HIGHLIGHTS
OF AGRICULTURAL RESEARCH

VOLUME 8, NUMBER 3 FALL 1961

Agricultural Experiment Station
AUBURN UNIVERSITY

HIGHLIGHTS *of* Agricultural Research

A Quarterly Report of Research Serving All of Alabama

VOLUME 8, No. 3 FALL, 1961

In this issue . . .

On the cover. This Meats Laboratory is filling a big need in the research and teaching program of the Animal Science Department. The 66 × 112-foot building has facilities for slaughtering and dressing experimental animals to more fully evaluate experimental production practices, and for chilling, curing, and processing carcasses. It also has a cutting demonstration classroom and a meats research laboratory. Included with the laboratory is an 80 × 100-foot judging arena, having a show ring and seats for 1,000. The Laboratory was constructed with funds provided by passage of Amendment 5 in 1957.

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Auburn, Alabama

New and Timely PUBLICATIONS

Listed here are timely and new publications reporting research by the Agricultural Experiment Station.

Bul. 332. Management of Irrigated Cotton presents results of experiments on effects of cultural practices on yield and fiber qualities of irrigated cotton.

Bul. 333. Financing Rural Homes summarizes sources of housing credit and problems in financing rural homes.

Bul. 334. Rural Housing Situation and Needs covers present conditions and needs of rural housing in the Southeast.

Cir. 139. Decision Making in Meat Buying reveals major factors that affect housewives' purchase of meat.

Cir. 140. Bahiagrass for Forage in Alabama gives information on production and utilization of Bahiagrass in the State.

Leaf. 65. Warrior—A Bruchid-Resistant Vetch presents research information on the new, Auburn-developed variety.

Free copies may be obtained from your County Agent or by writing the Auburn University Agricultural Experiment Station, Auburn, Alabama.

J. R. HOWES, *Dept. of Poultry Science*
WALTER GRUB and C. A. ROLLO,
Dept. of Agricultural Engineering

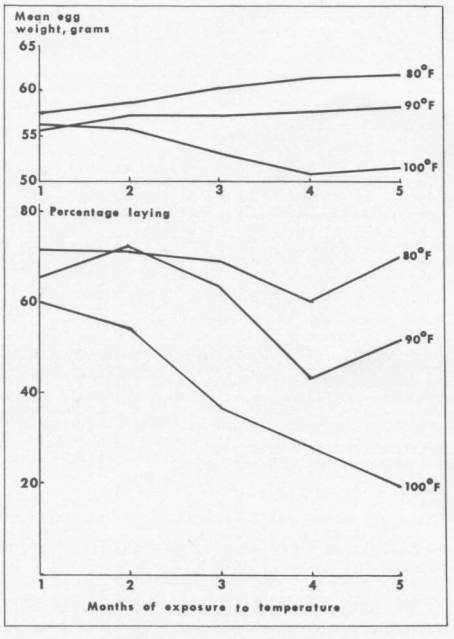
SUMMER STRESS ON LAYING POULTRY

CAMELS AND CHICKENS are about as different as two animals could be. But they have one thing in common – both can withstand severe summer conditions better than most other animals. The camel's heat tolerance has been known for a long time, but only recently has this characteristic of the chicken been learned.

Summer stress is a term coined to describe the stress to which an animal is exposed during summer. It represents total disruption in an animal's normal well-being caused by heat, humidity, light radiation, and other factors.

Poultrymen are becoming increasingly aware of the environment in their efforts to economically produce eggs and meat. This is evidenced by the increasing number of controlled environment houses being constructed.

One reason the Southeastern United States is not a leading egg-production area is because of difficulty encountered in economically producing good quality eggs during the long, hot and humid summer. Many parts of the nation experience heat stress in short periods when temperature goes well over 100° F. When this happens, it is not uncommon for hundreds of birds to die as a result of the sudden influx of intense heat. Fortunately, this is not normally experienced in the Southeast, but this area is burdened with summer stress that usually lasts for several months.



The graphs show effect of high temperature on laying White Leghorn pullets in Auburn experiments. There were 80 birds to each treatment, all on 14 hours light daily and 60% relative humidity and ventilated at 1 cu. ft. per minute per bird.

The first problem is to identify the main stress factors. This is necessary to economically combat the situation and produce environments largely free of the factors that reduce egg production.

From work at Auburn and elsewhere, it appears that humidity reduces egg production and growth only at the highest temperatures. Thus, humidity probably is one of the lesser evils.

Previous research has shown that changes in day length stimulate egg production and growth. Since changes in day length during May to August are relatively small, part of the adverse summer effects might be blamed on lack of change in day length. However, the extended period of high temperature (at least 4 months) would appear to be the main cause of summer stress in the Southeast.

Physiologists at Duke University have revealed how camels are able to survive in intense desert heat. One of the main mechanisms permitting survival is the large range in body temperature between midday and midnight (108-93° F.). The camel is able to "load" heat during the day and "unload" it during the cooler night.

Auburn research indicates that the chicken possesses the same ability as the camel, but to a much lesser degree. Thus, chickens can survive and produce much better if hot days are relieved by cool nights than under continuous high temperatures.

When exposed to heat, there are two actions that help chickens maintain their bodies – increased heat losses and reduced heat production in the body. To step-up heat losses, respiration is increased (panting), blood supply in the skin is increased, wings are flexed, and the birds drink more water. Reduced heat production results from reduced activity, appetite, growth, egg production, egg size, and fertility.

Effect of high temperatures on egg weight and egg production is illustrated by the graph. These data show that White Leghorn pullets produce adequate good eggs at 80° F. It was also found that these birds produce as well at 80° F. as at 50-60° F. This is contrary to earlier, limited work elsewhere that showed 50-60° F. as the best temperature for laying poultry.

USDA work has indicated that birds will not survive at 100° F. and 60% relative humidity. However, in Auburn studies females not only lived under these conditions but produced eggs. Shown in the photograph are layers panting in the chamber maintained constantly at 100° F. and 60% relative humidity.

Based on the Auburn research results, it appears that some accepted concepts concerning heat stress in poultry may need revising. Especially from the standpoint of the Southeast, results indicate that laying White Leghorn pullets will adequately produce when the temperature is as high as 80° F. Since a man not exerting himself in heavy work begins to perspire at about 80° F., the poultryman can serve as his own thermometer. When the operator begins to feel uncomfortable, he can assume his hens are likewise affected. This would be his signal to take practical steps to alleviate high temperatures.

Developing NEW VETCHES

E. D. DONNELLY, *Plant Breeder*
E. M. CLARK, *Associate Botanist*

A RESEEDING, non-shattering vetch variety that will produce good yields of forage and seed is badly needed.

None of the commonly grown varieties meet these requirements. However, these characteristics do exist within the family or genus. If the desired trait doesn't occur in a species, often it can be found in another of the same genus. If the two species can be crossed, then the desirable characteristics of the two might be combined into one variety. This has been the story of vetch breeding research at Auburn Agricultural Experiment Station.

Legume seed vary greatly in size. Several vetch species have large seed, giving them certain advantages as pasture plants, such as greater seedling vigor. Most vetch species grown in Alabama produce low seed yields because of diseases and insects. Some produce good seed yields, but make seed over a long period of time, shatter badly, or do not reseed. The species differ greatly in percentage of hard seed and in winter hardiness.

Species Crossed

Since 1951 numerous attempts have been made to cross vetch species. Emphasis was placed on crossing hard-seed species with non-shattering species.

One species hybrid was obtained in 1958 – common vetch *(V. sativa)* X narrowleaf vetch *(V. angustifolia)*, see illustration. This hybrid offers possibilities for developing a reseeding, non-shattering, weevil resistant variety. The female parent (1), Ala. 1894, is a white flowered line of common vetch that is relatively non-shattering and produces good yields of forage and seed in Alabama. However, it has a low percentage of hard seed. The male parent (2), narrowleaf vetch (a Turkish introduction, 121275), has purple flowers and is low in vigor. On the other hand it has a high percentage of hard seed that are relatively non-shattering and mature uniformly. Other tested introductions of narrowleaf vetch shattered their seed.

