fed the basal sorghum silage gained at a faster rate than was predicted.

The addition of 100 lb. of ground shelled corn to sorghum silage at time of ensiling consistently improved animal gain and was more valuable than additions of $CaCO_3$ or urea. Rolling of the ensiled sorghum grain prior to feeding was not beneficial even though the grain was mature when cut. The addition of $CaCO_3$ and urea to sorghum at ensiling depressed silage intake. Further study of the exact cause is warranted. Digestible dry matter intake is apparently related to animal performance and thus should be useful in predicting animal response.

TABLE 1. ANIMAL PERFORMANCE ON CORN AND SORGHUM SILAGES

	Corn silage	NK-300 sorghum silage						
		Basal (dough)	Limit-fed	Corn added[1]	CaCo3 added[2]	Basal (mature)	Mature rolled	Mature[2] CaCO3
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Animal data								
Initial wt.	517	515	516	516	517	515	515	516
Final wt.	727	734	703	741	701	738	725	709
ADG	1.50	1.56	1.34	1.61	1.31	1.59	1.50	1.38
Daily feed								
Snapped corn	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CSM	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Silage	31.11	32.26	28.41	33.75	29.52	30.30	29.34	27.09
Silage, DM/cwt. gain	574	554	577	625	645	632	649	637

[1] 100 lb. ground shelled corn added per ton of green material at time of ensiling.
[2] 20 lb. $CaCO_3$ added per ton of green material at time of ensiling.

TABLE 2. RELATIONSHIP OF DIGESTIBLE DRY MATTER INTAKE TO ANIMAL GAIN

Silage	Dig. D.M. intake daily	140-day ADG
	Lb.	*Lb.*
NK-300 basal (dough)	5.14	1.56
NK-300 dough (limit-fed)	5.29	1.34
NK-300 dough ($CaCO_3$)	5.48	1.31
NK-300 mature ($CaCO_3$)	6.08	1.38
NK-300 mature (rolled)	6.32	1.50
Corn silage basal	6.76	1.50
NK-300 basal (mature)	7.01	1.59
NK-300 dough (corn)	7.25	1.61

ALABAMA CROPS and LIVESTOCK
Now and Long Long Ago

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

ALABAMA crop and livestock production today differs from the time of our forefathers. Changes, in some cases, have been rapid and dramatic. In other respects, progress has been rather slow.

In most cases data do not exist for crops and livestock produced in 1819, when Alabama became a State. The first complete Census of Agriculture was not taken until 1925. Nevertheless, certain crop records go back to 1866. Although this article cannot provide a "sesquecentennial treatment" (150 years) of Alabama agriculture, much information presented goes back to the earliest years for which records are available.

Cotton has been a mainstay and still is an important cash crop. In 1866, 977,000 acres were harvested with an average yield of 120 lb. of lint per acre.

Cotton acreage increased until 1911 when 3,833,000 acres were harvested with an average yield of 214 lb. of lint per acre. Price received that year averaged 9.58¢ per lb. From 1911, cotton acreage decreased to the early 1920's, increased until 1930, and declined since the 1930's. In 1967, 340,000 acres were harvested. This was the smallest acreage on record, about one-third of that harvested in 1866. Today's production is mainly from highly mechanized farms.

The 200-lb. lint yield was not reached until 1904, and 300 lb. was not reached until 40 years later, in 1944. A 500-lb. yield was first attained in 1963 and held for 3 consecutive years.

Cotton prices have also fluctuated since early years. First available price data were for 1876 when Alabama farmers received an average of 10¢ per lb. for cotton lint or $50 per 500-lb. bale. Prices dropped to an average of 4.8¢ per lb. in 1894, then rose to an average high of 34.9¢ in 1919. During the depression of the 1930's the annual average reached a low of 5.64¢ per lb. In 1950, the highest average cotton lint price was 40.23¢ per lb.

Years of highest average price were not necessarily the ones with highest value of the crop. Alabama farmers produced the most valuable crop of cotton in 1948 when price averaged 30.86¢ per lb., acreage was 1,630,000, and average yield was 353 lb. of lint per acre. Value of the crop was $184,769,000.

Alabama's harvested peanut acreage was 300,000 in 1919, with average yield of 550 lb. per acre, and average price of 7.9¢ per lb. Acreage reached the three-quarter million mark in the early and mid-forties and has since been reduced. In 1968, 182,000 acres were harvested averaging 1,350 lb. per acre.

Soybeans for beans have grown rapidly in acreage. Only 3,000 acres were harvested in 1924 compared with 557,000 in 1968. Soybean acreage exceeded cotton in both 1967 and 1968.

Corn, historically, has occupied the largest acreage of any crop in Alabama. There were more than 1,000,000 acres in 1866. Acreage of corn increased until 1917 to a peak of 3,800,000 acres. Since the 1930's acreage has been declining, although feed grain needs for livestock and poultry have increased.

A part of the decline in acreage since the 1930's may be explained by variable and relatively low average yields per acre. A State average yield of 20 bu. per acre was not reached until 1948. The 30-bu. average yield was not reached until 1958 and the 40-bu. average yield was first reached in 1965. In the 1950's, corn yields varied from a low of 11.0 bu. per acre average in 1952 to a high of 31.0 in 1958. Average yield in 1954 was only 2.0 bu. per acre higher than in 1952. The 1968 average Alabama corn yield was 32.0 bu. per acre compared with the U.S. average of 78.5 bu.

Lowest average price received for corn was 37¢ per bu. in 1895, while the highest average was $2.20 in 1947.

Corn at one time was a major feed crop for mules and provided "cornbread" for humans. It continues as the major feed grain crop in Alabama.

Alabama acreage of oats harvested increased from 55,000 in 1866 to a peak of 410,000 acres in 1883. Since that date when oats served as a major feed crop for mules and horses, fluctuations in acreage harvested have been rather wide. Today acreage of oats harvested is only a fraction of the peak acreage. In 1968, Alabama farmers harvested only 28,000 acres.

Acreage of all hay harvested increased from 8,000 acres in 1866 to 1,228,000 in 1943. The 1866 all hay crop yielded an average of .80 ton per acre or a total of 6,000 tons with an average price of $12.96 per ton. The 1943 all hay crop averaged .67 ton per acre. Total production was 826,000 tons with an average price of $26.80 per ton.

