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YUCHI ARROWLEAF CLOVER

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ON THE COVER. Yuchi arrowleaf clover has a distinctive appearance that makes it easy to recognize at all stages of growth. The cover photograph, made in central Alabama during late June when seed heads were near maturity, shows the characteristic appearance near end of the growing season.

SUMMARY

Yuchi arrowleaf (*Trifolium vesiculosum*) is a highly productive winter annual clover that is adapted to well drained soils in most of Alabama and areas of similar climate. Some features of this clover, which was released by Auburn University Agricultural Experiment Station, are: (1) 2 months longer productivity in the spring than crimson, (2) excellent drought tolerance, (3) high percentage of hard seed and good reseeding ability, (4) better seed germination at low temperature than crimson, (5) high forage quality throughout the productive season until maturity in June, and (6) excellent resistance to alfalfa weevil and clover head weevil.

Based on results of Alabama experiments, these suggestions are offered for growing Yuchi arrowleaf clover:

1. Select well drained soil. Avoid poorly drained and high-lime soils of the Black Belt.

2. Soil test to make sure fertilizer and lime needs are met. Yuchi is not a low fertility clover and will not produce well on very acid soil.

3. On prepared land, plant early to obtain maximum autumn growth. In northern Alabama, this means late August or early September. Farther south, mid to late September is fine. Plant 5 to 8 pounds of scarified and inoculated Yuchi seed with 1 bushel of rye per acre. Use special arrowleaf clover inoculum. Plant clover seed at a depth of ⅛ to ¼ inch.

4. Plant only **certified** Yuchi arrowleaf to be sure of obtaining high quality seed of the right variety.

5. Plant on bahia or bermudagrass sods later, after they become dormant. Grass should be mowed or grazed closely in the fall before overseeding with clover.

6. To prevent seedling loss by striped field crickets, apply ½ pound active Diazanon granules per acre. Do not depend on natural reseeding of clover under continuous grazing. Overseed grass sod each fall.

7. Permit clover plants to make 6 inches of growth before grazing.

8. If a hay or seed crop is desired, stop grazing in early April.

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YUCHI ARROWLEAF CLOVER (*Trifolium vesiculosum* Savi), a reseeding winter annual legume, is adapted to well drained soils in Alabama. It makes high yields of forage in late winter and spring, maturing about 2 months later than crimson clover.

ORIGIN

Released by the Auburn University Agricultural Experiment Station *(5)* and named for an Indian tribe that once inhabited east-central Alabama, Yuchi is a selection of arrowleaf clover introduced from Italy in 1956. The introduction, P.I. 233816, was first grown at the Southern Regional Plant Introduction Station, Griffin, Georgia. Plantings were made in Alabama by the Soil Conservation Service. It probably dates back to selections made in the 1930's by Prince Tuleo Ruffo of Calabria from *T. vesiculosum* plants growing in uncultivated places in the district of Segni (Rome), Italy *(11)*. Favilli *(3)* in Italy described this species as being drought resistant, high yielding, hard seeded, and having considerable cold resistance.

Two other arrowleaf clover varieties have been released in the United States. Amclo *(2)*, released by the Georgia Agricultural Experiment Station and Soil Conservation Service, matures 2 to 4 weeks earlier in the spring than Yuchi. The Mississippi Agricultural Experiment Station and the Soil Conservation Service released Meechee *(10)*, which is somewhat later maturing than Yuchi and is reported to be more cold hardy.

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DESCRIPTION

Yuchi arrowleaf clover makes its early growth from a leafy rosette, similar to crimson clover, later producing branching stems that curve upward and attain a length of 24 to 60 inches. The thick hollow stems are often purple, becoming fibrous and hard near maturity.

Leaf petioles are 3 to 8 inches long. Long white stipules, which narrow to a point, are at the base of the petioles. The leaves are large, each of the three leaflets being 1½ to 3 inches long and 1 to 1¼ inches wide. Each arrow-shaped, non-hairy leaflet has pronounced veins and develops a large, white, V-shaped mark as it matures, Figure 1. Considerable variation in plant type occurs within the variety.

The flower heads are conical, often exceeding 2 inches in length and 1¼ inches in diameter, Figure 2. From 150 to 170 individual florets make up the head, the corolla being white initially and later turning pink to purple. This gives each head a pink-purple

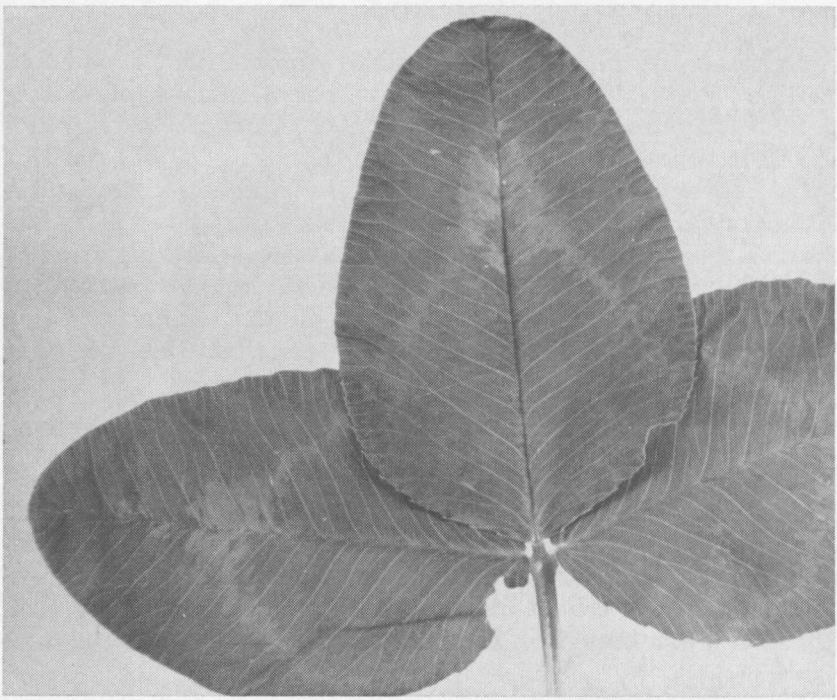

FIG. 1. Pronounced veins and large V-shaped mark on each leaflet are identifying features of Yuchi arrowleaf clover.