Results

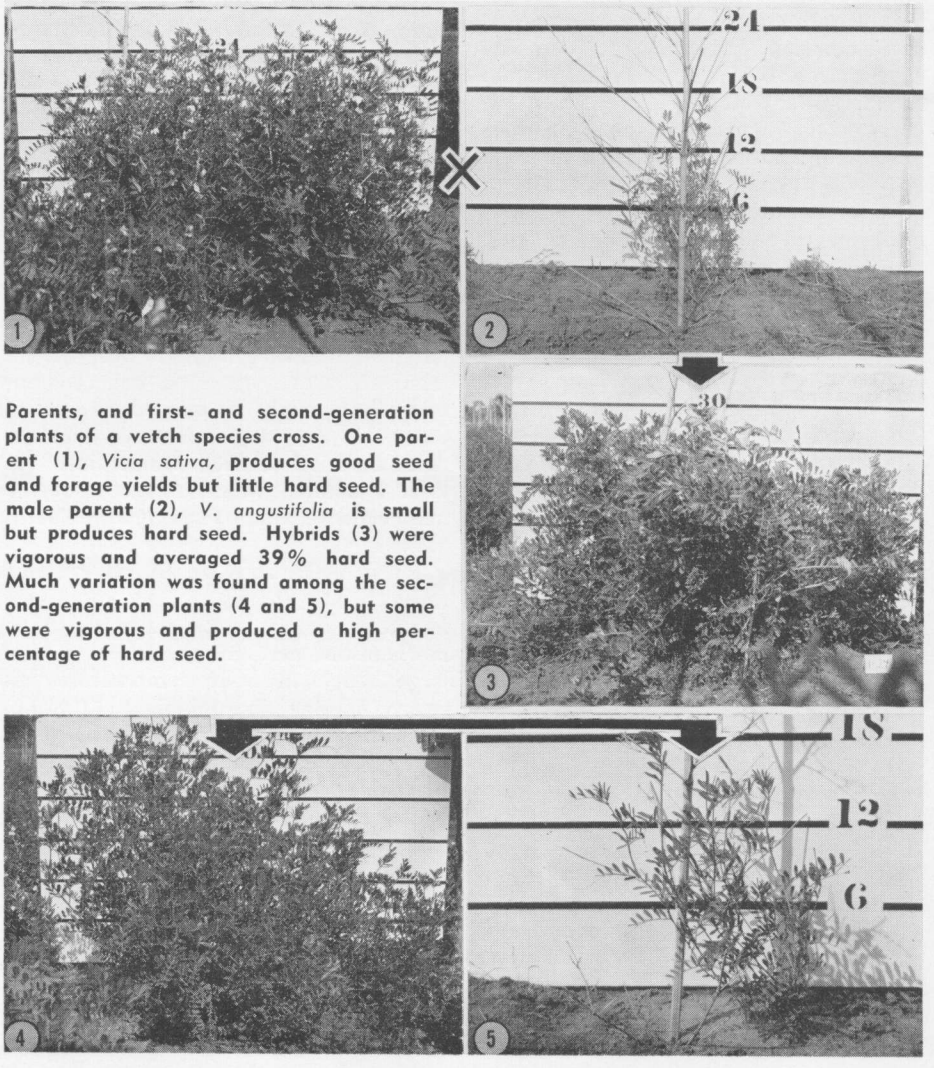
The presence of purple pigment in the emerging seedlings distinguished the hybrids from plants resulting from self pollination. Seedlings from self pollinations had the solid green stems of the female parent.

The two parents differ in chromosome number (the structures that carry the genes). As a result, the first-generation crosses were 93% sterile. In the next generation, 11% of the plants were highly fertile.

Ala. 1894 (female parent) had practically no hard seed and introduction 121275 (male parent) averaged more than 90%. Hybrid plants produced seed that varied from 19 to 60% hard seed and averaged 39. Thus, first-generation hybrids produced seed intermediate between the two parents with respect to hard seedcoats. Seed of second-generation plants ranged from 0 to 96% hard.

Second-generation plants varied considerably in plant type; vigor; earliness of maturity; shape, size, and color of pod; and size and color of seed and flower. There were some vigorous second-generation plants that produced a high percentage of hard seed.

These research results provide evidence that productive, non-shattering, reseeding vetch varieties can be developed.



Parents, and first- and second-generation plants of a vetch species cross. One parent (1), *Vicia sativa*, produces good seed and forage yields but little hard seed. The male parent (2), *V. angustifolia* is small but produces hard seed. Hybrids (3) were vigorous and averaged 39% hard seed. Much variation was found among the second-generation plants (4 and 5), but some were vigorous and produced a high percentage of hard seed.

The areas here show plot immediately after January burn in 1952 and the same area five years after second January burn.

FIRE *vs.* FOREST REPRODUCTION

SHERMAN D. WHIPPLE, *Associate Forester*

PRESCRIBED BURNING can be an important tool in forest management. However, a woodlot owner needs to know the effects that one or two fires can have on established reproduction before starting a burning program.

Fires are erratic and unpredictable. Such factors as amount and types of trees and litter, wind, humidity, soil structure and moisture, and time of year influence fire behavior and subsequent effects on forest reproduction.

A burning study in the Upper Coastal Plains region made on the Agricultural Experiment Station's forest unit at Fayette consisted of August burnings in 1951 and 1954; January burnings in 1952 and 1955; and complete fire protection. The test areas were hilly and the soils had sandy loam topsoil. An open stand of loblolly-shortleaf pine 20 to 30 years old with a variable understory of pines, miscellaneous hardwoods, vines, and shrubs was used in the test.

Controlled backfires were set, each within a few days after a substantial rain and with relative humidity at about 75% and wind velocity at 2 to 3 miles per hour. Ten years of litter had accumulated before the 1951-52 fires. Rainfall was 10 in. below normal for the previous year and the year after the 1954-55 fire. A count of all stems 1 ft. high to 3.6 in. diameter was made in (1) 1951, before the fires; (2) in 1956, 1 year after the second fires; and (3) in 1960, 5 years after the second fires.

The no-burn plots represented a natural thinning trend through the reduction in number of stems of all species from 1951 to 1960. Pine stems decreased most, but breakdown by pine size class indicated that 1-in. class absorbed this loss (3,004 to 1,257 stems per acre), whereas the 2-in. to 3.6-in. classes increased (345 to 451 stems per acre).

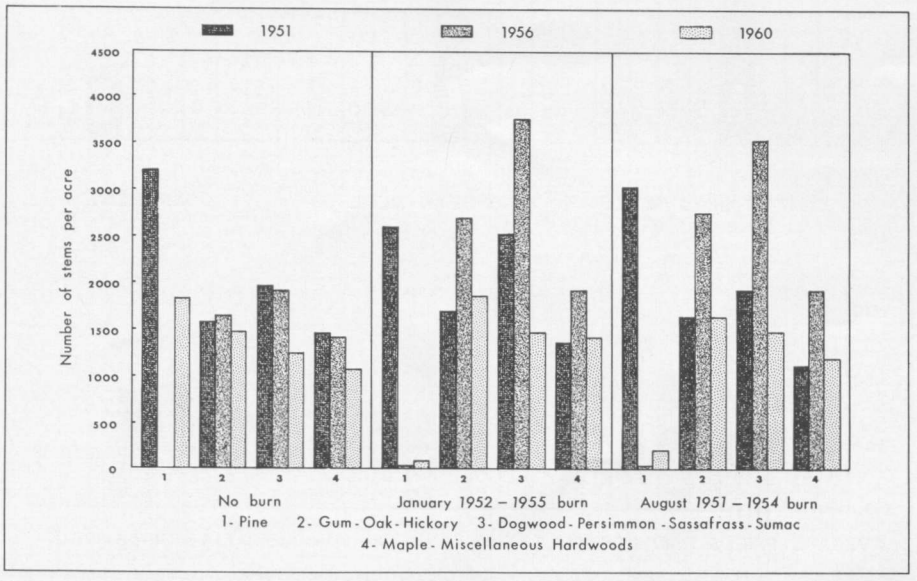
By 1956, or 1 year after the second January and August burning, pine reproduction had been reduced to 25 stems per acre and these were mostly in the 3-in. class.

By 1960 new pine seedlings and sprouts from top-killed shortleaf pines brought this stocking up to 100 and 250 per acre in January and August burn plots, respectively. An exceptionally dry year following the second burnings, and the possibility that 1955 was a poor seed year, are probable explanations for the present low stocking of pine. Five years after two prescribed fires under conditions as related, pine regeneration was considered insufficient for desirable pine stocking.

Gum, oak, hickory, maple, and miscellaneous hardwoods all responded to both January and August burnings in a similar manner. They nearly doubled in number from 1951 to 1956 as a result of sprouting stimulated by the intervening first burns and repeat burns. In stocking, stem numbers were back to the same as before prescribed fires, but the stems are smaller in size. Dogwood, persimmon, sumac, and sassafras more than doubled immediately after the second burns. By 1960 mortality had reduced these species to fewer than before the prescribed fires.

Two January or August burns under open pine stands do not ensure satisfactory pine regeneration.

Hardwood sprouting increases the number of hardwood stems immediately following fire with the effects of fire lasting about 5 years. Sprouting is more noticeable in the semitrees (dogwood, persimmon, sumac, sassafras) than in tree-type hardwoods.



Reproduction stocking changes following prescribed burning in different growth areas are shown above.

FEED PRICES—
changing as livestock industry expands

MORRIS WHITE, *Agricultural Economist*

TEN YEARS AGO about a third of Alabama's farm income was from sale of livestock and livestock products. Today livestock brings in 55% of the State's cash farm receipts.

Growth in livestock production has greatly increased needs for feed. Since feed is the major cost item in producing livestock, price of feed has an important bearing on farm profits.

Price Changes

Prices paid for mixed feed and for feed concentrates (except cottonseed meal) went down in Alabama during 1956-60. The change was both gradual and continuous for almost every kind of feed.

Cost of corn meal for feed in 1960 was down 16% from the 1956 price, but soybean meal dropped only 3%. Reported farm prices for broiler growing mash, laying mash, and mixed dairy feed were down 8, 6, and 4%. Farmers paid 12% more for cottonseed meal in 1960 than they did in 1956.