In recent years the average acreage of all hay has been approximately 500,000 with average yields near 1.5 tons per acre.

In 1867 there were 625,000 head of all cattle on farms while as of January 1, 1969, there were 1,896,000 head on Alabama farms. Alabama ranked 19th out of 50 states in number of head on farms in 1969. Cattle numbers have followed a cyclical pattern.

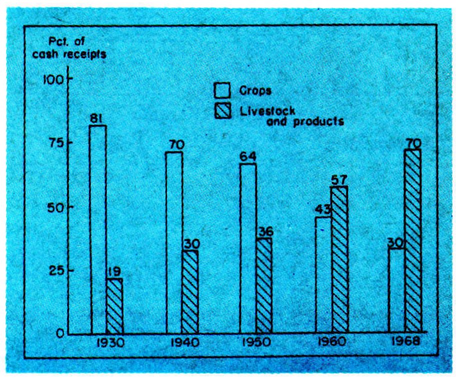
There were 140,000 milk cows on Alabama farms in 1867. This number increased to a peak of 471,000 in 1945 and declined to approximately 156,000 head.

The year 1867 found Alabama farmers with slightly over 1,000,000 head of swine. Numbers have fluctuated to the present number on farms – 937,000 head – not far different from 1867. However, weight of pork marketed has increased many times since more than 100 years ago.

Data for chickens on farms only go back to 1925 when 6.7 million were reported. Today Alabama has almost 19 million chickens on farms, ranking 5th in the Nation.

Alabama's giant broiler industry is a late-comer in terms of the past 100 years. It came forth with 328.5 million broilers in 1968 that accounted for almost $152 million in cash receipts by Alabama producers. The broiler industry is based on purchased feed, much of which is imported.

In 1968, crops accounted for 30% and livestock and livestock products including poultry made up 70% of cash receipts. Surely the future for Alabama crops and livestock and the methods and techniques used in production will hold as many interesting changes as have occurred in the past.



Per cent of cash receipts from farm marketings, Alabama 1930-1968.

BIOLOGICAL Attack on PLANT DISEASE FUNGUS

R. RODRIGUEZ-KABANA and E. A. CURL
Department of Botany and Plant Pathology

BIOLOGICAL CONTROL may be an answer to plant disease control. Matching the saprophyte with the parasite may turn the trick.

Its use as a control of the southern blight fungus, *Sclerotium rolfsii*, has been demonstrated previously in artificial culture media and in the greenhouse using an antagonistic saprophyte, *Trichoderma viride*.

Scientists do not completely understand how this control effect takes place, largely because there has been no suitable method for measuring growth of the pathogen in soil in the presence of another organism (mixed culture). It is essential to know how the two organisms interact in the soil environment before an attempt is made to apply biological control practices in the field.

Growth activity of a fungus in soil is accompanied by certain physiological responses. For example, the organism gives off carbon dioxide (CO_2) into the atmosphere and uses up oxygen (O_2). Either of these can be measured by standard methods, and they indicate the activity (respiration) of the organism. However, when two organisms are growing together in the same soil, only total respiration can be measured. Thus, the activity of one organism cannot be separated from the other.

Enzymes are proteins produced by living cells. These substances are essential in bringing about the chemical reactions necessary for an organism to utilize its food source. Different organisms may produce different kinds of enzymes, and these can be measured chemically. Thus, if two fungi having different enzyme systems are grown together in a container of soil, an analysis of the soil can be made for presence of their respective enzyme and thereby trace the growth activity of each fungus independently. This approach was taken in the Department of Botany and Plant Pathology, Agricultural Experiment Station, to study the interaction of the southern blight fungus and *T. viride*.

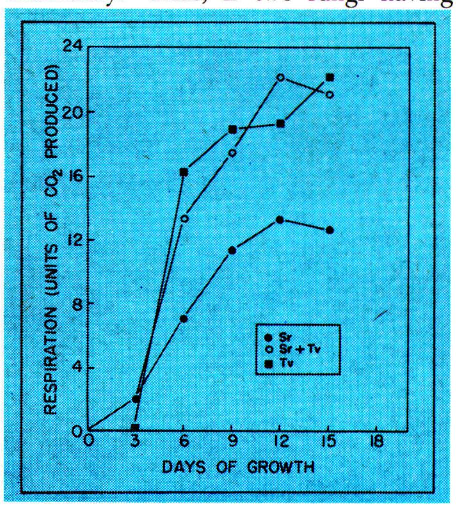


Fig. 1. This chart shows respiration of the southern blight fungus, Sclerotium rolfsii (Sr) and an antagonistic saprophyte, Trichoderma viride (Tv) growing in soil alone or together. Note that respiration of the mixed culture is similar to that for Trichoderma viride alone.

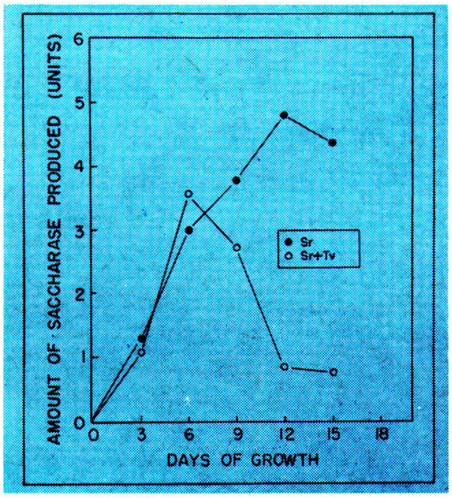


Fig. 2. This chart shows the production of the enzyme saccharase (indicating growth) by Sclerotium rolfsii (Sr) when grown in soil alone as compared to production when grown together with Trichoderma viride (Tv). Note the sharp decline in enzyme production where the inhibitory saprophyte is present.