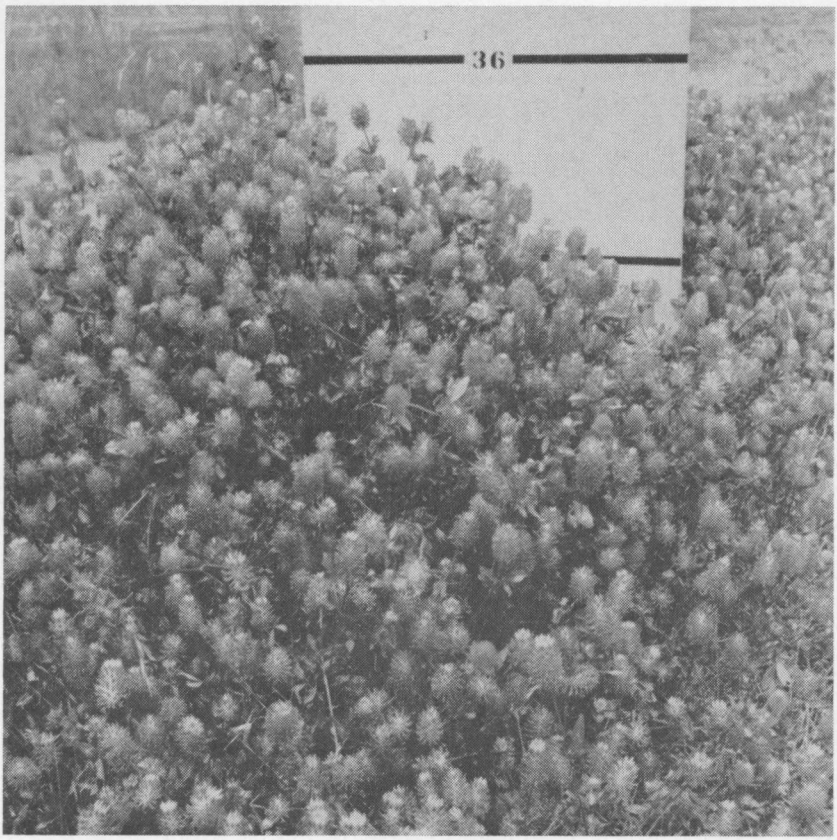

FIG. 2. Yuchi arrowleaf clover heads near maturity are shown in this photo made in late June in central Alabama.

and white striped appearance. Flowering normally occurs from late May to July in central Alabama, but blooming may be delayed by grazing and/or good soil moisture. Each floret produces two to three rough brown seeds, each about twice the size of white clover seed. There are about 400,000 seed per pound.

SEED GERMINATION

Yuchi arrowleaf clover germinates more rapidly at 40°F temperature than crimson clover, Figure 3. At alternating temperatures, such as one might expect at the soil surface, low temperature during the seed swelling period reduces germination and vigor of crimson clover but has no effect on Yuchi arrowleaf *(7)*.

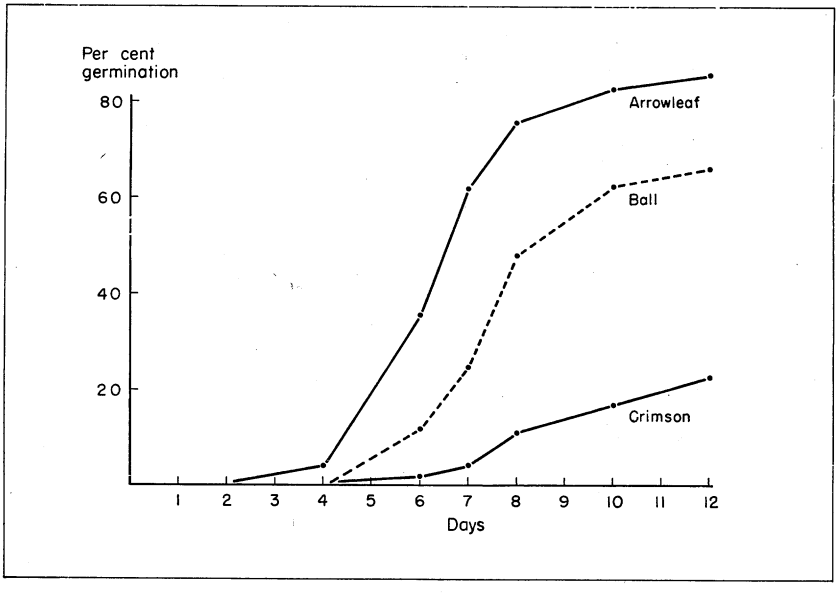

FIG. 3. Germination of Yuchi arrowleaf clover seed at constant 40°F temperature is compared with that of ball and crimson clovers.

The ability of Yuchi arrowleaf to germinate well at low temperature may be a valuable adaptive feature enabling it to produce new plants throughout the winter. Field observations in Alabama indicate that the number of new clover plants increases through December and January when moisture is good and temperatures are often low. Crimson clover, on the other hand, is less likely to germinate successfully during this period. A dry autumn followed by a cold winter may result in poor stands of crimson clover, while seeds of Yuchi arrowleaf frequently continue to germinate and grow throughout the winter.

The seed coats of this clover are unusually hard and require more scarification than most other reseeding winter legumes. Hard seed content of combine harvested seed may exceed 70 per cent. Mechanical scarification of Yuchi arrowleaf by commercial scarifiers reduces the hard seed content to about 25 per cent. Thus, it is essential that scarified seed be planted to ensure a stand the first year. Non-scarified seed may lie in the soil several years before seed coats break down sufficiently for germination. Good stands of Yuchi have been obtained in fields where no natural reseeding had been permitted for 4 years.

FORAGE PRODUCTION ON PREPARED LAND

Clover Alone

Yuchi arrowleaf has been tested at 10 Alabama locations by Auburn University Agricultural Experiment Station. It has been compared with crimson, ball, and Amclo arrowleaf clovers. In these tests, the 5- × 20-foot plots were replicated four times and clipped every 4 to 6 weeks after the clovers were 6 inches tall.

Total annual yields of Yuchi arrowleaf have generally equalled or exceeded those of crimson or ball clovers, Table 1. At Muscle Shoals and Alexandria (near Anniston) in northern Alabama and at Prattville in central Alabama, Yuchi has been considerably more productive than crimson clover. Late spring droughts severely reduced Yuchi yields during several years in southern Alabama. Yuchi made poor growth at the Black Belt Substation on Sumter clay.