Feed prices fluctuated much less within the year than did prices of farm products. Prices tended to be highest in July and August and lowest in November and December. The feed having the greatest seasonal change in price was corn meal. It increased an average of 10% between the low in December and the high in August. Laying mash had the most constant average monthly price, showing only a 3% increase between November and June.

Price data demonstrate that there was not a close relationship between price of feed and price of the principal product produced. The usual proportional change in average price of eggs is greater than the change in prices for other agricultural products.

Area Comparison

Continued expansion of livestock and poultry production in Alabama will be influenced by the price of feed in relation to other areas. To show the relative levels, 5-year averages of prices for three mixed feeds and three important feed ingredients were compared for eight states. These states represent five areas of the United States (see graph).

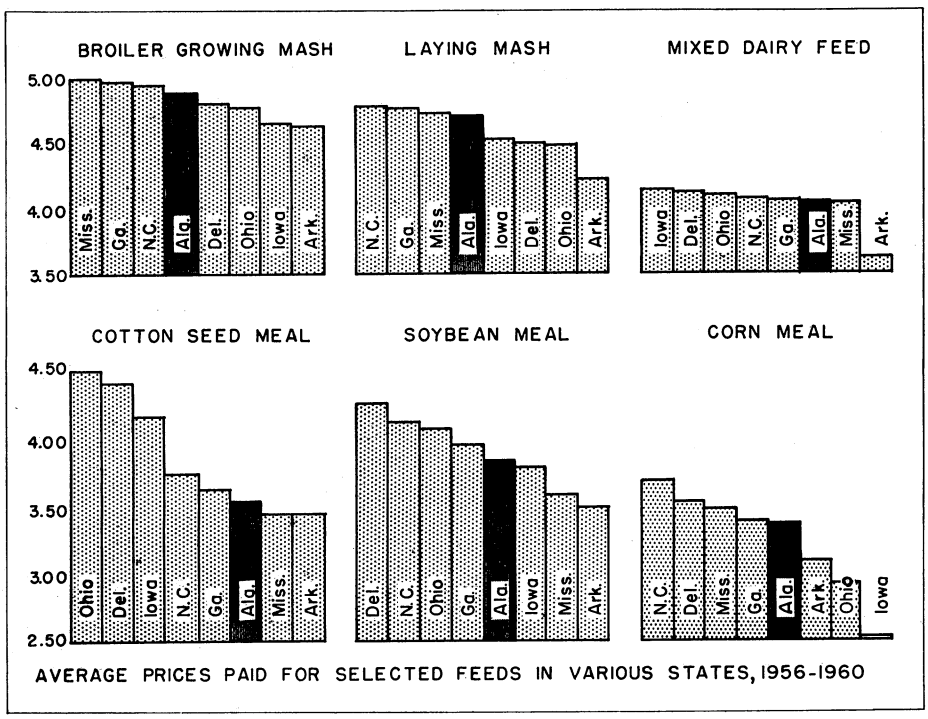
Arkansas had a price advantage for all feeds except corn meal, for which price was lowest in Iowa. Prices in Alabama were below those in Georgia and North Carolina, and were lower than in Mississippi for broiler growing mash and laying mash. However, prices for broiler growing mash and laying mash were lower in Iowa, Ohio, and Delaware than in either of the Southeastern States. Soybean meal was most expensive in Delaware, whereas cottonseed meal was most costly in Ohio. Price differences among states were greatest for cottonseed meal and least for mixed dairy feed.

Feed Use Increasing

During the 5-year period of 1956-60, total Alabama feed sales increased at an average rate of 12.3% per year. Tons of poultry feed reported sold were 89% greater in 1960 than in 1956.

Some states that had lower feed prices did not experience an expansion in use of feed similar to that which took place in Alabama. Among the reasons were lower feed conversion ratios obtained, existence of profitable alternative opportunities, less favorable climate, and higher costs for other production items.

A relatively low price for feed is only one factor that contributes to expansion of livestock and poultry enterprises, but it is an important one. Efficient facilities for handling and processing feed are essential in maintaining competitive feed prices and to continued expansion of livestock and poultry industries in the State.



Shown are average prices per cwt. paid for selected feeds in various states in 1956-60.

FIELD TURNING SPACE *needed for* TRACTOR EFFICIENCY

ELMO S. RENOLL, *Associate Agricultural Engineer*

CAN YOU cultivate as many acres per day as you think you should? Does your neighbor get more capacity from his row crop machines than you do?

Field capacity of farm machinery varies greatly from field to field and is influenced by many factors. Some have been analyzed and their effects determined. Other factors, such as turning space, physical condition of turning area, and turning time, are being studied at Auburn University Agricultural Experiment Station.

Turning Time

Time spent turning the tractor in row crop operations may amount to 25% of the field time. Any reduction in time needed to make these turns would increase machine efficiency and field productive capacity.

The time needed to complete a single turn in row crop work depends mainly on width of available turning space and ground surface condition in turning area. A narrow space that requires backing the tractor will increase turning time. Turning on rough area will also result in longer than normal time.

Turning Space and Pattern

Width of turning area will nearly always dictate the type of turning pattern used. Space large enough to turn a tractor in an easy semi-circle pattern will usually result in the least turning time. A narrow turning space will require a longer than minimum time.

Some common patterns used to turn tractors doing row crop work are shown in Figures 1, 2, and 3. The turning space in Figure 1 is wide enough for an easy, normal turn. In Figure 2, the turn space is too narrow for turning the tractor without backing. This pattern requires 50% more time than a normal turn. The turning pattern in Figure 3 is used in fields having no turning space at end of row. This type turn may double the normal turning time.

Surface Condition

Physical condition of the surface in turn area can greatly affect the time needed to complete the turn. Rough ground, rocks, ditches, or other obstructions in the turning area will increase the turning time. The table shows how obstructions in the turning area affect time needed to complete the turn.

Under the conditions of these tests, obstructions in turning area increased the turning time by as much as 29%. Ditches in the area increased turning time by about 25%, while turning on a rough area resulted in an 11% increase in turning time.

Summary

1. Turning space at the edge of row crop fields should be wide enough to turn the tractor and equipment in an easy semi-circle turn. A narrow turning space may increase the turning time by as much as 50%. In the case of fields having no space beyond end of rows, the turning time may be double.

2. Physical condition of the ground in turning area will affect turning time. Smooth turning areas require a minimum of turning time, whereas obstructions will materially increase it.

3. Turning space at edge of field makes it easier to operate large machines, such as a cotton picker or corn picker, and also helps to keep ends of rows free of weeds.

Increased field efficiency obtained by using a turning space that is both adequate in size and free of obstructions will make it possible to (1) handle more acres with a given size tractor or (2) to use smaller and less expensive machinery for a given acreage.

COMPARISON OF TURNING TIME FOR SEVERAL CONDITIONS

Field number	Field operation	Favorable		Unfavorable		Increase in turning time
		Ground condition	Time	Ground condition	Time	
			Sec.		*Sec.*	*Per cent*
A	Cultivating	Smooth	14.8	Ditch	18.0	22
B	Cultivating	Smooth	18.6	Gullies	20.8	12
C	Sidedressing	Smooth	20.4	Ditch	26.3	29
D	Sidedressing	Smooth	26.0	Rough	29.0	11

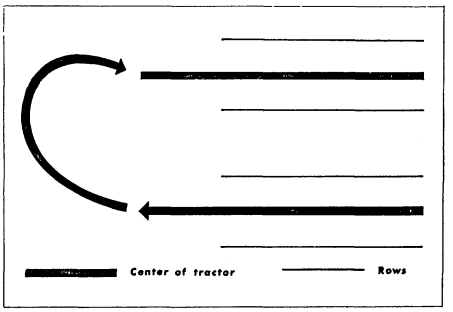


FIG. 1. Average or normal turn pattern at row end where turning space is adequate.

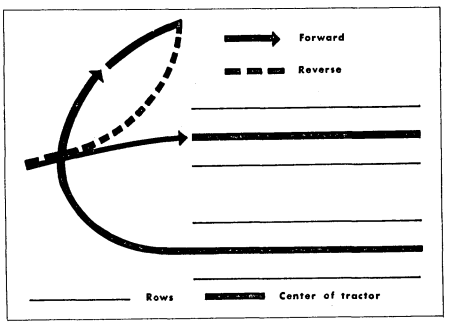


FIG. 2. Here space at end of rows is too narrow to make a complete turn, and requires backing the tractor. Turning time in this case is 50% more than that used for making the normal turn.

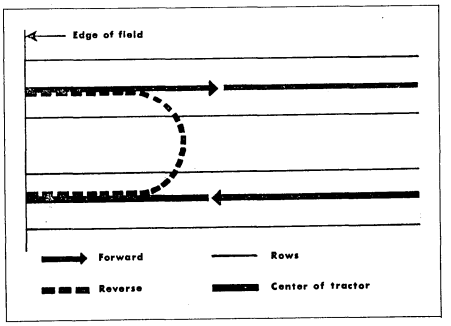


FIG. 3. With no space available beyond end of rows, tractor is turned by backing in a semi-circle onto the next pair of rows. Turning time is 2¼ times as great as that needed for normal turning.

One area of the Station before development is shown above.