Before the principal study could proceed, however, certain questions needed to be answered: (1) What were the enzymes produced by each fungus under the environmental conditions of the experiment? This was determined by growing each organism separately in sterilized soil (free of other organisms) and then analyzing the soil to see which enzymes were produced. (2) Did the parasitic fungus produce an enzyme that the antagonistic saprophyte did not produce? For example, it was found that *S. rolfsii* produced an enzyme called saccharase, which *T. viride* did not. (3) Was the amount of enzyme produced by the parasite a function of growth? Several tests were required to investigate this. It was found that the addition of increasing amounts of chopped mycelium of *S. rolfsii* to sterilized soil caused a proportionate increase in the amount of saccharase activity when the soil was analyzed. Further, CO_2 production (respiration) of soil cultures showed a linear relationship to enzyme production. Nutrient utilization also was shown to correlate with saccharase activity. (4) Finally the optimum soil pH (acidity or alkalinity) for saccharase activity by the parasite had to be established, since enzyme activity is very sensitive to changes in pH.

With this information, the background was established for determining the effect of *T. viride* on *S. rolfsii* when they are grown together. This was done in flasks with 100 g. of sterilized soil. One set of flasks was "seeded" with *S. rolfsii* alone, another set with *T. viride* alone, and a third set with both fungi.

Soil from flasks was sampled at intervals over a period of 15 days, and saccharase activity and CO_2 production (respiration) determined. The results are plotted in Figures 1 and 2. Note in Figure 1, showing respiration, that values for the mixed culture (*T. viride* and *S. rolfsii*) are essentially like those for *T. viride* alone. Although respiration of the pure *S. rolfsii* culture is lower than for the other two cultures, this does not tell how the saprophyte affects the parasite in mixed culture. It only reveals the period of maximum respiration in the three sets of cultures.

When saccharase activity was measured, Figure 2, the picture was entirely different. Since *T. viride* does not produce measureable amounts of saccharase under these conditions, we know that the recorded enzyme activity represents growth of the parasite only. When *S. rolfsii* was cultured alone, growth continued uninhibited for 12 days. In the mixed culture, however, the parasite produced saccharase up to the 6th day; thereafter, enzyme activity drastically decreased.

From this it is evident that the saprophyte interferes in some way with the saccharase production of the pathogen. Change in soil pH is a key factor in this interaction. *S. rolfsii* requires a low pH (more acid) soil for saccharase production and best growth; it lowers the soil pH itself by producing an acid. *Trichoderma*, on the other hand, causes soil pH to rise (more alkaline), and this is probably the cause of inactivation of the pathogen's saccharase producing system. Further research at Auburn has shown that *Trichoderma* also interferes with production of other enzymes by the parasite.

Effect of Nitrogen Source, Rate, and Time of Application to Tall Fescue, 1966-67 Average, TVA Forage Research Area, Muscle Shoals

Nitrogen treatment		Forage yield and protein content, by harvest					
		May 1 harvest		July 1 harvest		October 1 harvest	
Date	Lb./acre	Forage	Protein	Forage	Protein	Forage	Protein
		Lb.	*Pct.*	*Lb.*	*Pct.*	*Lb.*	*Pct.*
Ammonium nitrate							
Dec. 15	75	2,540	11.8	1,560	8.6	2,010	8.4
	150	4,140	12.9	2,160	8.9	2,200	8.6
Jan. 15	75	2,820	11.7	1,450	8.6	1,910	8.3
	150	4,030	13.9	2,080	8.9	2,140	7.8
Feb. 15	75	2,600	13.9	1,440	8.6	2,170	8.2
	150	3,840	16.1	2,110	9.1	2,520	8.1
Mar. 15	75	2,450	12.7	1,640	8.1	2,090	8.1
	150	3,540	17.3	2,450	9.1	2,240	8.4
Urea							
Dec. 15	75	2,130	11.5	1,290	8.4	1,940	8.6
	150	3,400	12.2	1,710	8.5	1,950	8.8
Jan. 15	75	2,660	11.3	1,380	8.3	2,000	8.6
	150	3,680	14.1	2,140	8.8	2,200	8.1
Feb. 15	75	2,560	12.9	1,570	8.4	2,240	7.9
	150	3,620	14.8	2,260	8.7	2,340	8.1
Mar. 15	75	2,380	12.4	1,410	8.6	2,130	8.1
	150	2,900	14.3	1,920	8.1	2,060	8.1
Check plot, no N		830	10.6	780	9.1	2,130	7.6

Winter Application of Nitrogen Satisfactory for Tall Fescue

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E. M. EVANS, *Department of Agronomy and Soils*

An adequate supply of nitrogen is necessary for tall fescue pastures to make rapid spring growth for early grazing. Getting the nitrogen out at the preferred time – just before the most favorable period for growth – is a problem because of wet fields or heavy work loads in spring. This is a particularly troublesome problem on heavy soils of the Tennessee Valley area.

A possible solution to the application problem is indicated by findings of a project at the Tennessee Valley Authority's Forage Research Area, Muscle Shoals. In this 1966-67 test, mid-winter application gave satisfactory results with tall fescue.

Nitrogen rates of 75 and 150 lb. per acre from ammonium nitrate were used for established fescue on Lawrence silty clay loam on December 15, January 15, February 15, and March 15. Soil test values on the area that had been well fertilized and limed previously showed pH of 6.4 and medium to high phosphorus and potassium levels. Phosphorus and potassium were applied annually at per acre rates of 22 lb. P and 83 lb. K. Forage was harvested about May 1, July 1, and October 1 each year.

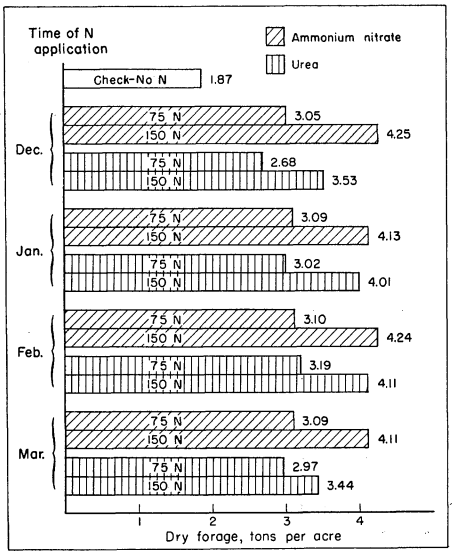
Because of rainfall differences, forage yields were about one-third greater in 1967 than in 1966. However, relationships between rates, application dates, and sources of nitrogen were similar, so data in the table are averages for the 2 years.

