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Pastures For The Coastal Plain of Georgia

by

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PASTURES FOR THE COASTAL PLAIN OF GEORGIA[1]

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In many respects the Coastal Plain of Georgia is well suited to livestock production. The mild climate, long growing seasons, and great variety of feed crops produced on sandy soils which permit grazing without injury to the land, are all advantageous to cattle production.

Native grasses are not satisfactory for improved permanent pastures because they do not stand up under grazing, are not nutritious, or they offer good grazing for only a short period. In an attempt to improve permanent pastures it has been necessary to bring in introduced grasses and legumes adapted to our climate and soil and to work out cultural practices or methods of handling to control weeds and get maximum results.

Under average unimproved range conditions 5 to 10 or even 15 acres of land are required per animal. Grazing is good during April, May and June, and the cattle become fat and sleek. By July the native grasses are becoming tough and continue to be less palatable up to November. During November, December, January, February and March there is practically no grazing and relatively poor browsing. At this period the cattle become thin and require running in the fields, or some stored feed. Cattle cannot graze dead grass in the field to advantage as in dry climates because fall and winter rains soon leach out practically all soluble nutrients.

Fortunately some introduced grasses are hardy and are giving excellent results, among the more important being Bermuda grass, carpet grass and Dallis grass. These grasses have so completely established themselves as to be almost considered native plants.

Grazing offers the cheapest form of stock feed known and it is the principal form of feed for the greater part of the year, in fact grazing is the foundation of the livestock industry.

Improved pasture may be broadly defined as any artificial change from the natural state which tends to increase the amount and quality of grazing. The amount of improvement will determine the increased grazing to be had; sowing carpet grass seed on undisturbed ground is a step toward improvement, but the grazing results will be many times below a thoroughly harrowed, drained and fertilized soil planted to a grass and legume mixture.

There are relatively few improved pastures at present so that most farmers will have to start from the beginning, and gradually improve as time and money permit. The following steps appear logical toward this goal.

(1) Fence the entire farm, for by doing this one is able to utilize what is already there. Many native grasses and plants are palatable and, although

[1]Investigations conducted by the Georgia Coastal Plain Experiment Station in cooperation with the United States Department of Agriculture, Division of Forage Crops and Diseases, Bureau of Plant Industry.

the carrying capacity is low and the grazing period short, the only expense involved is fence. Grazing is not the only advantage, for the woods area is kept cleaner and danger from forest fires reduced when grazable plants are kept down.

(2) Start pasture improvement on favorable "patches" that are easiest and cheapest to improve. Select places that are already comparatively free from timber, and that have about the right amount of moisture naturally present without the added cost of drainage. Simple ecology or the study of plants growing naturally on land will assist greatly in helping select a suitable site for improving pastures. For example, in selecting a site for lowland pastures a good indicator in South Georgia is vigorous growing gallberries, *Ilex glabra*. This plant grows vigorously only on a rich, moist soil or the same soil that is ideal for lowland pasture. Scrub oak bushes are an indication of a deep dry sandy soil not suitable for pasture. Pitcher plants, *Sarracenia* spp., indicate that the soil is waterlogged and too wet for pasture unless drained. Prepare the land well before seeding for it will pay in the long run.

(3) Highly improved pastures will call for drainage in some areas. Fertilizing with 500 to 600 pounds of a high grade complete fertilizer per acre will, roughly speaking, double the grass yield, while legumes will be increased even more.

NATIVE GRASSES

Some of the most important native grasses for grazing are wire-grass (*Aristida* spp.), broom sedge (*Andropogon* spp.), tickle grass (*Panicum* spp.), Vasey grass and bull grass (*Paspalum* spp.), and crab grass (*Digitaria* spp.). In addition to the above there are maiden cane and various swamp grasses, numerous weeds and twigs of bushes and also hundreds of sedges which on the whole are not very palatable.