The PIEDMONT SUBSTATION

A story of research for a depleted area

E. L. McGRAW, *Associate Editor*
E. L. MAYTON, *Superintendent*

The Piedmont Area of Alabama developed as a major agricultural area during the half century after Andrew Jackson defeated the Creek Indians at Horseshoe Bend.

During the development and until the present, farmers cleared the land, watched rich top soil carried away by sheet erosion, had a seige of boll weevil infestation, and underwent cotton acreage controls.

These and other reasons caused many farmers to leave the once prosperous area and others to seek sources of income to supplement that from cotton.

Realizing the need for answering many such farm problems in the area the Alabama Legislature in 1943 authorized the establishment of a substation in the Piedmont Area for the purpose of determining what agricultural enterprise or enterprises would best supplement or replace income from cotton.

Substation Located

The substation was subsequently located at Camp Hill in Tallapoosa County. This Station is operated to serve the Piedmont Soil Area comprised of Cleburne, Clay, Randolph, Coosa, and Chambers counties, the greater portion of Tallapoosa, the northern half of Lee and smaller areas in Elmore, Chilton, Shelby, and Talladega counties. The Station has 1,409 acres, with about 600 acres of open land and the remainder in stands of mixed timber.

Since the establishment of the Station, personnel of the Agricultural Experiment Station have been interested in appraising the situation, analyzing, conducting research under similar conditions, and making available results to help farmers improve their farming programs and increase incomes.

From 1840 to 1930 cotton was the main cash crop in the area. In the early thirties cotton acreage controls caused a decline in row-crop acreage. The cotton acreage of a typical county once 70,000 acres is now down to less than 6,000 acres. This suggested the idea of research on a farm management unit basis.

Permanent vegetation of sericea, kudzu, permanent pasture, and winter annuals was used for grazing dairy cows. These forage crops were supplemented with alfalfa grown as hay in the year-round forage feeding program.

Cotton-Dairy Management Unit

The establishment of a milk plant in the area in 1942 gave impetus to the establishment of a Cotton-Dairy Management Unit as the first formally organized project on the Station in 1947. This unit included 195 acres of land with ultimately 130 acres open, and 65 acres remaining in timber or too steep or rough for farming.

The Unit was operated over the 11-year period 1947-57, as a family-type farm that required the labor of about 1½ full-time workers. Manufacturing grade milk and cotton were the principal sources of cash income.

The dairy phase of the Unit began with nine grade cows and one heifer. An average of 22 cows were milked during the last year (1957) with a total of 27 heifers or heifer calves on inventory.

The combination auditorium and office made available by legislative appropriation was dedicated in December 1958.

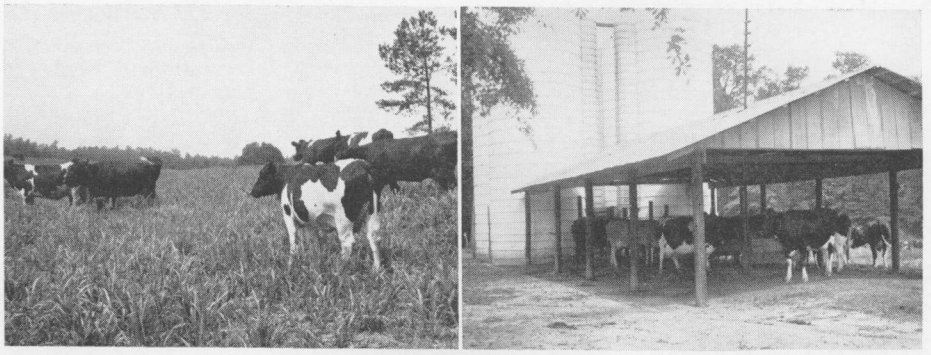
During the first 3 years, annual sales averaged $3,975 and expenses $2,638, leaving a net cash income of $1,337. Total sales for the 11-year period 1947-57 averaged $5,788 annually with annual cash expenses of $2,994, leaving an average net cash income of $2,794. The first 3-year average showed 61% of the income came from dairying, 37% from cotton, and the remaining 2% from other sources. The 11-year average showed that 70% come from dairying, 24% from cotton, and 6% from other sources.

Expenses were high in relation to income during the early years as crops were established, fences built, and fewer cows milked. Income and expenses stabilized after about 5 years of operation. Milk prices declined approximately one-fourth after 1948 and increased production was offset somewhat by this decline in price. Dairying accounted for more of the cash sales as cow numbers and production increased and cotton acreage was limited.

As the Unit progressed the forage program was shifted from crops such as sericea and kudzu to summer and winter annuals. Such grasses as Sudan and Starr millet were used in summer, and small grains and crimson clover-ryegrass mixtures in winter and early spring. These proved to be better crops for milk production.

The breeding program in this herd has included proved sires or sires proved within the herd. This has given a tremendous increase in production during the past 4 years. The average production per cow has increased from 6,402 lb. in 1957 to 10,953 in 1960. The highest annual increase per cow, 2,381 lb., came in 1959.

The results of the operation have been used to answer the question – can the production of manufacturing milk supplement the income from cotton to provide a farm family living? The answer would be yes in many instances, provided dairying is handled on a year-round basis with a sufficient number of cows of reasonably high production level to utilize family labor. Profitable dairying must be on a continuing basis of good feeding, good breeding, and good management.



The dairy-cotton management unit has highlighted the research at the Station. Here animals are grazing Starr millet and feeding on silage representing the two feeding systems used in the dairy research.

In early 1958 the Management Unit was discontinued. New facilities were added to provide a milking parlor and equipment, and four silos. The herd was converted to a program to compare drylot feeding, with pasture as feed sources in milk production.

Under the new program drylot cows are fed corn silage and alfalfa hay as roughages. Pasture cows graze Starr millet, small grains, crimson clover-ryegrass mixture, and permanent pasture at different periods of the year. The comparison is year-round with both groups fed the same 14% concentrate ration according to individual production. This experiment is approximately half way through the projected 5-year period. The first 2-year results indicate little difference in milk production on the two forage systems with only a slight cost difference in favor of the pasture group.

The beef cattle research work at the Station consisting of the cow-calf system of production started in 1949-50. Fall calves are sold at 8 to 10 months of age, averaging slightly over 500 lb.

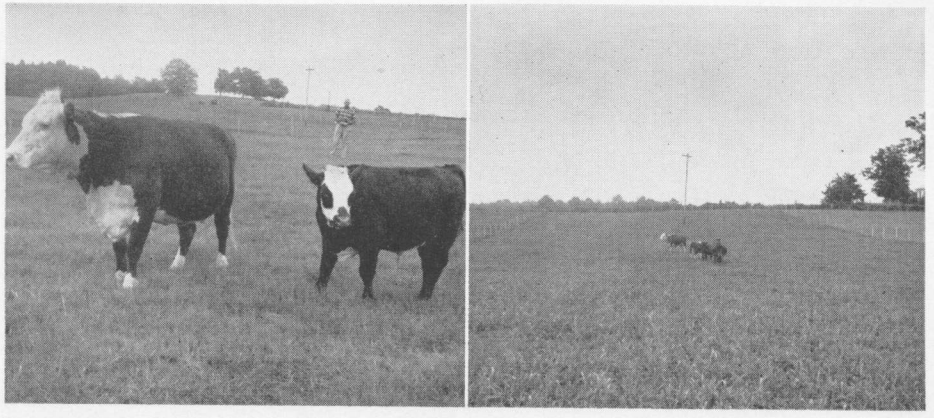
An experiment on pasture plants for beef animals was started in 1955. Plants being compared are Coastal Bermudagrass with legumes, Dallisgrass with legumes, Bahiagrass with legumes, and lespedeza sericea. In 1956 and 1957 the pastures were grazed with yearling steers, and since 1958 with cows and nursing calves.

Coastal Bermudagrass with legumes has given the top yield of beef per acre with both steers, brood cows and calves. At present additional work with weaned calves is contemplated to carry them on to heavier weights before marketing.

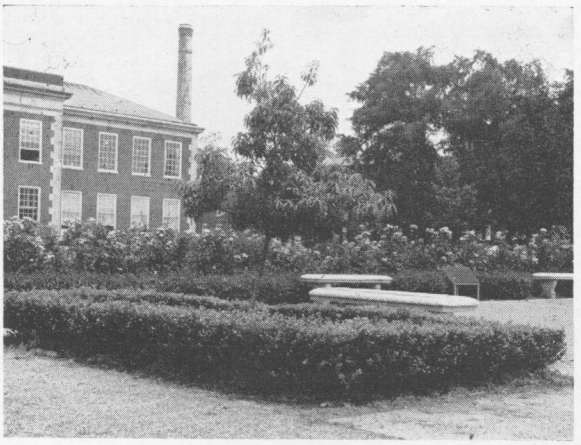
In 1954, 60 breeding ewes of two breed compositions, Rambouillet and Suffolk-Rambouillet crosses, were purchased for research. In 1957, 125 additional Rambouillet ewes and a like number of Targhee ewes were added. These ewes have been used primarily to detemine which breed would give fall-dropped lambs for the spring market. Ewes of the Rambouillet breed have consistently given more fall-dropped lambs.

Other research projects at the Station include varietal tests of alfalfa, lespedeza sericea, small grains, corn, grain sorghum, and sorgo; rate of lime and placement for alfalfa; perennial grass mixtures; effect of seed treatment on stand and production of oats; time of planting and methods of utilizing oats and wheat; and a comparison of corn and sorghums at different spacings and rates of fertilization for silage.