Winter application date had little effect on total yield response to ammonium nitrate, as shown by the graph. Urea, however, was less effective when applied in December or March than if put out in January and February. In addition to its less certain response at early and late winter applications, urea was generally less effective than ammonium nitrate in improving yields. With all rates and times of application averaged, urea produced 90% as much forage as ammonium nitrate at the first harvest and 92% as much at second cutting. There was little yield response to residual nitrogen at the October harvest.

Forage yield response to the first 75 lb. of N from ammonium nitrate averaged about 1,800 lb. in May and 700 lb. in July. The second 75 lb. of N increased yields an additional 1,300 lb. in May and 600 lb. in July, for a total of about 1 ton of dry forage. This increase from the second increment of N would be an economical response if the additional yield were utilized.

The second 75-lb. increment of N from ammonium nitrate also gave a decided improvement in the forage's crude protein content. Crude protein content generally followed the yield response pattern. Urea produced forage of slightly lower protein content at comparable N fertilization rates. Protein levels at the May harvest were generally adequate for all classes of beef cattle, especially at high fertilization. Forage from July and October harvests had too little protein for adequate nutrition of all except non-lactating, mature cattle unless supplemented with protein.

The response patterns for yield and quality indicate that more than one nitrogen application is needed for grass pastures during the year. It is recommended that N be applied to fescue pastures in late August or early September to stimulate fall growth and again in winter to help spring production. This winter application can result in a savings because of somewhat lower fertilizer prices and less demand for labor at that time.



How total yield of tall fescue forage is influenced by rate, source, and time of N application is shown by these 1966-67 averages from the Muscle Shoals test.

A History of Dairy Science at Auburn University

K. M. AUTREY, *Department of Dairy Science**

COMMERCIAL DAIRYING began in Alabama about 1915. Although most farms throughout the State had family milk cows at this time, there were no commercial markets for dairy products.

Alabama agriculture was based largely on a cotton economy. Therefore, there was little demand for people trained in dairy science. Likewise, there was little need for research in this area. However, there was limited instruction of students in dairy husbandry. A herd of Jersey cows was developed on the Auburn University campus in 1888 (then Alabama Agricultural and Mechanical College at Auburn). There were some facilities for making butter and the first 'creamery' butter made in Alabama was produced at Auburn in 1915.

An early report by Earl S. Garton, manager of the Auburn University Creamery, indicated that cream routes were developed near Auburn in 1915 and production increasd rapidly. Butter production was the first step in the development of commercial dairying in Alabama.

In 1918 W. H. Eaton came to Alabama from North Carolina as an Extension Dairy Specialist, employed by the U.S. Government. He joined the staff of Auburn University in 1920 to become the first instructor of dairying. Perry Creamery of Tuscaloosa was developed in 1924 and in the following years there was considerable development of fluid milk processing plants. Cheese and evaporated milk plants emerged during the period 1930-1945.

As commercial dairying was born, there was serious need for people with college training in the science of milk production and processing.

Auburn's President Bradford Knapp saw the potential in the livestock industry and was largely responsible for obtaining appropriations with which an Animal Husbandry-Dairy Building and a dairy barn for the expanding herd were constructed on campus. These structures, built in 1929, are still important parts of the current physical plant of Auburn University.

A. D. Burke of Oklahoma joined the staff in 1929 as Professor in charge of dairy instruction in the Division of Animal Industry.

After Professor Burke's resignation in 1946, Dr. K. M. Autrey was employed as Head of the Department of Dairy Science, which was then separated from the Division of Animal Industry (now Animal Science). Dr. Fred Warren was employed in 1947 to teach in the area of dairy processing and dairy food technology. Following his resignation in 1948 Dr. Robert Y. Cannon was employed to teach and do research in this area. Dr. G. H. Rollins joined the staff in 1948 as an additional staff member in dairy production.

By 1950 almost 50% of all milk produced in Alabama was sold through commercial channels. Because of the rapid growth of commercial dairying there was serious need to develop a research program at Auburn University to serve the two broad segments of the industry.

The Dairy Research Unit was developed in 1950 at its present location, 5 miles north of Auburn. On it was constructed one of the first three milking parlors of Alabama with such labor-saving features as vacuum movement of milk through sanitary pipelines and an overhead feeding system designed by staff members. These features are commonplace now on modern dairy farms. Prior to 1950 there were no funds for dairy research at Auburn University. There were some good dairy farming demonstrations developed at the following substations during the 1940's: Tennessee Valley, Sand Mountain, Upper Coastal Plain, Alexandria Field, Piedmont, Black Belt, and Gulf Coast. Work on these units was primarily on the value of improved pastures for milk production.

With the development of the Dairy Research Unit, some research projects in dairy science were developed and the research staff increased by the addition of Dr. George E. Hawkins in 1952. His main research interest is in ruminant nutrition. The initial research emphasis of the Department of Dairy Science was in the area of dairy cattle nutrition and feeding and in dairy product quality and flavor improvement.

Much of the nutrition research from 1952 to 1960 dealt with the feeding value of such crops as crimson clover, sericea, millet and Coastal bermudagrass, johnsongrass, and sorghum silages. These studies involved considerable cooperative work with the departments of Agronomy and Soils, Agricultural Economics, Agricultural Engineering and the substations: Tennessee Valley, Sand Mountain, Piedmont, Black Belt, Upper Coastal Plain, and the Gulf Coast. Also, some cooperative work with the Regional Animal Disease Laboratory resulted in some improvements of the portable calf pen system of rearing dairy calves. This system proved to be the most practical management system to control coccidiosis.

Gary Paar was a member of the research staff from 1961-1966. Many analytical methods developed by him are still in use in the dairy laboratories.

Research efforts in nutrition and feeding were expanded with the addition of Joe Little to the staff in 1962. Recent research has included causes of milk fat depression, the role of salvia in rumen metabolism, blended complete rations, and group feeding of concentrates and roughages.

With the addition of Dr. T. A. McCaskey to the dairy staff in 1967, the research program was further expanded to include more work on microbiological problems in the dairy industry. His current research includes projects on: The effect of milk composition on growth of psychrophilic organisms; pollution problems associated with waste disposal; and salmonellae organisms in vended foods.