Winter forage production of Yuchi arrowleaf has generally been lower than that of crimson clover. One factor contributing to less winter growth of Yuchi has been slow nodulation by nitrogen-fixing bacteria, particularly on fields where it is planted for the

TABLE 1. TOTAL FORAGE YIELD OF CRIMSON, BALL, YUCHI, AND AMCLO ARROWLEAF CLOVERS, TEN LOCATIONS

Location and soil	Years tested	Per acre yield of dry forage			
		Yuchi arrowleaf	Amclo arrowleaf	Crimson	Ball
		Lb.	*Lb.*	*Lb.*	*Lb.*
Northern Alabama					
T.V.A. Forage Research Area, Muscle Shoals, Sango silt loam	2	5,420	5,290	3,930	3,702
Alexandria Exp. Field, Decatur clay	4	4,150	3,560	3,680	3,740
Central Alabama					
Tuskegee Exp. Field, Boswell fine sandy loam	2	2,550	------	3,130	3,230
Plant Breeding Unit, Cahaba fine sandy loam	8	3,890	3,230	4,020	4,260
Prattville Exp. Field, Lucedale fine sandy loam	6	4,770	3,670	3,640	4,060
Lower Coastal Plain Sub., Amite sandy loam	1	4,780	4,940	3,750	1,790
Black Belt Substation, Sumter clay	1	2,120	1,660	------	2,360
Southern Alabama					
Monroeville Exp. Field, Magnolia fine sandy loam	5	4,060	3,740	4,140	3,000
Brewton Exp. Field, Kalmia fine sandy loam	5	4,210	3,560	4,490	4,180
Gulf Coast Substation, Marlboro fine sandy loam	7	3,220	2,830	3,810	2,520

first time. Where plants develop nodules early, winter growth of Yuchi has exceeded that of crimson.

Yuchi arrowleaf continues to grow for about 2 months longer than crimson and 1 month after ball clover matures. Since much of Yuchi's growth is made in late spring, hot dry weather in May and June may reduce yields. However, drought tolerance is excellent and recovery is rapid after rains. In contrast, ball clover is less drought tolerant and forage yields have fluctuated more from year to year.

Yuchi has generally been more productive than the Amclo variety in Alabama, Table 1. Winter production has been equal or superior to Amclo, but Yuchi has a longer spring productive period. Blooming of Amclo begins 2 to 4 weeks earlier than Yuchi, Figure 4, reducing forage digestibility in late spring. Forage harvested May 17 at Prattville had digestible dry matter values of 78 per cent for Yuchi and 65 per cent for Amclo.

FIG. 4. Amclo arrowleaf (left) was already in bloom when photo was made May 18 at Plant Breeding Unit, Tallassee, but Yuchi (right) was still vegetative.

TABLE 2. FORAGE YIELD OF CRIMSON AND YUCHI ARROWLEAF CLOVER MIXTURES, FOUR LOCATIONS

Location	Per acre yield of dry forage		
	Crimson and Yuchi arrowleaf	Yuchi arrowleaf	Crimson
	Lb.	*Lb.*	*Lb.*
3-year test			
Prattville Experiment Field	4,310	5,360	3,310
Plant Breeding Unit	4,880	4,530	4,160
2-year test			
Monroeville Experiment Field	5,340	4,800	4,660
Brewton Experiment Field	5,930	5,560	4,850

Since crimson generally produces more early winter growth and Yuchi arrowleaf more late winter and spring forage, mixtures of the two clovers would appear desirable. However, in experiments at four locations where the clovers were seeded together and harvested every 4 to 6 weeks, total yields were generally improved only slightly over Yuchi arrowleaf alone, Table 2. At Prattville, yields of the mixture were considerably lower than Yuchi arrowleaf alone. Winter forage yields of the mixture at all locations were generally higher and late spring production considerably below that of Yuchi arrowleaf alone.

Clover-Grass Mixtures

On prepared land, Yuchi arrowleaf can be planted with rye or with rye and ryegrass for a high quality, long season pasture. Yuchi grown in combination with rye or ryegrass has been productive over a longer period than crimson clover in similar mixtures, Table 3. In the 2-year experiment at the Plant Breeding Unit, Tallassee, planting was in mid-September on prepared land, and plots were harvested every 4 to 6 weeks. All treatments received 80 pounds of nitrogen per acre.

TABLE 3. FORAGE YIELD OF CLOVER-GRASS MIXTURES, PLANT BREEDING UNIT, TALLASSEE, 2-YEAR AVERAGE

Mixture	Per acre yield of oven dry forage			
	November-December	January-March	April-May	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*
Rye-Yuchi arrowleaf clover	1,670	3,070	2,840	7,580
Rye-ryegrass-Yuchi arrowleaf	1,440	3,120	2,510	7,070
Rye-ryegrass-crimson clover	1,600	3,230	1,970	6,800
Rye-crimson clover	1,790	3,310	750	5,850

Adding ryegrass to rye and crimson clover nearly tripled April and May forage yields, Table 3. This was not the case with rye and Yuchi arrowleaf clover, where ryegrass did not improve spring yields. Rye and crimson produced slightly more early winter forage than rye and Yuchi arrowleaf. April and May production by the rye-Yuchi mixture was nearly four times that of the rye-crimson mixture. Quality of the maturing forage in the latter mixture was much lower than in the rye-Yuchi arrowleaf. Further information on quality differences between the two clovers is given in the section, "Forage Quality and Animal Performance."

FORAGE PRODUCTION ON SUMMER GRASS SODS

Overseeding of bahia and bermudagrass sods with winter annual clovers can extend the grazing season by 4 to 8 weeks and provide higher quality forage. Good natural reseeding by the clover is desirable. In northern Mississippi, Yuchi arrowleaf reseeded well on Coastal bermuda sod over a 3-year period *(9)*. At this location, most of the Yuchi growth was after May 1 and drought reduced clover yields slightly below that of crimson. However, total annual grass-clover yields were similar for both clovers.

Reseeding of Yuchi was excellent on Coastal bermuda the second year at the Upper Coastal Plain Substation, Winfield, Table 4. In this experiment the grass was cut to 2 inches in late fall. Natural reseeding of clover and vetch occurred where these species grew the previous spring. Early spring forage yield of crimson was slightly higher than for Yuchi arrowleaf, but late spring growth of the latter resulted in considerably more total production.