Timber has been an important source of income to the Station. In 1951 and 1960 timber stands were cruised and marked by professional foresters on a fee basis. Approximately ¾ million bd. ft. of saw logs were sold at each cutting.



Beef research at the Station includes the cow-calf system. One of the cows with her calf and a group of animals on a grazing paddock are shown here.



Hollies can be used as a low growing hedge in garden areas.

HOLLIES *for Alabama* LANDSCAPE

HENRY ORR, HOMER FISHER, and TOK FURUTA
Department of Horticulture

HOLLIES, ADAPTED to the South, may meet major landscape needs of the average Alabama home.

Variations in size including standard medium, large trees, and dwarf compact plants and variations in foliage and fruit broaden the range of uses.

The collection of hollies used in the landscape plan at Auburn University is small in relation to the number of known species and cultivated varieties. It is valuable, however, because it includes native and introduced species and cultivated varieties.

Native Species

The number of evergreen and deciduous species native to North America is between 20 and 30. Many of these are important plants in landscaping. Of this number, the following have proved valuable on the campus: American Holly *(Ilex opaca)*, Dahoon and Alabama Dahoon Holly *(I. cassine* and *I. c. angustifolia)*, dwarf and regular Yaupon *(I. vomitoria)*, Inkberry *(I. glabra)*, and Common Winterberry *(I. verticillata)*. Other species will be added periodically for testing.

Low Spreading Types

In the Auburn collection are spreading, relatively low types – Hellers, Stokes, and Repandans forms of Japanese Holly, and Dwarf Yaupon. These plants have proved valuable as low borders, ground covers, and as entry, facing, or foundation plants around low buildings. For a low, dense effect in well-drained planters, these plants are especially effective in full sun or partial shade.

Intermediate Types

Intermediate, dense spreading, and round-headed plants include these Japanese Holly forms – convexleaf, roundleaf, and Hetz. A usable, popular Chinese Holly in this class is *I. cornuta rotunda*. All of these plants can be easily and effectively used in the contemporary landscape as specimen, mass, or group plantings. Little clipping is required to develop a dense, well-formed plant. With the small leaf, dark green forms, a "boxwood effect" can be maintained with less insect and disease problems than with boxwood. *I. cornuta rotunda* is a coarser plant with the spread being twice the height. Plants 10 to 12 years old are 2 to 3 ft. high and 4 to 6 ft. wide. Because of spininess and denseness, it can be used as a low barrier.

Upright Forms

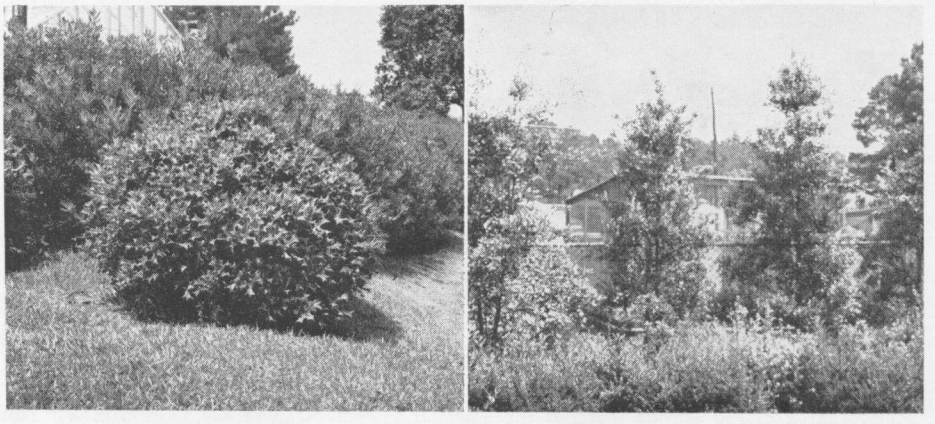
Upright forms of value in the Auburn collection are: *Ilex cornuta*, Chinese Holly and the cultivated variety, Burford Chinese Holly; four of the Foster's Hybrids, Nos. 1 through 4; *I. aquipernyi* Brilliant; *Ilex cassine*, Dahoon; *I. cassine angustifolia*, Alabama Dahoon; and *I. vomitoria*, Yaupon.

With the exception of *I. aquipernyi* Brilliant, all of the upright plants listed are suitable for background screens. Brilliant tends to grow loosely and picturesque. It is particularly valuable for a line-tracery effect against a tall plain panel of a building or against a background garden wall. Foster's Hybrid hollies, Nos. 1, 2, and 3 are narrow upright forms that fruit heavily each year at Auburn. The fruit colors early and is held until new fruit is set. Foster's Hybrid No. 4 has not grown as strong at Auburn as in Bessemer where all the Foster's Hybrids originated. These hollies grow more compactly at Auburn than at Mobile, but not as compactly as they would in areas further north.

Unusual Hollies

Unusual hollies of value in the Auburn collection include: Lusterleaf Holly (*I. latifolia*), one of the largest leaf forms with leaves 4 to 7 in. in length; Longstalk Holly (*I. pedunculosa*), with peduncles and pedicle (fruitstalk) up to 2 in. in length; pendulous forms of Yaupon (*I. vomitoria*); and several yellow fruited varieties of American Holly (*I. opaca*).

Periodically selections from many sources, such as the USDA plant introduction station and arboretums, are added for evaluation. Also selected seedlings from several nurseries are being compared with cultivated varieties.



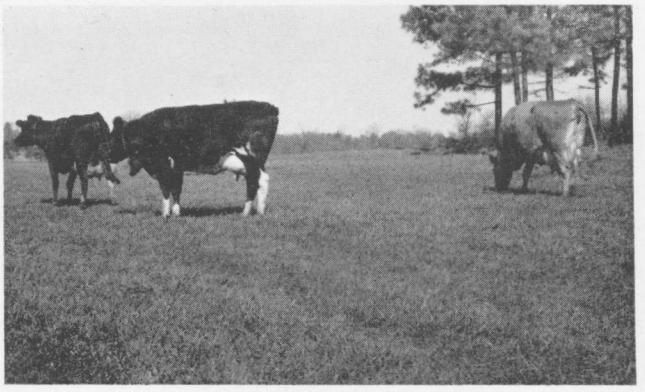
Certain varieties of holly may be used as accent plants, at left, or as screen plantings, right.

Forage Quality of Annuals Varies During Grazing Season

G. E. HAWKINS, *Dept. of Dairy Science*

E. L. MAYTON, *Piedmont Substation*

J. A. LITTLE and G. H. ROLLINS, *Dept. of Dairy Science*



These cows are grazing an Italian ryegrass-crimson clover test pasture at the Piedmont Substation.

ALABAMA DAIRYMEN rely on annual forage crops, and with good reason. Cows milk heavily when grazing lush oats, rye, wheat, ryegrass, crimson clover, and Starr millet pastures.

A problem with annual crops is variation in forage quality during the grazing season. When these forages pass their peak and begin decreasing in quality, cows respond with a production drop unless supplementary feeding is done.

Nutritive Quality Studied

Variations in nutritive quality of several annual forages have been studied during the past 3 years by the Auburn Agricultural Experiment Station. Chemical composition and digestibility of forage dry matter have been determined and, in some studies, forage dry matter consumed by cows was measured.

Some of the pastures were grown at the Piedmont Substation, Camp Hill, and others at the Dairy Research Unit, Auburn. Since all were not grown at the same location or during the same year, most comparisons are limited to changes within species during a part of the growing season. Forages grown at the Piedmont were grazed rotationally and those at Auburn were grazed continuously. All study pastures were fertilized with 365 lb. or more of 8-8-8 or its equivalent and at least 120 lb. of ammonium nitrate per acre.

Composition and Digestibility

Crude protein content of all forages was relatively high at each sampling period, ranging from 26.7 to 17.1%. However, there was a pronounced decrease in crude protein between the first and last samplings.

Crude fiber content of abruzzi rye was 17.5% or less from November to January. Abruzzi rye, oats, and wheat forage samples collected March 12-15 had similar crude fiber contents (20.1 to 21.9%), as compared with 14.2% for Italian ryegrass-crimson clover during the same period. Crude fiber contents of oats, wheat, and ryegrass-crimson clover increased markedly from the March to April 12-19 sampling dates. However, crude fiber of abruzzi rye remained relatively constant from March to April. Starr millet increased in crude fiber by 2.7% from June 29 to July 27.

Average digestibility of dry matter of all winter annual forages was high, ranging between 68.4 and 74.9% from December 8 to March 31. However, digestibility of oats, wheat, and abruzzi rye decreased rapidly from March to the middle of April. Continuously-grazed wheat had the most rapid drop in digestibility. Digestibility of Italian ryegrass-crimson clover remained relatively high through May 5 and then decreased rapidly to a low of 58.8% on May 30. Range of digestibility of each forage is given in the table.

Forage dry matter intakes by cows grazing oats continuously decreased from 3 lb. per 100 lb. of body weight on March 12 to 2.7 lb. on April 17. Intakes by cows grazing wheat continuously decreased from 2.9 to 2.2 lb. per 100 lb. body weight during the same period. Thus, as wheat and oats neared the end of their growth period, digestible nutrient intake of cows was reduced by both quality and quantity of forage eaten.