The contributions of the department to dairying in Alabama through undergraduate instruction is illustrated by alumni in positions such as: teaching, research, extension, marketing, feed manufacturing, dairy farming, milk processing, and governmental service.

The graduate program in the department currently has 6 students.

* On leave.

ANYTHING THAT AFFECTS INCOME is important. And that is why changes in per capita consumption and consumer prices of poultry and red meat are important to farmers who produce meat animals. Since about half of 1968 cash farm receipts in Alabama were from sales of poultry and red meats (nearly equally divided), factors affecting such income are of importance to a large segment of farmers.

Total per capita food consumption in 1968 averaged 5% above the 1957-59 level. There were increases for both animal and crop food products, but consumption increases for animal products have been greatest in recent years. Poultry (73% of which is broilers) and beef have experienced most of the increases, as shown by the graph.

There were only 3 years in the past 15 when per capita consumption of poultry did not increase. The average person consumed 60% more pounds of poultry and 139% more

producer profits affected by varying consumption and prices of poultry and red meats

MORRIS WHITE, *Dept. of Agricultural Economics and Rural Sociology*

pounds of broiler meat in 1968 than in 1954. Increased consumption of broilers was made possible by rising production at a time when prices were declining.

Average retail price for broilers dropped 17.4¢ per lb. (31%) between 1955 and 1961. Since 1962, annual average retail price has remained stable, varying from 1.8¢ above to 1.7¢ below the average of 39.5¢ per lb. However, production in 1968 was 35.6% greater than in 1961.

Consumers ate beef in 1968 at a rate never before equaled. Per capita consumption increased from 80 lb. in 1954 to 109 lb. in 1968. A decrease occurred in only 1 year during this period. The increase of 29 lb. per capita was a greater increase in pounds consumed than were the increases for pork and poultry. Proportionally the change was approximately 37%, which was double the rate of increase for pork but only about one-fourth the rate at which broiler consumption increased.

Retail price of beef reached a low in 1956 for the 1954-1968 period. A sharp increase occurred in 1958, when average retail price rose about 15%. During the next 7 years the retail price remained relatively stable, fluctuating from 2.0¢ above to 1.6¢ below the average of 80.8¢ for the period. The trend in retail price has been upward since 1964, with the 1968 average of 87.2¢ representing a 27% increase over 15 years earlier.

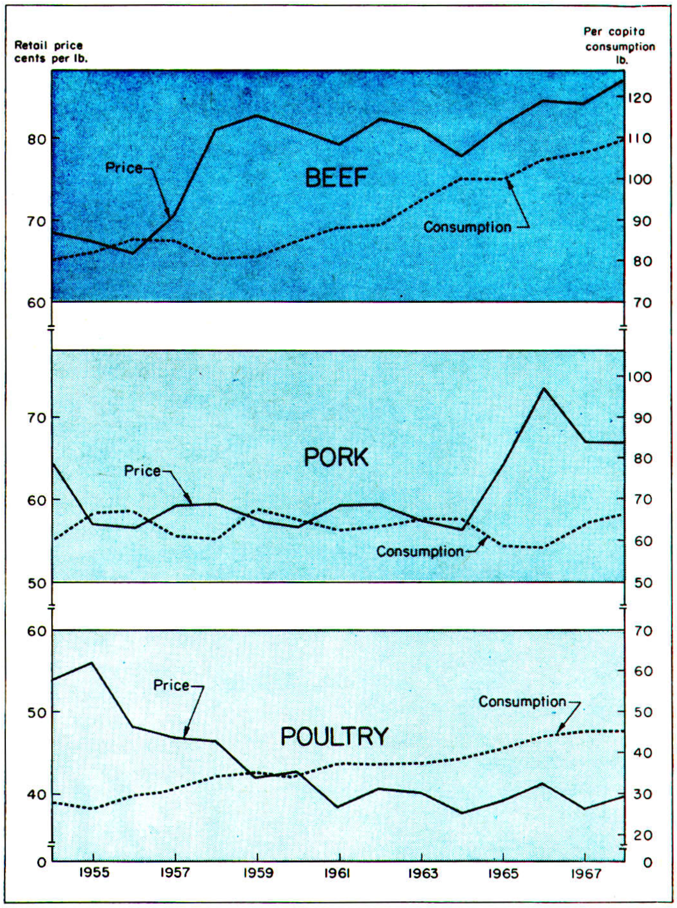
Average prices received by beef producers were unusually low in 1954. Producer prices rose 72% by 1958 and have fluctuated within 18% of the 1958 level during the past 10 years. The average in 1968 was approximately 10% above the 1958 price, but was 89% greater than 1954 prices.

Relative stability describes the fluctuations in both per capita consumption and average retail prices for pork during the 1954-1968 period. No trends similar to those that occurred with beef and poultry developed with pork. Per capita consumption varied from 7% above to 8% below the average of 63.4 lb. during the 15-year period. In 1968, consumers ate only 6 lb. more pork per person than in 1954.

Changes in the average retail price of pork established the pattern of 2 years of falling prices followed by 2 years of rising prices. The amount of change, either up or down, never amounted to as much as 5% between 1955 and 1964. There was a sharp increase of 14% in retail pork prices in 1965 and again in 1966. This was followed by a 9% drop in 1967, with no change in 1968. This was the only time in the past 18 years that average retail price of pork failed to change in the same direction for 2 consecutive years.

Changes in prices paid to pork producers generally followed the pattern of 2 years of rising and 2 years of falling prices. On a proportional basis, pork producer prices changed almost three times as much as per capita consumption and average retail prices.

Data for the 15-year period show: **for poultry,** an almost continuous upward trend in per capita consumption that has persisted even though prices leveled off during the last half of the period; **for beef,** an unusual situation in which both price and per capita consumption increased, particularly during the last third of the period; and **for pork,** short term adjustments in supply and demand with no definite trends either upward or downward.



Relationship between retail price and per capita consumption is illustrated by the U.S. price and consumption curves shown here for beef, pork, and poultry during the 1954-68 period.