Reseeding of clovers is generally more uncertain on bahiagrass sod than on bermudagrass. In the Georgia Piedmont, researchers reported stand failures of Amclo arrowleaf 50 per cent of the time

TABLE 4. FORAGE YIELD OF LEGUMES FROM NATURAL RESEEDING ON COASTAL BERMUDAGRASS SOD, UPPER COASTAL PLAIN SUBSTATION, WINFIELD, 1966-67

Legume	Per acre yield of dry forage			
	April 4	April 27	May 16	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*
Yuchi arrowleaf clover	1,620	690	1,100	3,410
Autauga crimson clover	2,100	80	0	2,180
Ball clover	840	770	480	2,090
Hairy vetch	380	770	410	1,560

TABLE 5. EFFECT OF BAHIAGRASS STUBBLE HEIGHT ON STAND AND FORAGE YIELD OF YUCHI ARROWLEAF AND CRIMSON CLOVERS, AUBURN, 1968-69

Height of bahiagrass stubble, inches	Plants per square foot, December 27	Per acre yield of oven dry clover		
		April 16	May 23	Total
	No.	*Lb.*	*Lb.*	*Lb.*
Yuchi arrowleaf				
1	17	830	2,310	3,140
3	19	680	1,950	2,630
6	14	120	2,310	2,430
Crimson				
1	30	1,340	0	1,340
3	26	1,220	0	1,220
6	26	680	0	680

on bahiagrass, regardless of sod scarification or fertilizer treatment *(1)*.

Stubble height of perennial warm season grasses left in the fall may affect clover forage production. In an experiment at Auburn, bahiagrass was cut to different stubble heights in early November prior to seeding clover, Table 5. Stubble height had little effect on the number of clover seedlings in late December. However, a 6-inch grass stubble drastically reduced early spring production on both Yuchi arrowleaf and crimson clovers. The 3-inch stubble reduced forage yield only slightly below that of the 1-inch stubble. Recovery growth in late April and May was excellent on Yuchi arrowleaf at all stubble heights, producing over twice as much forage as crimson clover.

Little information is available on natural reseeding of Yuchi arrowleaf on grass sods under grazing. It has been observed that cows continue to consume stems and heads of Yuchi in June and July on Coastal bermuda sod. This suggests that the clover plants may not produce enough seed for dependable reseeding under continuous intensive grazing. The earlier spring grazing and improved quality forage obtained should offer enough incentive to replant Yuchi arrowleaf on grass sods each fall, especially since the required seeding rate is low.

SOIL REQUIREMENTS

Soil Fertility and pH

Yuchi arrowleaf is more sensitive than crimson clover to low soil phosphorus, Figure 5. Response by this clover to phosphorus, potassium, and lime on a previously unfertilized Marlboro fine

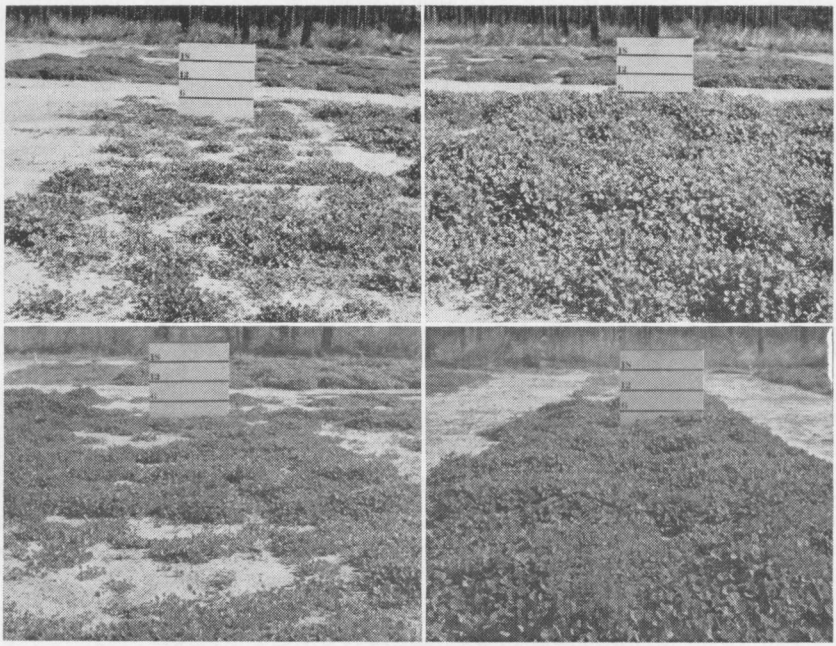

FIG. 5. Response of Yuchi arrowleaf (top photos) and crimson clover (bottom) to phosphorus fertilization is shown by growth in plots at Gulf Coast Substation, Fairhope, on January 6. Plots of both clovers in left photos got 13 pounds of P per acre, whereas plots at right were fertilized with 52 pounds P per acre.

TABLE 6. RELATIVE FORAGE YIELD RESPONSE OF YUCHI ARROWLEAF, CRIMSON, AND BALL CLOVERS ON VIRGIN MARLBORO FINE SANDY LOAM,[1] GULF COAST SUBSTATION, FAIRHOPE, 2-YEAR AVERAGE

Phosphorus and potassium added, pounds per acre		Forage yield expressed as percentage of best treatment		
P	K	Yuchi arrowleaf	Crimson	Ball
		Pct.	*Pct.*	*Pct.*
Soil pH 6.0				
52	100	100	100	100
26	100	55	75	52
13	100	6	35	13
0	100	0	1	0
52	25	90	79	85
52	0	41	66	78
Soil pH 5.0				
52	100	62	77	58

[1] Soil test values at beginning of experiment: 3 pounds P and 40 pounds K per acre (weak acid extractable) and pH 5.0.

sandy loam at Gulf Coast Substation, Fairhope, Table 6, shows Yuchi arrowleaf and ball clovers both made poorer growth than crimson at low soil phosphorus levels. When no phosphorus was added to this soil, Yuchi and ball clover plants died in the seedling stage, whereas crimson plants survived. Most cultivated soils do not show such extreme phosphorus deficiency, but low phosphorus level could be a problem on some pastureland that has received little fertilizer over the years. Yuchi arrowleaf growth also was less than the other two when soil potassium was low.