Starr millet was a high quality pasture during the early part of the grazing season – 68.2% digestibility on June 30. However, it had decreased to 57.7% on September 29 and continued to a low of 54.5% on October 15.

As revealed by the Auburn experiments, oats, wheat, abruzzi rye, Italian ryegrass-crimson clover, and Starr millet pastures are high quality forages until the plants begin to mature rapidly. However, quality decreases rapidly as the plants near the period when seed heads are formed. To maintain high levels of milk production, concentrate supplements should be increased as pasture quality drops.

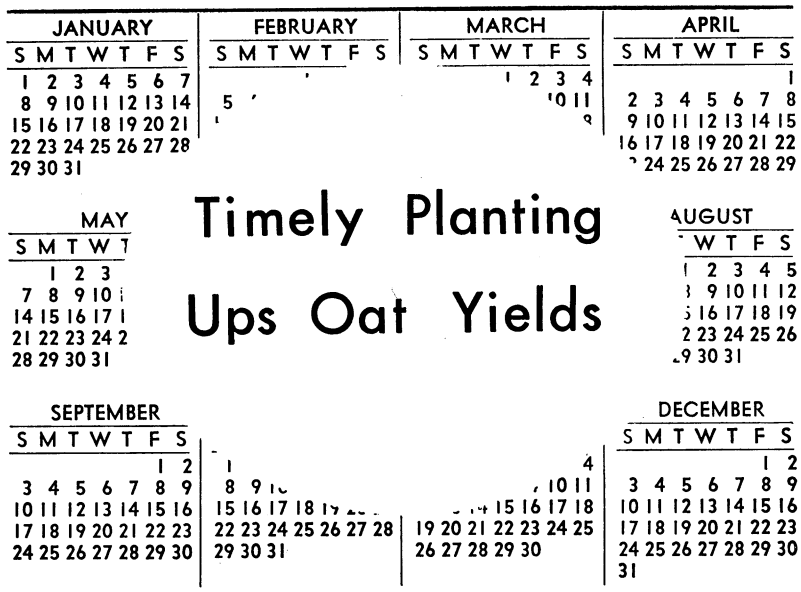
DIGESTIBILITY OF ANNUAL FORAGES GRAZED AT DIFFERENT SEASONS OF THE YEAR, DRY MATTER BASIS

Dates	Digestibility of each forage grazed				
	Oats	Wheat	Abruzzi rye	Italian ryegrass-crimson clover	Starr millet
	Pct.	*Pct.*	*Pct.*	*Pct.*	*Pct.*
12/8-20	69.5	--	70.7	69.3[1]	--
1/7	--	--	74.7	--	--
2/20-26	68.4	--	--	72.8	--
3/12-31	74.9[1,2]	73.2[3]	74.2	--	--
4/14-17	67.9[3]	62.4[3]	71.9[2]	--	--
5/4-5	--	--	--	71.0[1]	--
5/30	--	--	--	58.8	--
6/30	--	--	--	--	68.2
9/29	--	--	--	--	57.7
10/15	--	--	--	--	54.5
AVERAGE	70.2	67.8	72.9	68.0	60.1

[1] Averages of two trials during the period given.

[2] Average includes one continuously grazed at Auburn and one rotationally grazed pasture at Piedmont Substation.

[3] Continuously grazed pastures at Auburn, all other pastures rotationally grazed at Piedmont Substation.



F. S. McCAIN and C. C. KING, *Dept. of Agronomy and Soils*

PLANTING OATS at the right time can put more dollars in your pocket. Research results show that yields of oats can be increased by planting earlier than is the usual practice.

Experiments on dates of planting oats were conducted during 1952-57 by the Auburn University Agricultural Experiment Station. The tests at seven locations were designed to measure effect of date of planting on yields of oats grown for grain only and for forage and grain combined.

Two Management Systems Tested

Oats were seeded at the rate of 3 bu. per acre. Two series of plots were used at each location with one series managed for grain production only. These plots received adequate rates of phosphate and potash fertilizers at planting. Fifty lb. of nitrogen was applied as a topdressing about March 1.

Another series of plots was managed for production of forage (grazing) and grain. These plots received the same phosphate and potash fertilization at planting as those managed for grain only. In addition, a topdressing of 50 lb. of nitrogen per acre was applied when oats were up to a stand. Forage removal was discontinued about March 1 and an additional 50 lb. of nitrogen per acre was applied. All plots in both series were allowed to mature a crop of grain and grain yields were measured.

When consumed as green pasturage, 1 lb. of dry matter from oat forage is considered equal in feed value to 1 lb. of oat grain. This factor was used to convert forage yields to grain equivalents in measuring yields.

As shown in Figure 1, forage yields for comparable dates were highest in southern Alabama. There was little difference in forage yields for comparable dates between central and northern areas of the State. Highest grain yields on clipped plots for all planting dates were produced in northern Alabama, followed in order by central and southern regions, Figure 2.

A comparison of Figures 2 and 4 shows that yields of grain were decreased by clipping, but the forage obtained more than compensated for the loss. When forage and grain yields were combined, there was little difference in maximum per acre production of feed in all regions, Figure 3. However, there was a difference in the best date to plant for maximum yields.

Best Planting Dates

Recommended planting dates for forage and grain production in the three regions are: northern Alabama, September 1 to September 20; central Alabama, September 1 to September 30; and southern Alabama, September 20 to October 20. Planting dates did not materially affect yield of oats grown for grain only in any of the regions, Figure 4. The maximum difference, 8 bu. per acre, occurred between the September 10 and October 20 planting dates in central Alabama. This indicates that most any of the planting dates in any of the State's regions is satisfactory for grain production only.

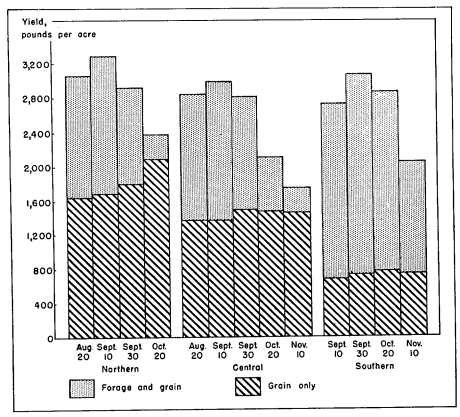


FIG. 3. Combined yields of forage and grain from oats planted at different dates during 1952-57 are shown in the graph.

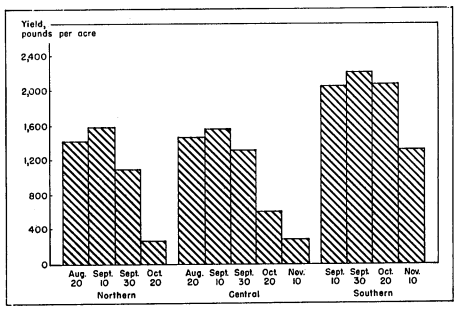


FIG. 1. Yields of oat forage from different planting dates during the 1952-57 test years are shown by the graph above.

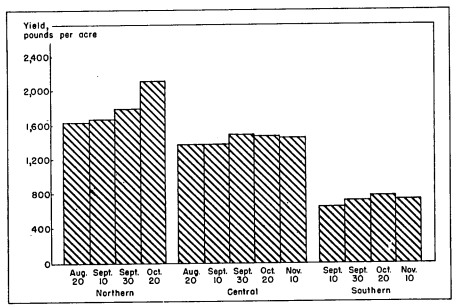


FIG. 2. Shown above is a comparison of grain yields from clipped oats from different planting dates during 1952-57.

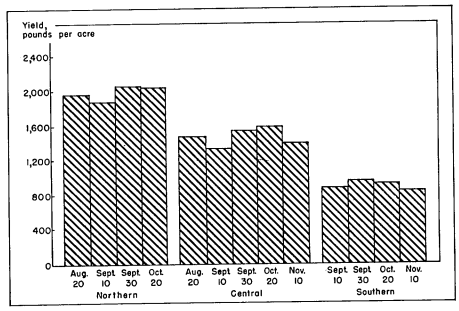
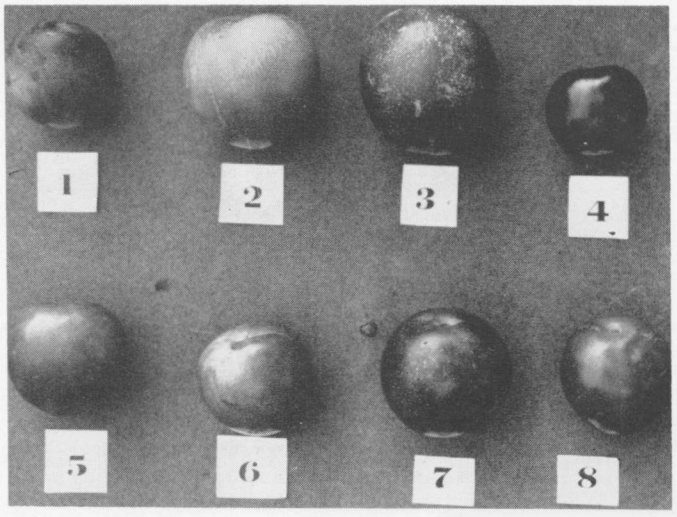


FIG. 4. Shown here are yields of oats managed for grain only from different planting dates in 1952-57 experiments.