Wire Grass: Of the native grasses, wire-grass (*Aristida stricta*) is the most abundant and wide-spread, growing vigorously in the cut-over pine woods, in the edge of swamps and on the hills. It is a perennial and grows in dense bunches. The leaves are very narrow, long and tough when mature. Good grazing is furnished for only about three months in early spring. This grass is responsible in large measure for the burning over of the woods so common during the winter. Burning the grass in fall and winter is often practiced in pastures to hasten the spring grazing and to get the dead grass out of the way so that cattle may readily get to the palatable and nutritious new grass leaves. The grass burns easily and with much heat, which does not appear to harm the grass but does great damage to young pines.

Broom Sedge (*Andropogon virginicus*) is a true grass and not a sedge. It is an upright bunch grass that comes most abundant in old fields where cultivation has ceased. Usually by the third year after cultivation has been stopped the stand is almost perfect. Broom sedge attains a height of 2 to 4 feet and burns readily during winter. Its burning is responsible for many abandoned fields failing to become reset to pines. Although fairly palatable to cattle when young, it becomes tough and woody during the latter part

of summer and in the fall. Broom sedge cannot stand heavy grazing and the best way to rid a field of it is to either break it with a turn plow or graze.

Andropogon tener is quite common especially on some of the heavier soils of South Georgia. It has fine stems and leaves and is sometimes called field wire-grass. This grass gives fairly good grazing in early spring but becomes tough by mid-summer. It goes out under continuous heavy grazing.

Miscellaneous Grasses: Many species of *Paspalum* are scattered over the Southeast. Of these the two most important are possibly Vasey grass, *Paspalum urvillei,* and bull grass, *P. boscianum.* These grasses are very palatable but do not stand up under continuous grazing.

Panicum spp. are quite common and widely distributed. They are generally palatable but do not stand intensive grazing.

Crab grasses, *Digitaria* spp., both native and introduced, are common. Most of these are palatable but do not give much grazing.

Weeds such as pursley, *Richardia scabra,* and ragweed, *Ambrosia* sp., are palatable but are not important as grazing plants.

INTRODUCED GRASSES

Bermuda Grass (*Cynodon dactylon*) probably came from India or the Mediterranean region. Because of its sod-forming habit and palatability it is good for grazing and makes excellent hay. It is one of the most important grasses in preventing soil erosion and is used extensively for lawns. It is a hot-weather loving plant and will stand considerable drought, but is damaged by severe freezes. This grass is palatable and nutritious even after frost until rains have leached the leaves. Bermuda grass is so aggressive as to be a serious pest in cultivated fields. Many farmers look upon it with disfavor for this reason but that is the price that has to be paid for an aggressive grass and these are the very qualities that make it so valuable as a pasture plant and soil protector. The grass is a perennial creeping plant that spreads by seed, rhizomes and stolons. In South Georgia only a small number of seed are viable. Once started in fields the rhizomes spread when being plowed through. Cultivation is a great boon to Bermuda grass, and turning the land helps rather than destroys it. Sod left undisturbed for several years tends to become "sod bound," that is, the runners creep along the surface of the soil, the roots are shallow, sod becomes spotted, competition from weeds is stronger which results in reduced grazing. When in this condition serious damage may result to the grass from drought. Bermuda grass is primarily an upland plant of cultivatable fields. It responds readily to commercial fertilizer and stable manure.

The very name Bermuda grass causes the average farmer to hesitate to give any quarter or encouragement to such an arch enemy in cultivated fields; however, it can be controlled. Its weakest point is that of shading. By proper rotations which include heavy shade to the soil during the summer the grass can be almost completely eliminated in two to three years. Some of the best shade crops include velvet beans and sweet potatoes. Turning or plowing and harrowing the land shallow in dry weather helps

to reduce the sod but is not so effective as a series of good shade crops and also requires more work.

Tift Bermuda Grass (*Cynodon dactylon*) is a selection of a possible natural cross of Bermuda grass. In 1929 one plant was found growing wild on an old farm in Tift County. The increase has been vegetatively from the one plant.