The clovers differed considerably in their growth at pH 5.0. Yuchi arrowleaf and ball are less tolerant of soil acidity than crimson clover. As previously noted, Yuchi is not adapted to lime soils of the Black Belt. On these soils having a pH of 7.5 or higher, Yuchi plants were chlorotic and made little growth, apparently because of iron deficiency. Rogers *(12)* reported iron deficiency chlorosis of crimson clover on such a soil.

Soil Drainage

Yuchi arrowleaf makes little growth on poorly drained soils *(8)*. This is an important consideration since flooding and wet soils are common in many areas of the State during the winter and early spring months. Field observations and greenhouse experi-

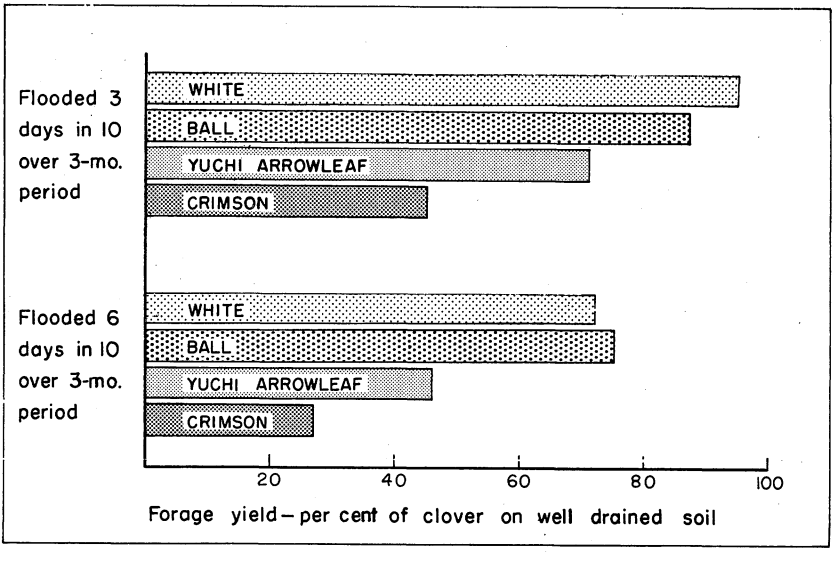

FIG. 6. Yuchi arrowleaf showed less flooding tolerance than white or ball clovers, but performed better than crimson clover under both flooding treatments.

ments indicate that Yuchi is less tolerant of poor drainage than ball or white clovers, Figure 6, but will make more growth than crimson clover under these conditions.

MANAGEMENT FOR PASTURE AND HAY

As with most forage species, management has a substantial effect on Yuchi forage yields *(6)*. Frequent cutting (to simulate frequent close grazing) reduced yields in a 2-year experiment at the Plant Breeding Unit, Table 7. Forage yield was highest when Yuchi arrowleaf was cut every 6 weeks. Harvesting at 5- or 6-week intervals (hay stage) decreased the productive period as did cutting every 4 weeks. Extended early spring droughts both years reduced yields. As expected, total yields were reduced by clipping weekly. However, yields differed little among 2-, 3-, or 4-week cutting intervals.

There was a sharp reduction in number of live shoots on clover plants cut every 4 weeks as compared with the 3-week cutting interval, Table 7. Shoot numbers were even less on clover cut every 5 or 6 weeks. In general, the number of new buds and

TABLE 7. FORAGE YIELD OF YUCHI ARROWLEAF AS AFFECTED BY CUTTING FREQUENCY, PLANT BREEDING UNIT, TALLASSEE, 2-YEAR AVERAGE

Time between cuttings	Live shoots per foot of row in May	Dry forage yield per acre
	No.	*Lb.*
6 weeks (hay stage)	2	5,240
5 weeks (hay stage)	1	3,950
4 weeks	10	3,250
3 weeks	21	3,080
2 weeks	22	2,830
1 week	29	2,120

TABLE 8. EFFECT OF CUTTING DATE ON FORAGE YIELD OF YUCHI ARROWLEAF, PLANT BREEDING UNIT, TALLASSEE, 1968-69

Treatment	Per acre yield of dry forage			
	Early season	May 1	May 21	Total
	Lb.	*Lb.*	*Lb.*	*Lb.*
Cut every 2 weeks until April 1	2,210	.....	5,220	7,430
Cut every 2 weeks until April 15	3,190	.....	730	3,920
Cut every 2 weeks until May 1	3,300	.....	210	3,510
Cut April 15	4,610	.....	0	4,610
Cut April 1 and May 1	3,020	1,120	0	4,140
Cut every 2 weeks until April 1, then cut May 1	2.170	2,540	0	4,710

shoots declined as cutting interval was lengthened, but the reduction was much greater when cut at the hay stage.

The sharp decline in live shoots in late spring as the cutting interval was lengthened suggests that there is an approximate date at which grazing should be terminated if hay or seed production is desired. Results of an experiment at the Plant Breeding Unit show that cutting (or grazing) should cease around April 1 in central Alabama for maximum hay yield, Table 8. Similar results were obtained in another trial at Prattville.

Two reasons may account for the poor regrowth and death of clover plants when a large cutting of hay is removed in mid-April or early May. First, fewer buds remain active under the dense shade of the hay canopy than when frequently clipped, Figure 7. More frequent defoliation, as is the case under continuous grazing, permits more sunlight to penetrate the sward and maintain buds in an active state. Second, the lack of reserve food storage in the stubble after a large hay cutting means that little energy is avail-