Phalaris Aquatica—Promising Cool Season Grass for Alabama

C. S. HOVELAND and E. L. CARDEN, *Dept. of Agronomy and Soils*
W. B. ANTHONY and J. P. CUNNINGHAM, *Dept. of Animal Science*

COOL SEASON PERENNIAL grasses are widely grown in Alabama to furnish grazing in winter and early spring when warm season perennials are dormant and unproductive. More than 770,000 acres of tall fescue and 25,000 acres of orchardgrass are now grown in the State.

The problem with these grasses is that all varieties available were selected or bred in areas much farther north where winter survival is a prime consideration. These varieties are generally winter dormant in Alabama and make little or no growth during the season when forage is badly needed and when soil moisture and temperature may be favorable.

The need for adapted cool season perennial grasses in central and southern Alabama has encouraged research with exotic species. A large number of *Phalaris aquatica* introductions from the Mediterranean area have been tested during the past 8 years. Many of these are like hardinggrass, a *Phalaris aquatica* grown in California, and have poor persistence. However, some introductions have performed well.

Grass growth begins in September or October and continues until May. Seed heads mature in June and the grasses remain brown and dormant until late summer. Persistence and productivity have generally not been satisfactory in northern Alabama or on poorly drained soils elsewhere in the State. Established stands have tolerated zero temperatures. In northern Alabama, however, survival of seedlings has been poor.

Winter productivity of several Phalaris introductions exceeded that of tall fescue or reed canarygrass at the Plant Breeding Unit in central Alabama over a 4-year period, Table 1. This test was fertilized with 160 lb. of N per acre annually. Total annual forage yields were about the same for the better *Phalaris aquatica* introductions as for tall fescue. However, P.I. 240261 from Morocco made over 36% of its total growth during the critical winter period as compared with only 18% for Kentucky 31 fescue.

Similar results were obtained in southern Alabama at the Brewton Experiment Field, but winter production of the best Phalaris introduction was higher there than in the central part of the State. November to February growth of perlagrass, another Phalaris from Morocco, was about 2½ times that of Kentucky 31 fescue, as shown below:

Grass	Dry forage per acre, lb. Nov.-Feb.	Dry forage per acre, lb. Oct.-Apr.
Perlagrass (P.I. 202480)	2,540	4,930
Hardinggrass	1,290	4,010
Kentucky 31 tall fescue	990	4,740

Growth characteristics of Phalaris grass were observed in this nursery at the Plant Breeding Unit, Tallassee, in April 1966.

TABLE 1. YIELD AND DIGESTIBILITY OF *Phalaris aquatica* AND TALL FESCUE, 4-YEAR AVERAGE, PLANT BREEDING UNIT

Grass	Dry forage per acre		Digestible dry matter		
	Nov.-Feb.	Oct.-Apr.	Feb.	Mar.	Apr.
	Lb.	*Lb.*	*Pct.*	*Pct.*	*Pct.*
P.I. 240261	1,740	4,740	78	75	61
Koleagrass	1,650	4,700	78	74	66
Hardinggrass	1,250	4,740	77	74	67
Ky. 31 fescue	890	4,800	73	73	58
Reed canary	750	5,120	78	76	63

TABLE 2. YIELD AND DIGESTIBILITY OF *Phalaris aquatica*, YEAR AFTER ESTABLISHMENT, PLANT BREEDING UNIT

Grass	Dry forage per acre		Digestible dry matter	
	Nov.-Feb.	Sept.-Apr.	Average	Range
	Lb.	*Lb.*	*Pct.*	*Pct.*
Phalaris synthetic	3,280	9,420	77	68-86
Perlagrass	3,130	8,620	74	69-79
Hardinggrass	2,220	7,940	75	67-85

Phalaris grasses are highly responsive to nitrogen and yields can be high in favorable years. Total yields exceeded 4½ tons of dry forage per acre with 200 lb. N in central Alabama during a favorable season, Table 2. High autumn-early winter production and persistence are also influenced by cutting management. These grasses must be rested during heading in late May through July to permit accumulation of food reserves for fall-winter grazing.

Forage quality of the winter productive *Phalaris aquatica* introductions appears excellent. Hardinggrass proved highly palatable in cafeteria grazing trials at the Tuskegee Experiment Field. Reed canarygrass has low palatability, but steers confined to it make satisfactory gains.

Digestible dry matter of *Phalaris aquatica* is high. Hardinggrass cut in April and fed to lambs had 65 to 74% digestible dry matter. Other Phalaris introductions were equally digestible, suggesting that animals should perform well on all these grasses. Forage from well fertilized Phalaris grasses contained 20 to 26% crude protein in March and April.

Based on the findings of the Auburn trials, several *Phalaris aquatica* introductions appear promising as cool season perennial pastures in central and southern Alabama. Excellent seedling vigor, good winter production, high palatability and digestibility, good seed production, and persistence are desirable characteristics of these grasses. However, persistence and productivity depend on management, and good performance requires that no grazing or cutting be done from heading through early summer.

Phalaris aquatica is not presently recommended in Alabama and no seed are available. A breeding project is underway to develop a variety suitable for Alabama.

WOODY ORNAMENTALS – A MULTIMILLION DOLLAR BUSINESS

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ALABAMA wholesale nurserymen marketed $4,839,700 worth of woody ornamental trees, shrubs, and vines in 1965.

The information comes from a survey made in 1967 of 47 wholesale nurseries in the State, based on 1965 business. The average of sales for each of these nurseries was $102,792.31. Each nursery employed an average of 15.6 full-time workers and 12,554 part-time man-hours per year, with peak part-time employment in March, April, May, and June.

All nurseries included in the survey produced broadleaf evergreen shrubs. Ilex (holly), Rhododendron (including azalea), and Camellia were the major broadleaf evergreens produced. These were sold either as liners, in containers, or b and b (balled and burlapped). A liner is a rooted cutting or seedling with one season of growth after rooting and capable of being transplanted to a larger growing area without adverse affects on continued growth.

Narrowleaf evergreen shrubs were produced by 89.4% of the nurseries. Juniperus (juniper) and Thuja (arborvitae) were produced in the highest volume among the narrowleaf evergreens. The majority of the junipers were sold as liners, with b and b plants second, and containers third in volume. The majority of Thuja was sold as b and b plants, liners almost equal volume, and containers a minor item.