Tift Bermuda is characterized by rapid growing, rather long and slender stems and leaves. There are usually very few seed heads produced. Underground stems are few but large. It is very hardy and in a good sod stands up 18 to 24 inches high. In addition to being a good pasture plant it has demonstrated its possibility of becoming a hay plant.

Cynodon spp. P. I. Nos. 105933 and 105935, recently introduced Bermuda grasses from South Africa, are similar in growth habit and yield to the Tift Bermuda. These new grasses are very promising.

Carpet Grass (*Axonopus affinis*) seems to have originally come from the West Indies about 100 years ago. It is hardy and well adapted to lowlands of the Coastal Plain. It is a creeping perennial which makes a dense sod. Stolons run along the surface of the soil and take root at the joints, with no underground stems, so it never becomes a pest in cultivated fields. Turning under the sod easily kills this grass. Carpet grass may be identified in the pasture by its creeping habit, flat stems and blunt pointed leaves. This grass is a moisture loving plant and is therefore well adapted to a considerable portion of the Coastal Plain low "flat woods" sandy soils, though not swamps or soggy land where seepage is continuous. Land wet enough to produce pitcher plants is too wet for carpet grass pasture sod unless drained. Although carpet grass plants are sometimes seen growing on high land, the sod is scattering and growth is slow. The plants mature an abundance of viable seed and its population is increasing rapidly. Even in the most remote "cut-over" pine lands small patches of carpet grass are found along the trails and turpentine roads. Cattle that roam such areas seek out these patches of carpet grass and graze them closely.

Carpet grass will stand some shading but best growth takes place in open timber and where competition is not too direct with gallberries, palmetto, or dense stands of wire-grass. It is very palatable and cattle make good growth on it; however, it is not nutritious enough to produce finished animals. Cattle cannot eat enough of the grass alone to make them fat. Carpet grass becomes tough in late summer when seeding and is not very palatable at that time unless it is kept grazed close.

The cheapness and abundance of carpet grass seed and its hardiness make it one of the easiest grasses to grow, and it is being used for planting on fire breaks in forests but fire breaks planted to carpet grass and grazed are not as effective as clean cultivated breaks. During extreme dry periods a fire can creep across, if not prevented; however, the plan is to be encouraged because the added grazing is of much benefit to cattle and the grass will gradually spread. When possible it is desirable to have carpet grass replace wire-grass in open timber land not only for the grazing advantage but because grazing reduces the fire hazard and even when

burned, carpet grass gives off less heat and therefore does less damage to trees.

Hogs should not be allowed in a lowland carpet grass pasture, as they damage the sod and also the hogs become infested with worms in this kind of environment.

Dallis Grass (*Paspalum dilatatum*) was introduced from South America probably around 1875. It is gaining in popularity because of hardiness, long growing season and the palatable and nutritious grazing it affords. Dallis grass is a perennial and grows in sprawling clumps or bunches. It is many branched, and the leaves are long and sharp pointed. The grass seeds abundantly but the viability is low due to ergot disease (*Claviceps paspali*) which attacks and weakens or destroys the seed. Because of the semi-bunch type plant and poor seed germination this valuable grass does not spread rapidly.

Dallis grass requires a moist, though not wet, soil. Best growth is obtained where organic matter is abundant. This grass never forms a dense sod but grows in patches with open spots between, which habit makes it an excellent companion grass to mix with other grasses, clovers or lespedezas. It is somewhat difficult to get a perfect stand of Dallis grass when seeded alone.

Bahia Grass (*Paspalum notatum*) which is kin to and slightly resembles Dallis grass, was introduced from South America. Ordinary Bahia grass is less winter hardy than Dallis grass but survives in the lower Coastal Plain, except under very adverse conditions. There are winter hardy strains which are being tested.

Bahia grass will probably be used in increasing amounts as hardy selections are developed.

Ribbed Paspalum (*Paspalum malacophyllum*), introduced from Brazil, somewhat resembles Dallis grass but with finer stems and more erect growth habit. This grass produces an abundance of good seed that can be harvested with a combine. The grass is adapted to upland and is very palatable. Tests are now under way to determine its grazing value and management.