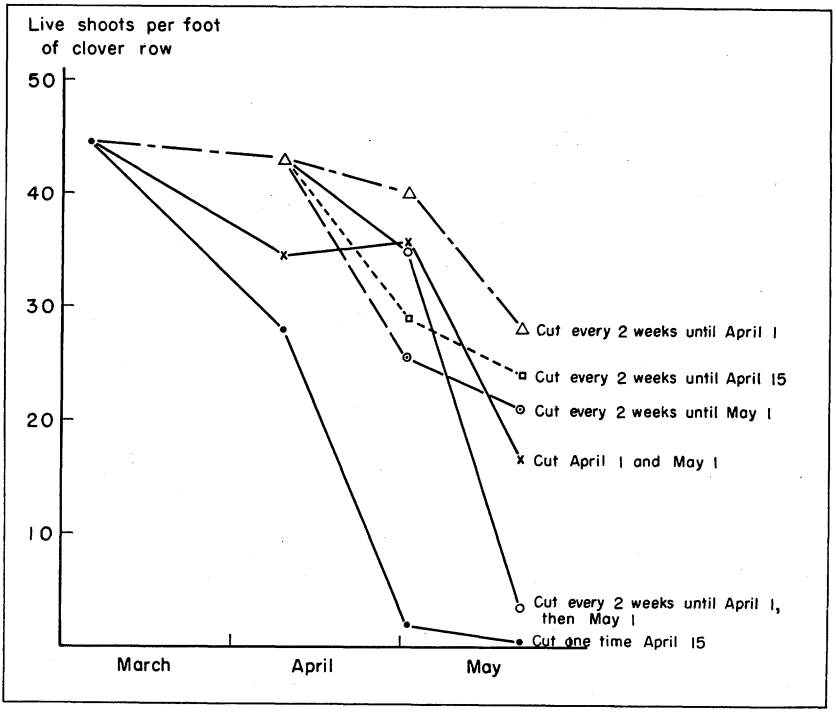

FIG. 7. How time of cutting affected live shoot production of Yuchi arrowleaf was determined in the test at the Plant Breeding Unit, Tallassee.

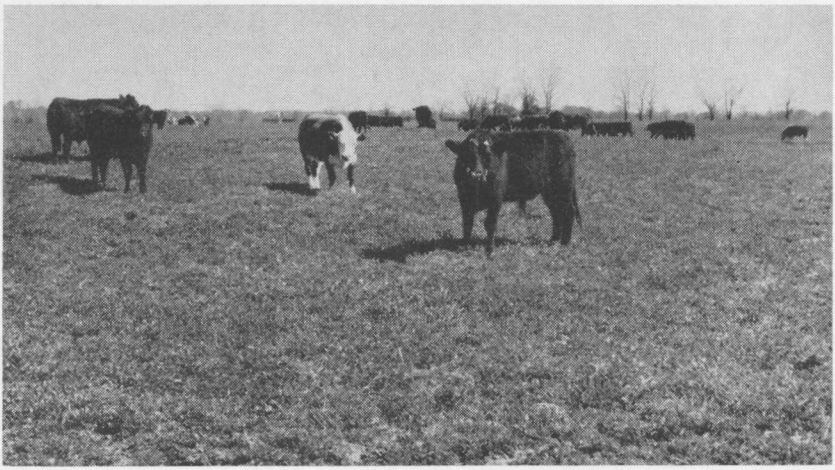

FIG. 8. In this January scene in central Alabama, beef cattle are grazing a reseeding stand of Yuchi arrowleaf clover.

able for developing new leaves and stems. In contrast, more frequently cut or grazed Yuchi arrowleaf clover has short prostrate stems containing both active buds and food storage areas.

From a practical standpoint, how should Yuchi be managed for maximum productivity? Continuous grazing after plants are 6 inches tall will permit a long productive season. Yuchi has considerable tolerance to animal trampling. Clover stands and growth have been good even when grazed during the wet winter months, Figure 8. If it appears that there will be surplus forage during the peak growing period of April and May, confining grazing animals to a part of the pasture in early April permits the ungrazed portion to be cut for hay in May or seed combined in June. Since heavy growth can be expected, the use of a crimper or stem crusher will speed up field drying.

FORAGE QUALITY AND ANIMAL PERFORMANCE

Forage Digestibility

Forage quality of Yuchi arrowleaf from a management experiment at the Plant Breeding Unit was evaluated on the basis of digestible dry matter (DDM). DDM was determined by placing nylon bags containing forage samples in the rumen of steers fitted with fistulas (openings in the rumen). The bags were removed after 24 hours and digestibility calculated on the basis of undigested matter remaining in the bag.

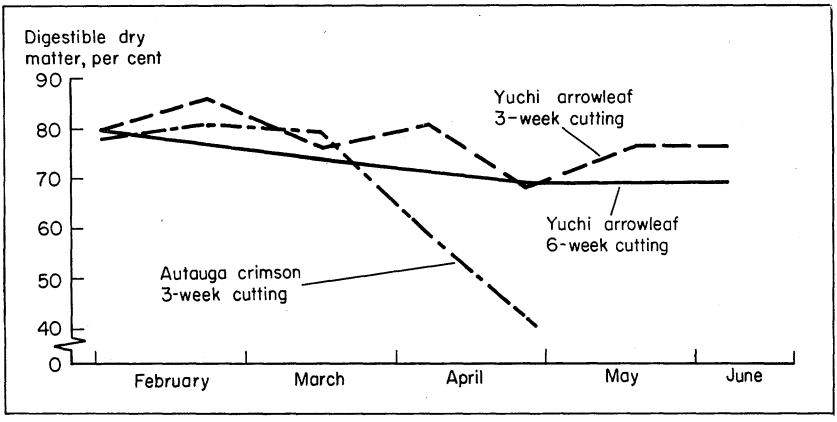

FIG. 9. Cutting frequency affected digestibility of Yuchi and crimson clovers.

DDM of Yuchi arrowleaf remained at a high level (70-85 per cent) throughout winter and spring regardless of cutting frequency, Figure 9. Forage from the other cuttings made at 1-, 2-, 4-, and 5-week intervals had digestibility similar to that of the 3- and 6-week treatments. Results were similar in both years of the experiment *(6)*. For Coastal bermuda in the same trial, DDM was only 43 per cent.

Generally, forages with about 65 per cent DDM or more are considered to have high quality. Thus, results of this experiment show that Yuchi arrowleaf cut at the hay stage has high quality. Quality also remained high during the blooming period in late May. In another experiment, hay cut May 21 and yielding over 2½ tons per acre had DDM of 70 per cent, Table 8. In contrast, digestibility of crimson clover cut every 4 weeks was high in winter but declined rapidly in late March and April. Autauga crimson clover normally reaches full bloom by early April in central Alabama.

In forage cut at the early bloom stage, DDM of leaves was similar for arrowleaf (84 per cent) and crimson (78 per cent). However, DDM of stems was 68 per cent for Yuchi but only 50 per cent for crimson. The high digestibility of stems probably accounts for the apparent high quality of Yuchi arrowleaf in late spring when it becomes more stemmy. These results agree with findings of Georgia experiments *(13)* that the amount of less digestible cell walls of arrowleaf clover remained relatively low until bloom stage, even though the percentage of stems in the forage was high.