Eight of the most promising plum varieties for Alabama are: (1) Methley, (2) Bruce, (3) Ozark Premier, (4) Giant Cherry, (5) Red June, (6) America, (7) Brilliant, and (8) Munson.

PLUM VARIETIES for ALABAMA

J. D. NORTON and J. L. TURNER
Department of Horticulture

SELECTING a good variety is the first step in producing high quality plums. Unless adapted varieties are grown, good production practices are wasted.

To provide needed variety information, 96 plum varieties were planted in 1955-56 for testing by the Auburn University Agricultural Experiment Station. These varieties, included in a breeding project, have been producing for 4 years.

Results of the study show the more promising varieties to be Methley, Bruce, Ozark Premier, Starking Delicious, Mammoth Cardinal, Royal, Red Roy, Brilliant, Giant Cherry, Hanska, Red June, Red Glow, America, Sapa, Munson, Kelsey, Burbank, and Satsuma.

Methley, Bruce, Premier, Starking Delicious, and Mammoth Cardinal performed best for commercial production. For home use, Methley, Giant Cherry, Ozark Premier, Starking Delicious, and Hanska have proved best. Date of bloom and harvest, fruit characteristics, and yield ratings are given in the table.

Methley produces a high yield of excellent quality fruit. The tree is vigorous with upright growth. Disadvantages of Methley are soft fruit and susceptibility to bacterial spot. The fruit, medium in size, ripens in early June.

Bruce has excellent color, size, and resistance to bacterial spot. The semidwarf upright type tree produces heavy yields that ripen in mid-June. Fruit is medium firm, but of low quality.

Ozark Premier has a vigorous spreading growth. Fruit is large, firm, freestone, and of high quality. The variety has medium susceptibility to bacterial spot; however, this has not been a problem. Fruit ripens in mid- to late June.

Starking Delicious has firm fruit of excellent quality, deep red color, and large size. However, the fruit is somewhat susceptible to bacterial spot. Because this variety ripens in mid-July it has good commercial possibilities.

The Mammoth Cardinal fruit has medium red color, large size, and excellent quality. This variety has low susceptibility to bacterial spot. Trees are medium in vigor. Fruit ripens in mid- to late June.

Red Roy produces perhaps the firmest fruit of any of the varieties. It develops a bright red fruit about 3 weeks before harvest. The high quality fruit ripens in early to mid-July. Trees are vigorous with upright growth.

Brilliant has a vigorous upright tree that produces a high yield of large, good quality fruit. Fruit is medium firm and susceptible to spot. Ripening time is mid-June.

Royal has a large fruit with execellent size and color. Fruit is similar to Mammoth Cardinal. Trees are upright in growth but weak. Fruit ripens in mid- to late June.

Giant Cherry has a vigorous, upright tree that produces high yields. The fruit is high in sugar. However, the fruit is coarse in texture, lacking in flavor and small in size. This variety ripens in mid- to late June.

Hanska has a vigorous, upright to spreading tree that produces high yields. Fruit is high quality and highly aromatic; it is small and highly susceptible to brown rot. Fruit ripens in mid- to late July.

Red June produces medium size, firm fruit of medium quality that ripens in mid-June. Trees are upright in growth habit and their production is medium.

Although Munson, Kelsey, Burbank, and Satsuma produce satisfactory yields, fruit quality is too low for use as commercial varieties in Alabama.

The remaining varieties were either unsatisfactory or additional tests will be required to determine adaptability.

FRUIT CHARACTERISTICS, BLOOM, HARVEST, AND YIELD RECORDS FOR 12 LEADING PLUM VARIETIES AT AUBURN, 1960

Variety	Date of full bloom	Date of harvest[1]	Fruit size[2]	Skin color	Stone freeness[3]	Flesh color	Yield[4]
Methley	3/24	6/10	6	pur. to red	2	red	10
Brilliant	4/3	6/25	9	reddish pur.	1	cream to yel.	9
Giant Cherry	3/29	6/27	4	cherry red	2	cherry red	10
Bruce	3/22	6/29	10	orange to red	1	orange to red	10
Red June	4/1	6/29	7	reddish pur.	7	cream to yel.	5
Royal	3/27	7/2	10	reddish pur.	2	yellow	8
Mammoth Car.	3/27	7/5	10	reddish pur.	3	light yel.	6
Red Roy	3/30	7/14	7	reddish pur.	2	cream	7
Munson	4/5	7/15	7	red	1	yellow	10
Ozark Premier	3/22	7/16	7	red to pur.	8	cream	10
Starking Del.	3/25	7/26	9	red	2	bright red	10
Hanska	3/29	7/26	7	red	7	yel. to cream	10

[1] Although bloom dates were near normal for this area, fruit maturity was 10-20 days later than normal on most varieties.
[2] Fruit size: 1 = smallest, 10 = largest.
[3] Stone freeness: 1 = cling, 10 = free.
[4] Yield: 1 = no yield, 10 = maximum yield.

CONTAINERS—problem in marketing vegetables

DONALD R. STREET and E. E. KERN,
Dept. of Agricultural Economics

CONTAINERS USED in marketing are an important problem of Alabama's vegetable industry. Produce is received by wholesalers in a great variety of packages. Even for the same commodity, containers vary widely in size, dimensions, and construction. Produce grown nearby is often delivered in bulk and in open trucks without refrigeration. One large handler reported receiving snap beans in shoe boxes.

Magnitude of the container problem was learned in an Auburn Agricultural Experiment Station study of procurement practices and problems of wholesale handlers of fresh vegetables in the State. A major objective was to investigate ways to increase marketing efficiency.

Representatives from 4 major chains, 3 brokers, 23 carlot receivers, and 32 jobbers were interviewed. Most fresh produce offered for sale in Alabama retail stores was channeled through one or more of these firms. In order of importance, firms purchased from broker-receivers, growers, shipper-growers, farmers' markets, jobbers, and repackers. Fresh vegetables from 39 states and foreign countries were brought into Alabama by the firms studied.

Containers Preferred

A summary of wholesale dealers' container preferences for major commodities is presented in the table. Several preferred containers were named for green-ripe tomatoes, collards, cucumbers, lima beans, rutabagas, turnips, and strawberries. The 12 commodities listed in the table were selected on the basis of volume handled from a total of 39 being sold by wholesale firms.

In 35 of the 62 firms studied, snap beans were of major importance. Thirty-two of these 35 firms preferred the product to be delivered in bushel hampers. Of the 39 firms reporting cabbage of major importance, 35 expressed preference for the 50-lb. mesh bag and the remainder preferred crates. All 39 reports concerning head lettuce favored a fiberboard vacuum-cooled package.

Fifteen of the 19 firms reporting new potatoes as a major commodity preferred 50-lb. bags, 3 preferred 100-lb. sacks, and the other, which had bagging equipment, chose to receive in bulk.

The 20-lb. fiberboard box was the choice of 25 of the 33 firms handling pink tomatoes as a major commodity. Two firms desired the 40-lb. fiberboard box, three the 60-lb. wirebound crate, and one each preferred the 60-lb. fiberboard box and bulk delivery.

General Agreement Found

There was much agreement on container preference for specific commodities. More than half of all reasons given for container preference involved quality maintenance and standardization of the trade. A few containers for each commodity capable of meeting these requirements permits quick and easy trading, according to the buyers.

Price discounting was reported where a variety of sizes and types of containers was used. Ease of handling, customer satisfaction, and ease of display were other reasons given for specific container preference.

Facilities available to marketing firms for handling commodities were related to container preference. One of the chain organizations had bagging and boxing equipment to service their retail outlets. Seventeen of the 23 carlot receivers had boxing and bagging equipment as compared with only 4 of the 32 jobbers. All of the carlot receivers and jobbers had adequate boxing and bagging equipment for present use, but only 12 of the carlot receivers and 3 of the jobbers had adequate facilities for the future.

The likely continued increase in chain store handling of vegetables may require better packaging of produce nearer the point of production. The trend toward direct marketing means that producers and shippers will have to give closer attention to acceptable containers than they have in the past. Inferior and nonstandardized containers are costly in terms of quality loss, cost of repacking, and price discounting. Packages will need to be easy to handle, stack, and load to be shipped with confidence.

Marketing efficiencies achieved can benefit farmers, distributors, and consumers through higher profits, lower prices, and better qualtiy of produce marketed.

VEGETABLE CONTAINERS PREFERRED BY 62 WHOLESALE VEGETABLE DEALERS IN ALABAMA, FOR MAJOR COMMODITIES HANDLED, 1959

Commodity	Firms reporting commodity to be of major importance	Major container preference	Preference over other desired containers
	Number		*Per cent*
Cabbage	39	50-lb. mesh bag	90
Lettuce	39	Fiberboard carton	100
Snap beans	35	Bushel hamper	91
Red and pink tomatoes	33	20-lb. fiberboard box	76
Celery	19	Wooden crates	89
New potatoes	19	50-lb. bag	79
Squash	11	Bushel hamper	82
Field peas	9	Bushel hamper	78
Sweet potatoes	9	Crates	67
Corn	6	Wooden crates	67
Okra	6	Bu. and half-bu. hamper	50-50
Sweet pepper	6	Bushel hamper and basket	50-50

Soil Fumigants for ROOTKNOT

W. A. JOHNSON, *Asst. Horticulturist*
E. J. CAIRNS, *Nematologist*
L. M. WARE, *Head, Dept. of Horticulture*

Various treatments with soil fumigants are shown above. The four rows represent Vapam treated, Telone, Nemagon, and check.