Ornamental trees were produced by 57.5% of these nurseries. The major genera produced were Cornus (dogwood), Magnolia, Cercis (redbud), Albizzia (mimosa), and Acer (domestic and Japanese maples). These were sold as liners, bare root, or b and b plants with containers being a minor method of preparation for sale.

Deciduous shrubs were produced by 76.6% of the nurseries. Lagerstroemia (crapemyrtle), Forsythia, Magnolia (Japanese), and Deutzia were the major deciduous plants grown. The majority of these plants were sold as liners. Woody ornamental vines were produced by 14% of the nurseries.

Wholesale nurserymen sold 46% of their plants to local buyers (located within 25 miles). However, 32% of the plants were shipped to distant southern cities with Atlanta receiving the largest volume, followed by Dallas – Fort Worth, Houston, Birmingham, Norfolk – Portsmouth, and Shreveport among others. Retailers in states outside the South bought 22% of the Alabama production. New York was, by far, the largest volume importer followed by Illinois, Indiana, Iowa, Maryland, Michigan, Ohio, Pennsylvania, and Wisconsin.

TABLE 1. PROPORTION OF ALABAMA WHOLESALE NURSERIES PRODUCING SPECIFIED TYPES OF WOODY ORNAMENTALS, 1965

Plant type	Production of Alabama wholesale nurseries
	Pct.
Broadleaf evergreens	100.0
Narrowleaf evergreens	89.4
Deciduous plants	76.6
Ornamental trees	57.5
Vines	14.9

Nurserymen are anticipating an increase in demand for ornamental shrubs and trees. Therefore they are planning to increase broadleaf evergreen shrub production by 25% between 1965 and 1970. Narrowleaf evergreen shrub production may increase as much as 69% and deciduous shrub production is anticipated to increase by 14%. The number of ornamental trees being grown by the nurseries may more than triple by 1970.

Wholesale nurseries still face many production problems such as a shortage of labor, weather hazards, weed control, unskilled labor wage rates, insect control, and production capital.

An area of marketing that could possibly be greatly improved is that of pricing and bookkeeping. Only 21.3% of the nurserymen could determine production costs per plant from their records. Imitating prices of larger, nearby nurseries was the leading method used in establishing prices for their products.

TABLE 2. VALUE OF SALES OF WOODY ORNAMENTALS IN ALABAMA BY LOCATION AND TYPE OF BUYER, 1965

Type of outlet	Value of sales		
	Dol.	*Pct.*	*Pct.*
Local sales*			
Individual consumers	743,350		33.4
Retailers	794,109		35.7
Wholesalers	142,250		6.4
Other growers	282,737		12.7
Public agencies	2,673		0.1
Landscape contractors	261,143		11.7
All local sales	2,226,262	46	
Distant sales			
Southern cities	1,508,704		32.0
Cities outside the South	1,064,734		22.0
All distant sales	2,613,438	54	
All sales	4,839,700	100	

* Within 25 miles of the nursery.

TABLE 3. MAJOR GENERA OF BROADLEAF EVERGREENS AND METHODS OF PREPARATION FOR SALE BY ALABAMA WHOLESALE NURSERIES, 1965

Type of broadleaf evergreen	Nurseries	Sold by sample	Method of preparation for sale: Rooted cuttings	Liners	Containers	Bare root	Balled and burlapped
	No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Abelia	2	80,000		80,000			
Aucuba	1	3,000			3,000		
Buxus	4	94,000		80,000	10,000		4,000
Camellia	3	175,000		43,600	118,000		13,600
Cleyera	1	34,000		20,000	8,000		6,000
Fatsia	1	2,000			2,000		
Gardenia	3	30,200		2,000	25,000		3,200
Ilex	11	2,957,300		2,331,100	542,600		83,600
Ligustrum	5	41,000			25,000		16,000
Magnolia	5	77,200	20,000	19,900	35,200		2,100
Photinia	2	34,000		10,000	22,000		2,000
Pittosporum	1	6,000		2,000	2,000		2,000
Podocarpus	1	10,000					10,000
Prunus	2	4,000					4,000
Pyracantha	1	52,000		5,000	47,000		
Rhododendron (including azaleas)	7	3,827,900		2,271,000	1,426,800	57,500	72,600
Other	8	880,200		696,300	102,200		81,700

Efficient Crop Production Can Increase Pest Problems

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MOST OF US are becoming increasingly concerned about the deterioration of our environment and the contributions of agriculture to its pollution. Consequently, it is our obligation to continue to evaluate agricultural practices and determine whether it would be possible to supply foods, fiber, fuel, and shelter of the quality and quantity our society needs without simultaneously despoiling our environment.

Imagine what Alabama would be like if man had never lived here. The land would be nearly all forested. Deer, turkey, fish, and other game would abound along with wolves, coyotes, foxes, and other predators. The air and water would be clear and unpolluted and the soils fertile. Plants and animals would live together in a stable, self-perpetuating community which would make nearly maximum use of all natural resources. Very little unused sunlight would reach the forest floor through canopies of plants. Most rain that fell would be held in the high organic soil of the forest floor.

Now imagine a few hundred families of people placed in the area but deprived of today's equipment and technology. They would find this beautiful and bountiful State a very inhospitable place. Essentially all of their efforts would be spent trying to find something to eat while avoiding being eaten. There would be little or no time for art, music, science, or recreation. This is probably what it was like when man first started his existence on earth. The bountiful state of Alabama that we have visualized could support no more than a few thousand people if they had no agricultural skills. Let us now examine some of the agricultural skills that allow it to support millions of Alabamians in relative comfort.

One of the first major steps in the development of civilization was taken when man first began cultivating crops rather than wandering about harvesting whatever he could find. It was then that he must have had his first battles with plant pests. He had to remove some competing weeds and drive off some animals to protect the fruits of his labor.