Para Grass (*Panicum barbinode*) probably came originally from Africa, but is now widely grown in Central and South America, also in the extreme southern part of the United States. Tifton, Georgia, is about the northern limit of growth. Para grass is very rapid in growth, and gives nutritious and palatable grazing where conditions are suitable. It is adapted to moist soils rich in organic matter. The future value of this grass depends on winter hardy selections yet to be made, and therefore is not recommended at this time.

Woolly Finger Grass (*Digitaria pentzii*), with several other species, were introduced from Africa. It is a perennial crab grass that grows in compact bunches and spreads by stolons. Many seed heads are formed, but very few seed develop. Propagation at present is almost entirely vegetative.

Grazing carried on with the above species has shown that this grass is winter hardy, palatable and nutritious.

Woolly finger grass is an upland plant which requires care and cultivation while being established. Until tested further, woolly finger grass is not recommended for pastures.

Italian Rye-Grass (*Lolium multiflorum*) or common annual winter lawn grass is sometimes used for temporary grazing. About 50 pounds of seed are required to plant an acre of pasture land. Seed should be sown in September or October and have to be planted every year.

For best growth, rye-grass requires plenty of moisture and a very rich soil. Indications are that it is not satisfactory for grazing on the average South Georgia soils. It is sometimes seriously damaged by rust in the spring.

Napier Grass (*Pennisetum purpureum*) is a native of Africa. It is a large perennial cane-like grass growing to around 15 feet with stems nearly one inch in diameter. It is very palatable and has long been used by dairymen for summer temporary grazing. Napier grass requires rich soil and cultivation. It should not be grazed continuously, and only disease resistant strains should be used.

Centipede Grass (*Eremochloa ophiuroides*) was introduced from China about 1917. It is a vigorous growing upland grass with creeping stems that root at the joints. It forms a very short, close, dense sod and seeds in abundance. This grass makes a good lawn but grazing results have been extremely poor. It is not recommended for this section even for lawns unless care is taken to prevent its spread into grazing areas where it is considered a pest.

LEGUMES IN PASTURES

The value of legumes in a permanent pasture can hardly be overestimated. By including legumes, the grazing period is extended, the quality of forage is improved and the associated grass is benefited and the soil enriched by the addition of atmospheric nitrogen. Only a limited number of legumes are adapted to the Coastal Plain.

LESPEDEZAS

Common Lespedeza (*Lespedeza striata*) is the most widely adapted pasture legume, and should be used in mixtures for both lowland and upland pastures. Lespedeza originally came from the Orient, possibly about 1830, and has long been known in Georgia as a good grazing plant. Common lespedeza is an annual, small and many branched plant that tends to flatten out and stay close to the ground. Leaves are divided into three lobes somewhat like the true clover. Seed germinate early in the spring during warm spells, even before frost ceases. Light frost does not appear to damage the young plants hidden away in grass and leaves, but late freezes sometimes do serious injury to the early crop. Fortunately the seed do not all germinate at one time and the later plants produce a crop.

Lespedeza requires plenty of moisture for best growth, however, it should not be planted on soggy land. Young lespedeza plants develop slowly in the spring until hot weather arrives. Plants are generally too small to give much grazing before about the first of July, but from this time

on excellent feed is furnished until frost when the plants are killed and the leaves quickly fall off. Common lespedeza reseeds well and if not grazed too close or crowded out by a very thick grass sod it will continue to reseed itself.

When planted in a mixture containing carpet grass or some other dense sod forming grass, lespedeza will eventually be crowded out but up until that time, from three to four years, it furnishes excellent grazing. When planted on a thick sod it is advisable to tear up the sod slightly in order to give the lespedeza a start. This can be done by partially cutting with a disk harrow. The addition of phosphate appears to increase the ability of lespedeza to compete in a grass sod.

Common lespedeza in South Georgia is most too small to be used as a hay plant. The seed should be planted in March. When sown in connection with a pasture mixture, 10 to 15 pounds per acre are sufficient but when sown in oats and the lespedeza is to furnish all of the late summer grazing, 25 to 30 pounds of seed per acre should be used. No inoculation appears to be necessary.