SOIL FUMIGANTS for rootknot control are proving valuable in the production of vegetable crops.

All vegetable crops are affected in varying degrees by rootknot and other nematodes. For the more susceptible crops to be grown on the same land in sucessive years, soil fumigants or other control measures are needed.

Research Conducted

In 1957 an experiment to compare the effects of soil fumigants on yields and control of rootknot in certain vegetable crops was begun at the Auburn University Agricultural Experiment Station. Given in the table are soil fumigants used, rates and dates of application, and planting time for test crops grown. The fumigants were broadcast annually.

A fall crop was grown each year to check residual effects of the soil fumigant applied before planting a spring crop. The fumigants were applied to same plots each year.

Effect of Fumigants on Rootknot

At the beginning of the experiment there was a low population of rootknot nematodes. This is given in the table as index readings on roots of plants of the first crop grown in the check plot. A reading of 10 indicates no visible knots on roots and 100 means severe knotting of roots.

The index reading for the check plot the first year was 17. For the fall crop, first-year reading was 43 and for the second year it was 98. Therefore, rootknot nematode population more than doubled by end of the second year when highly susceptible crops were grown.

Index readings were relatively low for both spring and fall crops grown after soil fumigation. There was a slight increase in rootknot recorded for fall crop over the spring crop when Nemagon, Dorlone, Vapam, and Dowfume W-85 were applied in 1957 and for Nemagon and Vapam in 1959. In no case was the amount of rootknot high enough to materially affect growth and production.

Growth of plants and production of spring squash, the first crop, were increased by all soil fumigants used. Some of the effects could have resulted from the control of soil pests other than rootknot nematode. Yields from plots receiving soil fumigants ranged from 50 to 125% higher than from check plots, see table. The smallest increase was from Nemagon. There were no significant increases in yields of the fall crop between check plots and those receiving soil fumigants.

In 1958 the spring crop was potatoes. The check plots produced as high or nearly as high yields as was produced on plots receiving fumigants with the exception of Vapam. Rootknot index was not recorded for this crop. Spring crops, in 1959 and 1960, were dwarf beans.

In 1959 beans were damaged from all soil fumigants except Vapam because of unusual weather conditions.

Because of the damage in 1959 from spring treatments, fumigants for the 1960 spring crop were applied in November. Yields of beans in 1960 were increased 45 to 50% from use of Telone, Dorlone, Vapam, and DD and 11 to 17% from use of Nemagon and Dowfume W-85.

The increase in yields of the fall crop of squash ranged from 120 to 180% in 1958 and from 310 to 630% in 1959. Yield of squash in the fall of 1958 was somewhat low and variable, partially because of downy mildew. Squash is more susceptible to rootknot than beans although both crops are highly susceptible.

The highest yields each year for the spring crop grown after fumigation were produced from plots receiving Vapam; the second and third highest yields were from use of Telone and DD. Although Nemagon and Dowfume W-85 produced less yields than the other fumigants, the increase over check plots warrant their use as soil fumigants.

EFFECT OF SOIL FUMIGANTS ON YIELD AND ROOTKNOT

Fumigants[1]	Gal. per acre	Yields in tons per acre and rootknot index readings											
		1957				1958		1959				1960	
		Spring squash		Fall squash		Fall squash		Spring beans		Fall squash		Spring beans	
		Tons	Index	Tons	Index	Tons	Index	Tons	Index	Tons	Index	Tons	Index
None	–	4.84	17	8.24	43	1.66	98	4.73	68	0.87	77	3.41	74
Telone	20.0	10.19	10	6.85	10	2.74	10	4.09[3]	13	6.34	10	4.92	11
Dorlone	12.5	9.34	11	8.01	17	3.26	10	4.26[3]	12	4.89	13	4.94	13
Nemagon	5.0[2]	6.82	16	6.73	22	2.54	13	4.30[3]	21	4.45	37	3.77	13
Vapam	40.0	10.80	11	8.69	18	3.09	15	5.94	12	5.23	17	5.17	12
DD	20.0	9.84	10	8.46	13	2.70	13	4.46[3]	13	5.76	10	4.96	12
Dowfume	4.5	9.62	15	6.46	34	2.82	10	4.62[3]	14	3.56	11	3.98	11
Dates applied		Mar. 11				Feb. 22		Mar. 10				Nov. 4	
Dates planted		May 2				Apr. 14		Apr. 9				Apr. 12	

[1] Telone—formulation containing 90-95% dichloropropene.
Nemagon—formulation containing 1,2-dibromo-3-chloropropane.
Vapam—formulation containing sodium methyldithiocarbamate.
DD—formulation of dichloropropenes and dichloropropanes.
Dowfume W-85—formulation containing ethylene dibromide.

[2] This amount per acre was used in 1957 and 1958; 1 gal. per acre was used in 1959 and 1960.

[3] Yields were reduced because of toxic effects from fumigants.

LEGUME INOCULATION—
Product of Early Research

KENNETH B. ROY, *Editor*
LILLIAN FOSCUE, *Graduate Assistant*

INOCULATION and its importance to successful production of certain leguminous crops is common knowledge among Alabama farmers today.

But few know that some of the first research in this country with inoculum or "germ fertilizer" was done at the Auburn Agricultural Experiment Station more than three score years ago. Its results provided the answer to the mystery why certain leguminous plants produce poor yields on soils on which no legume had been recently grown. Legumes used in this early work included vetch, crimson clover, lupine, lespedeza, alfalfa, Canada field peas, and cowpeas.

"The subject of maintaining fertility of the land very closely concerns every tiller of the soil, whether cotton planter, tobacco grower, grain farmer, livestock breeder, or horticulturist."

The foregoing paragraph is the introduction to Auburn Station Bulletin No. 87, published in the summer of 1897, reporting early research on soil inoculation for leguminous plants. The words are those of the late Prof. J. F. Duggar, who joined the Auburn staff a year earlier and whose later work made it possible to condition the soil for growing certain legumes to supply much needed nitrogen. He is credited with having been one of the first researchers in this country to have experimented with "artificial cultures" for growing clovers and other legumes.

In the light of discoveries in Europe, Professor Duggar determined that some Alabama soils had to be inoculated by the necessary germ-life to grow legumes. First with a homemade preparation and then with a patented concentrate from Germany, he launched a long-range campaign to get Alabama farmers to inoculate their fields so soil improving legumes could be grown.

In Station Bulletin 87, Professor Duggar in the main presented results from greenhouse pot experiments in which he compared growth of inoculated and uninoculated legumes. His yield increases were dramatic.

Professor Duggar emphasized the value of inoculation in Bulletin No. 96, published August 1898. Reporting on experiments with crimson clover and hairy vetch, he wrote, "clover, vetch, and similar leguminous plants are able to draw much of their nitrogen from the air when enlargements called tubercules or nodules are found on their roots. They are unable to do this, or to store up fertility, when tubercules are absent.

This is the second article of a series on Auburn University and its Agricultural Experiment Station System—its founding and its contributions down through the years to the progress of Alabama's agriculture. The series is being published in conjunction with Auburn's Centennial Celebration.—*Editor*

"In order for tubercules to develop, specific germs of bacteria must come in contact with the young rootlets. In the regions where the clovers, vetch, alfalfa, etc. are extensively grown, these germs become generally distributed in the soil of the entire region. In a number of localities in Alabama, where these legumes are not grown to any great extent, these germs are absent from some soils or present in insufficient numbers."

The researcher reported good results from two methods of inoculation: (1) scattering on a field some of the germ-laden soil from a field where the legumes have borne tubercules, and (2) use of a prepared material called Nitragin, "a concentrated germ fertilizer containing myriads of germs which are able to cause the growth of tubercules on the roots of certain leguminous or soil improving plants."

Large yield increases in field experiments resulted from the use of an inoculum, as reported in Bulletin 96. Hairy vetch inoculated with vetch Nitragin produced hay at the rate of 3,270 lb. per acre, as compared with 564 lb. without inoculation. Using soil from an old vetch field as inoculum increased yield by 2,308 lb. of hay over an uninoculated companion plot. Crimson clover yield increase from inoculation was reported to be 3,296 lb.

Long lasting effect of inoculation was also learned. It was reported that "a field once inoculated, whether naturally or artificially, remains inoculated for years." Other information included the fact that, in general, each genus of leguminous plant has its own specific or adapted germ.

Successful growth of legumes in Alabama was a major breakthrough that has been invaluable to farmers of the State. Use of these crops as soil improving and forage plants came about as a direct result of the early, basic research.

Research on legume production has not stopped. Work has continued through the years on variety testing and development, time of planting, seedbed preparation, fertility requirements, and on other cultural practices. This ongoing research continues to provide information that enables farmers to do a better job of legume production and utilization.

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