Steer Grazing Results

Rye, ryegrass, crimson clover, and Yuchi arrowleaf clover were planted on prepared land in September of 1967 and 1968 at the Piedmont Substation, Camp Hill. This 10-acre hilly red clay area had been fallowed during the summer months. Phosphorus and potassium were applied according to soil tests, with 80 pounds of nitrogen per acre added in fall and winter. Ten yearling beef steers grazed the pastures continuously from stocking in December until June each year. Steers were given a 24 mg. stilbestrol ear implant at the beginning of the experiment. No supplemental feed was used. Ten heifers were added to the grazing area from April 4 to May 16 in 1969 to utilize surplus forage.

Excellent results were obtained both years, although there were greater gains over a longer period in 1968-69, Table 9. This is probably because of the better stands of Yuchi arrowleaf the second season. Rye furnished most of the early season forage and Yuchi arrowleaf produced most of the grazing from early April to June. Crimson clover made only a minor contribution, especially the second season. Ryegrass furnished grazing in late February and March when rye was booting.

The average daily gains of 1.96 pounds in 1967-68 and 2.39 pounds in 1968-69 are highly satisfactory. Although per acre gains were good, it is likely that carrying capacity would be higher on less droughty soils. Steers were slaughtered directly off the pasture and graded high Good.

SEED PRODUCTION

Yuchi arrowleaf begins blooming in late May or early June and matures seed in late June or July. Seed are borne in clustered pods produced at tips of stems that remain erect if plants have not

TABLE 9. PERFORMANCE OF STEERS ON RYE-RYEGRASS-YUCHI ARROWLEAF[1] PASTURE, PIEDMONT SUBSTATION, CAMP HILL

Performance measure	Resultant	
	Winter 1967-68	Winter 1968-69
Dates grazing began and ended	Dec. 13-June 3	Dec. 2-June 3
Average initial live weight, lb.	590	574
Average final live weight, lb.	931	1,012
Total gain per acre, lb.	341	483
Average daily gain per steer, lb.	1.96	2.39

[1] Stands of Yuchi arrowleaf were thin the first year but excellent the second. Some crimson clover was present in the pastures, especially the first year.

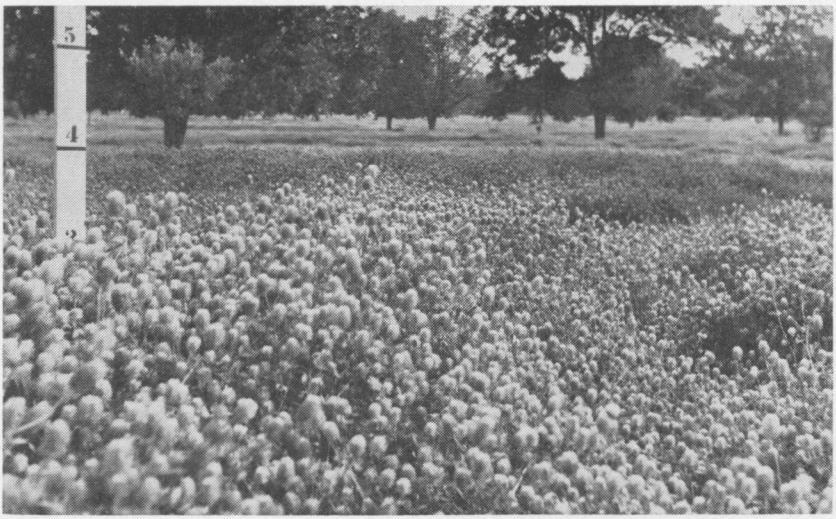

FIG. 10. This Yuchi seed field in a pecan orchard, photographed June 23, shows promise of a good seed crop after being grazed until early April.

made too much vegetative growth. The variety is a good seed producer and seed yields of 100 to 500 pounds per acre have been reported by farmers.

Several practices are necessary for satisfactory seed yields of Yuchi arrowleaf clover:

(1) Potential seed fields should be grazed during winter until early April. Failure to graze will often result in extremely heavy growth that mats down, rots, and produces only a small number of seed heads. Regrowth after grazing in a seed field under pecans is shown in Figure 10. Thin stands of clover or late planted clover may give little or no grazing but often are the most productive seed fields.

(2) Fields need to be checked carefully for dodder (*Cuscuta* sp.), and any present should be removed. Dodder seed are extremely difficult to separate from Yuchi arrowleaf clover seed since both are of similar size and have rough seed coats.

(3) Bees are essential for pollination. If not enough native bees are present, one colony per acre should be placed in the seed field.

(4) Seed harvest should be started in late June when weather is usually sunny, dry, and hot. July is generally a wet month in Alabama, making seed harvest difficult and sometimes impossible. Yuchi continues to flower and the stems may remain green much

FIG. 11. Being combined in mid-July, Yuchi still has some immature seed heads.

of July, even though there is a heavy crop of mature seed heads, Figure 11. Drying of the plant material can be done by cutting and swathing, but some seed losses may occur with this method. Dessicants are more effective and permit direct combining of the dry plants 2 to 5 days after application. (See section on dessicants.)

Weed Control

Weeds present a major problem in the culture of Yuchi arrowleaf clover. Broadleaf winter weeds are usually the most troublesome. Annual winter grasses often occur but seldom offer any serious competition. Curly dock (*Rumex crispus*), cutleaf evening primrose (*Oenothera lanciniata*), pepperweed (*Lepidium virginicum*), and camphorweed (*Heterotheca subaxillaris*) comprise a group of the most important ones. Henbit (*Lamium amplexicaule*), carolina geranium (*Geranium carolinianum*), and little barley (*Hordeum pusillum* Nutt) are also often found in Yuchi arrowleaf.

Weeds are particularly bothersome during clover establishment.

TABLE 10. WEED CONTROL AND FORAGE YIELD OF YUCHI ARROWLEAF CLOVER AS AFFECTED BY PREEMERGENCE HERBICIDE TREATMENT, AUBURN AND PRATTVILLE, 1969

Herbicide, pounds per acre active	Weed control,[1] Prattville	Dry forage per acre	
		Auburn	Prattville
	Pct.	*Lb.*	*Lb.*
DCPA, 4.0	65	3,300	3,380
DCPA, 8.0	90	2,880	3,240
DCPA, 12.0	90	2,580	3,720
Chlorpropham, 2.0	55	950	3,890
Chlorpropham, 4.0	70	220	3,150
Chlorpropham, 8.0	95	0	3,090
Benefin, 0.5	80	1,620	4,150
Benefin, 1.0	80	540	3,890
Benefin, 2.0	80	0	2,670
Check	0	2,780	3,720

[1] No weeds at Auburn because of non-uniform weed populations.