Kobe Lespedeza (*Lespedeza striata*) is a large growing selection or strain of the same species as common lespedeza. This plant is not as well adapted for pasture planting where reseeding is desired as the regular common lespedeza because it is more upright and under heavy grazing is kept down too low to seed well; however, many farmers prefer this variety and count on plowing and replanting every year. Kobe lespedeza is a good hay or grazing plant and gives good yields when planted on land moist enough for its requirements.

Tennessee 76 (*Lespedeza striata*) is also a large upright type of common lespedeza. It is a heavy vegetative yielder suitable for hay or grazing. When grazed close it does not reseed satisfactorily.

Korean Lespedeza (*Lespedeza stipulacea*), while an excellent plant farther north, is not as desirable in Coastal Plain pastures as the common lespedeza. There is not much difference in actual size as compared to common lespedeza and it is fairly hardy but the main objection is its early maturing habit. Korean lespedeza matures in October which is about a month earlier than common lespedeza. It is highly desirable to have lespedeza furnish grazing right on up to frost, that is, extend the grazing period as long as possible which makes common lespedeza a more desirable pasture plant than Korean.

All of the above lespedezas are annuals, therefore, they produce their entire growth, mature seed, and die each season. The following year's growth comes from seed.

Lespedeza sericea is a perennial which develops from new growth coming from the same root each year. This lespedeza has a well developed root system and will grow on drier soils than the annual lespedezas. No inoculation of seed seems necessary but it is desirable to scarify the seed in order to get quick and uniform germination. Seed should be planted around the first of April. Five pounds of scarified seed in two-foot rows or 15

pounds when sown broadcast will plant an acre. Seed should be covered very shallow, or packed into the soil with a roller.

The first year's growth of *Lespedeza sericea* is very slow and the young plants may be covered by weeds, however, they stand shading well. By the second year, plants are well established and growth starts in late February. *Lespedeza sericea* has not proved very satisfactory in South Georgia. It is not very palatable for pasture or as hay.

TRUE CLOVERS

White Clover (*Trifolium repens*), commonly called white Dutch clover, is a creeping plant which seeds abundantly. It may be an annual or a perennial even in the same field because some plants die while others continue to remain throughout the summer.

White clover requirements are somewhat exacting but when conditions are favorable to its growth it is a very desirable pasture plant. Results at the Experiment Station have shown that it does better when grown in combination with grass than when planted alone.

Most favorable conditions appear to be moist soil rich in organic matter and in a permanent sod. Lack of phosphorus seems to be more of a limiting factor than lime. Inoculation of seed is desirable but not absolutely necessary.

White clover is a cool weather loving plant. Growth starts in the fall in September and October and continues through the winter and spring. Unless there is considerable severe cold, growth is rapid and some grazing may be had in February. March, April and May are the months in which it blooms and, where the stand is good, the pasture is almost solid white with flowers about 10 to 12 inches above the ground. Viable seed set in abundance and appear to go through cattle without injury to the seed for much spreading occurs this way. When hot summer weather sets in, white clover is mature and although scattering plants can be seen all summer they are really going through their rest period preceding starting of growth in the fall.

White clover increases the quantity and quality of grazing. The soil is improved and the grazing period extended. It competes very little with the grasses for sunlight, plant food or moisture. A broadcast planting of 3 to 5 pounds of seed per acre in a sodded pasture is sufficient because it produces good seed crops and spreads rapidly. While good stands have been secured in one year it often takes two to three years for clover to become established. When planting clover on a sod it is always best to have the sod close grazed or clipped short. When seeded alone on a sod it should be planted in September or October, but good results have been had by including it in the "pasture seed mixture" and seeding in the early spring. Southern grown seed are preferable.

Low Hop Clover (*Trifolium procumbens*) is being tested extensively. Not enough data have been gathered to offer any recommendations, for it appears to have some special requirements. It grows best on upland in Bermuda grass sod.