It was not long, historically speaking, before man began to recognize the benefits of organic fertilizers either in the form of manure or plant and animal products. Fish and sea weeds were among the early organic materials used to fertilize crops. Unfortunately, increased fertility also favored competing weeds and root diseases and healthy, vigorous plants were more attractive to herbivores and insects. In time, man learned that the value in organic compounds came from inorganic materials within them. He learned how to economically manufacture, distribute, and apply chemical fertilizers formulated with these inorganic materials. These fertilizers also have problems associated with them. One is that they are more subject to loss through leaching and surface erosion and hence may cause excess fertility in ground water and streams.

A few apple trees scattered through a forest will produce some apples each year. If competing trees are removed, fertilizers applied, and animal and insect pests held somewhat in check, then the yield is markedly increased. Man soon recognized that it is much easier to do these operations if the trees are together. This, however, creates more pest problems. Trees scattered through the forest may be subject to occasional attacks by disease or insect pests which seldom destroy all of the fruit on any one tree or affect all of the trees. Where apple trees are assembled in one orchard a disease agent or insect pest attacking one tree may multiply rapidly and spread to all of the trees. Not only are more trees affected but often the infestation is more severe. Again in increasing his efficiency man increased plant pest problems.

When man began assembling plants in one place for ease of cultivation and harvest he observed that all plants were not equally productive so he began selecting particular varieties for superiority in quantity or quality of yields. He also began bringing in desirable plants from distant lands. However, many of his selections and introductions were poorly suited to the natural environment and were particularly subject to diseases and other pests. Virtually all major crops in Alabama would disappear if not propogated, cultivated, and protected by man.

Thus, increased fertilization, concentration of a single crop in one area, and selection of plants with little regard for their resistance to pests created a situation in which pest control was essential to crop production. Man compounded the problem by introducing alien plant and animal species. Many of these introduced species, removed from an environment where they had natural controls, multiplied and became serious pests.

It is not surprising that farmers were overjoyed when 2,4-D, DDT, and zineb were added to their arsenal of weapons for fighting pests. However, not all weeds could be controlled by 2,4-D, nor all diseases by zineb, nor all insect pests by DDT. Furthermore, many insects developed resistance to DDT. Industry met the challenge and an increasing array of pesticides was produced. Public demands for perfect fruits and vegetables led to steadily increasing usage of pesticides. Often more than one insecticide was used and predacious insects and birds that helped hold some pests in check were killed along with the pests. The public has now become concerned that species other than the target species are being affected. This completes the full cycle and we are back where we started.

Two things must be kept firmly in mind. The demands of the present population cannot be met by dependence on natural foods and the balance of nature. Man must alter his environment to survive. It is equally important that all recognize that pest control, while necessary, must be accomplished with the minimum damage to our environment. Chemical weapons should be used wisely and pointed directly at the target species. More research to this end is essential.

Amazons of the Insect World

WHITE-FRINGED BEETLES

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AMONG WHITE-FRINGED BEETLES there are only females, bringing to mind the Amazons of Greek mythology. Each female beetle will lay about 1,000 eggs during her lifetime, thus potentially increasing the population 1,000-fold at each new generation. These insects are known to feed on 170 kinds of plants as adults and 240 kinds as larvae. Among those plants attacked by both larvae and adults are peanuts, corn, sugarcane, Irish potatoes, soybeans, and cotton. These are just a few of the reasons white-fringed beetles are taken seriously by scientists in the southeastern United States.

The white-fringed beetle is a native of South America, where it is widely distributed throughout Argentina, Brazil, Chile, and Uruguay. It was first reported in the United States in 1936 when specimens were found in Okaloosa County, Florida. Later, beetles were found in Covington and Geneva counties in Alabama. These insects have now spread throughout 8 southeastern states, with local infestations reported in 6 adjoining states.

The northern distribution of this insect is probably limited only by the depth to which the soil freezes in winter. The white-fringed beetle overwinters as a larva 6 to 8 in. below the soil surface and can probably spread northerly to any region where the soil does not freeze to an appreciable depth. Its westward spread would be limited by available moisture, but in an irrigated situation sufficient moisture would be available.

White-fringed beetle adults are wingless and cannot move any appreciable distance on their own, probably less than a mile during their life span. This insect's spread is accomplished primarily through the commercial movement of crops, soil, sod, nursery stock, farm machinery, etc.

The insect's reproductive potential is phenomenal. One heavily infested cotton field was estimated to have 240,000 adults per acre, and the authors observed such vast numbers of beetles in the Dothan area during the summer of 1966 that houses and roads in some parts of the city were literally covered. Many small gardens had been abandoned to the insect.

White-fringed beetles have only 1 generation a year. From May until August the adult beetles emerge. Adults are approximately ½ inch long, dark grey with a white band extending along their side, and possess a short, broad snout. All are females and reproduce parthenogenetically. The average lifetime of the white-fringed beetle adult is 2 to 5 months. The eggs, which are laid throughout the summer, hatch in 2 weeks to 3 months, depending on temperature and moisture. The larvae feed entirely below ground and the duration of the larval stage is normally 10 to 11 months. The insects pass the winter in the larval stage. From late May to the end of July the larvae pupate in the soil. The duration of the pupal stage is approximately 14 days.

In 1965 Auburn University Agricultural Experiment Station received a grant from the USDA to develop a laboratory-rearing technique for the white-fringed beetle. This posed a rather unique problem since most insects routinely reared in the laboratory do not inhabit the soil as larvae and usually produce a generation within 18 to 25 days. A brief description of the technique developed here at Auburn is given below.

Adults were kept in cages and fed either alfalfa leaves or an artificial diet consisting of fats, carbohydrates, proteins, vitamins, minerals, and dried alfalfa leaf meal mixed together in an agar base.

Eggs were hatched by placing them on moist filter paper in petri dishes. The eggs would begin to hatch 20 days after being placed in the dish. Eggs could be stored under dry conditions for as long as 120 days and would still hatch within 24 hours when placed in a moist situation.

Larvae were reared in a sterile soil with sprouting Irish potatoes. By manipulating the temperature the larval period was shortened considerably and the percentage survival was increased over field-reared populations or populations reared at constant temperatures.

More research is needed on the biology and control of the white-fringed beetle. When such work is undertaken this rearing method will give researchers ready access to the various life stages of this insect.

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PUBLICATION—Highlights of
Agricultural Research 12/69 10M

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