Weed seeds will often germinate ahead of the clover, when plantings are made during relatively dry periods. Especially when given the initial competitive advantage, weeds cause severe reduction in yield of forage and seed.

DCPA (Dimethyl tetrachloroterephthalate), benefin (*N*-butyl-*N*-ethyl-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine), and chlorpropham (isopropyl *m*-chlorocarbanilate) have shown the most promise for preemergence weed control in Yuchi arrowleaf, Table 10. DCPA and benefin are primarily grass herbicides but give some control of small seeded broadleaf weeds. Chlorpropham is effective against annual grasses and many broadleaf weeds at 4 pounds per acre. Usually cool weather during weed control period favors results with this herbicide.

None of the herbicides (except the 2 pounds per acre of benefin) mentioned in Table 10 caused any injury to Yuchi arrowleaf at Prattville. At Auburn, chlorpropham and benefin caused substantial injury. The major factors contributing to the greater injury at Auburn were lighter textured soil and a severe drought during the 12 weeks after herbicide application. When moisture did become available, temperatures were unfavorable for good growth. Consequently, the clover made no appreciable growth until mid-spring.

Dessicants

Dessicants may aid in drying plant material sufficiently for rapid seed harvesting at an earlier date, thus increasing seed saved. At the Prattville Experiment Field over a 2-year period,

TABLE 11. EFFECT OF DESSICANTS ON DRY MATTER CONTENT OF YUCHI ARROWLEAF CLOVER, PRATTVILLE EXPERIMENT FIELD, 1968 AND 1969

Dessicants, pounds per acre active[1]	Dry matter content of plants			
	1968		1969	
	2 days	5 days	2 days	5 days
	Pct.	*Pct.*	*Pct.*	*Pct.*
Paraquat, 0.5	86	90	69	68
Paraquat, 0.75	84	88	64	66
Endothall, 0.75	68	88	59	60
Sodium cacodylate, 3.0	77	90	58	62
Glytac (diesel), 1.5	72	90	64	74
DNBP (diesel), 1.5	88	96	73	76
Check	76	79	54	54
Cut and windrowed	----	----	96	92
At application	*66*		*56*	

[1] Applied June 26 in both years.

dessicants were applied June 26 and seed harvested 2 and 5 days after application, Table 11. Dry matter content of the clover was determined at time of application and at each harvest date. Severe drought in 1968 reduced moisture content of the plants to a lower level at application time and caused faster drying than in 1969. Seed yields averaged 240 pounds per acre in 1968 and 440 pounds in 1969. Seed germination was not affected by any of the dessicants in these experiments.

Dinoseb (2-*sec*-butyl-4,6-dinitrophenol) in diesel oil was one of the most effective dessicants in both years. Paraquat (1,1'-dimethyl-4,4'-bipyridinium) and Glytac [ethyleneglycol bis (trichloroacetate)] in diesel oil also caused fairly rapid drying. Sodium cacodylate (arsenic acid) and endothall (7-oxabicyclo [2.2.1] heptane-2,3-dicarboxylic acid) resulted in slower drying. However, none of the dessicants caused plants to dry as rapidly as cutting and windrowing. The latter treatment likely may result in a greater seed loss than when the clover is combined directly.

Bees

Yuchi arrowleaf clover requires bees for seed production. In two 1969 tests in central Alabama, a honey bee colony was placed in the center of clover fields. Seed per head were counted in 100 seed heads collected at various locations in the fields, including those from plants in a screen cage that excluded bees. Numbers of seed per head from the caged areas were 0 and 3, whereas heads outside the cage had 96 seed per head at one location and 49 seed at another. No difference was noted in distance from the

bee colony. The large number of native bumble bees present in both fields was probably sufficient to pollinate the clover.

DISEASES AND INSECTS

No serious disease problems have been encountered with Yuchi arrowleaf clover. It is susceptible to crown and stem rot (*Sclerotinia trifoliorum*) like other clovers, and stand losses may occur during warm, wet, winter periods. The problem is more severe where a heavy accumulation of forage occurs. Grazing the clover to remove surplus growth and permit light to penetrate the sward will reduce disease losses.

Yuchi arrowleaf is remarkably resistant to insects that attack many other legumes. Clover head weevil (*Hypera meles*) causes severe seed losses in crimson clover but has little effect on Yuchi. Weevil counts made weekly during late spring at the Plant Breeding Unit showed populations were much lower on Yuchi than on ball or crimson clovers.

Alfalfa weevil (*Hypera postica*) numbers have been extremely low on Yuchi arrowleaf clover adjacent to mike clover that was severely damaged by large numbers of weevils *(4)*. Little or no alfalfa weevil damage has been noted on leaves of Yuchi as compared to severe damage on alfalfa.

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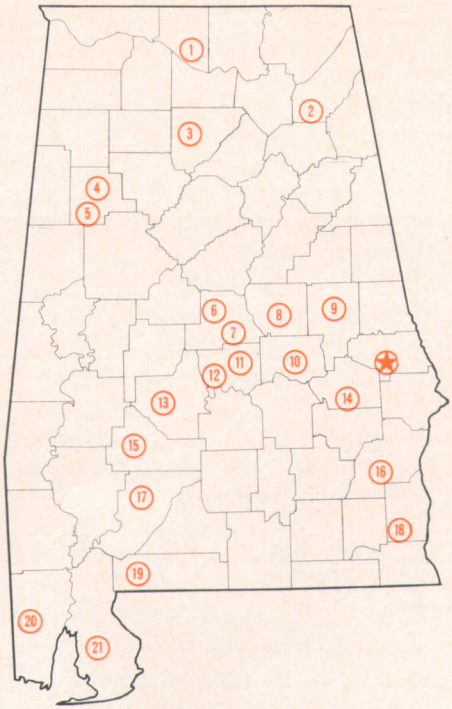
AGRICULTURAL EXPERIMENT STATION SYSTEM OF ALABAMA'S LAND-GRANT UNIVERSITY

With an agricultural research unit in every major soil area, Auburn University serves the needs of field crop, livestock, forestry, and horticultural producers in each region in Alabama. Every citizen of the State has a stake in this research program, since any advantage from new and more economical ways of producing and handling farm products directly benefits the consuming public.



Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.