Various other clovers are also being tested, which include *T. dubium, T. glomeratum, T. resupinatum, T. incarnatum* and others.

BUR CLOVERS

Tifton Bur Clover (*Medicago rigidula*), Southern bur (*Medicago arabica*), black medic (*Medicago lupulina*) and others are sometimes used in pastures to advantage. Experimental trials have shown that these plants are more or less restricted in range. Success has not been had often enough to recommend them for widespread plantings. One objection is that winter growth is fairly slow and not much grazing can be expected before late March or early April. Therefore, the grazing period is not greatly extended by their use.

True clovers and bur clovers require patience for their establishment. A combination of the following factors is important.

(1) Most clovers adapted to this section do better when planted on a short sod than when planted on fallow soil.

(2) Most clovers require an abundance of plant food to get established. In starting clovers it is desirable to use a 6-12-6 or 4-8-4 fertilizer and stable manure. The stable manure is not only a good fertilizer but helps to increase inoculation rapidly. After clover is well established, fertilization may be reduced to an application of phosphate every two or three years.

(3) Thorough inoculation takes time, which means that clovers should be grown on the same land for at least three years before complete inoculation can be expected.

KUDZU

Kudzu (*Pueraria thunbergiana*) is a perennial woody legume vine introduced from Eastern Asia. It is now fairly common in the Southeast and is often seen along highways, and is used for porch shade on dwellings. On old vines, purplish flowers are produced in clusters from which usually only a small amount of seed develop. Most seed are imported.

Kudzu appears best adapted to the heavier types of well drained soil but can be grown under a wide range of conditions.

It has long been known that kudzu prevents erosion and gives good grazing, but some trouble has been had in keeping the plants from eventually "going out." It has been found that this can be prevented under proper management. Alternate grazing has been practiced to advantage; however, this is not absolutely necessary.

Land should be prepared for kudzu in the latitude of Tifton by turning in early February. Furrows may be opened four to six feet apart and checked if desirable so as to cultivate both ways. One to two gallons of stable manure should be placed in each hill. It is absolutely essential to get the plants started off vigorously because not only is quicker grazing obtained but healthy kudzu plants choke out competing weeds and grass. Crowns should be set so as to bring the roots in direct contact with the soil, and be covered deep enough so that only a bud or two show above the ground.

Propagation is usually done by crowns. Plants should be set in late February before spring growth gets underway. Plantings made after growth is well underway usually result in a poor stand.

During the first year, two or three cultivations are necessary to keep back weeds and grass. Kudzu vines grow so rapidly that plowing will have to be stopped before the summer is over. By the end of the first season the ground should be covered with vines. No grazing can be had the first year and should be very light or none at all during the second year so as to get the crowns well established. By the third year, provided the plants are well established, the field should carry one animal per acre the entire season.

Caution should be used not to over-graze. Never graze more than one animal per acre when the pasture is being grazed continuously. The field may appear to be able to carry twice as many animals, but plant food is manufactured in the leaves and stored in the roots and, if leaves are grazed too close, the roots will be starved.

Kudzu vines when in contact with the soil take root at the nodes and after two or three years under favorable conditions the field is a solid mat of vines.

After five or six years of grazing it may be noted that the vines tend to become smaller and weaker and that there is a tendency for the stand to thin out. It has been found that the growth can be invigorated by applying two to five tons per acre of stable manure during the winter, then in late February, when crowns are ordinarily planted, to turn the field deep with a two-horse turn plow. This procedure not only loosens up the packed soil, but resets the plants and the manure gives new vigor. Grazing may be delayed the following season for two or three weeks.

No fertilizer tests have yet been conducted on kudzu at this Station.

One year, 1934, grazing had to be stopped about a month before frost because of army worm damage. These worms seem to prefer velvet beans and other crops more than kudzu and take it only as a last resort.

Kudzu is also a good hay plant. It will yield two cuttings per season of easily cured fine quality hay. The first two or three cuttings may be fairly difficult to rake because of rake teeth catching in large vines that have rooted at the nodes. A very satisfactory way to handle the viny hay is for three men to work together, two with forks and one with a machete or long knife to cut the vines apart. When handled this way it is comparatively easy to handle.

MISCELLANEOUS CROPS

Hairy vetch can be used as a grazing and cover crop. Many other crops suitable for hay or soil building can be grown in the Coastal Plain. Those mentioned in the preceding paragraphs are probably the most important ones at this Station.

ESTABLISHING LOWLAND PERMANENT PASTURES

Land Preparation: Land preparation for lowland permanent pastures is more difficult and expensive than for upland pastures. The problem includes the elimination of pine, black gum, gallberry, briars, palmettos, wire-grass, etc. The most economical procedure is to find suitable open areas and at first concentrate on them. However, if all of an area is to be improved, the first step is to remove or burn logs and clear out the underbrush, then take out undesirable trees. Except in very special cases the forest and pasture program should be worked together, and timber thinned but not destroyed. After underbrush is cleared away comes the land preparation. Turning the land is all right but usually this type of land contains so many stumps and roots as to make turning almost impossible. The best implement for this type of work is a heavy eight-disk harrow. Either a tractor or four mules are required to pull it when weighted and set to cut deep. The land should be cut from two to five times, depending on the roughness and the amount of gallberries, wire-grass, etc. Thorough preparation is time well spent because the preparation is only once, while the permanent pasture will continue for many years. Wire-grass not destroyed in the beginning will continue to compete with the introduced grasses for years to come. The work can be done during fall and winter when time can be used without loss to other crops and usually fall droughts facilitate work in low areas. Following the disk harrow should come the drag harrow to level the soil.

Sowing on land without any preparation is not recommended. Some improvement might be secured in patches by doing this, but competition with native vegetation will make the improvement slow and the sod will be expensive in the long run and not satisfactory.

Branch bottom land usually requires drainage. An open central ditch should be dug along the main drain. Sometimes it is necessary to dig side ditches paralleling the central ditch to cut off seepage water. These should be dug along the upper edge of the seep and not through the center. Seepage water comes from the hills on either side and must be cut off to dry the land. These lateral seepage water ditches should be around three feet deep and can be either open or tile drained. If tile drained, a four-inch tile will usually carry off the water. The tile must be laid to grade. The Experiment Station has had best drainage when a fall of 8 to 12 inches per hundred feet is given the tile. Fall should never be less than four to five inches per hundred feet. The tile joints should be covered on top with strips of 2x6 inch tar roofing, and a handful of cinders, if available, to keep the pipe from sanding until the soil is settled. If open ditches are used, the banks should be sloped. A ditch three feet deep and 12 to 18 inches wide in the bottom should be five to six feet wide at the top. If this slope is not given, sandy banks will cave and soon obstruct drainage.

Seeding: Seeding can be done any time from fall until spring but the best time to seed is during March. When seedings are made in the fall, the heavy winter rains wash the small seed into the low places before spring and the result is a spotted stand. Seed should be sown just before

time for them to come up so that they will soon germinate and the plants anchor themselves to the soil. Seedings made in late April are likely to germinate and the young, poorly established plants be killed by May and June dry weather. It is desirable to pack the seed into the soil with a log roller or cultipacker rather than drag them in with a drag harrow because dragging in seed will cover many of them too deep.

Pasture Mixture: Generally speaking, it is more desirable to have a plant mixture in a pasture rather than any one plant alone. The reason for this is that each plant has its special growing season and all plants of that species start growth, develop and mature at about the same time. The pasture mixture spreads good grazing over a longer period of time. For example, the present lowland pasture plant mixture recommendation includes carpet grass, Dallis grass, common lespedeza and white clover. All of these plants are hardy and the combination not only gives a longer grazing period of tender vegetation but the feed will be more varied, give a better average of materials for growth and fattening assimilation and also induce better appetite.

In the above mixture the growing periods of the different plants vary widely. Carpet grass and Dallis grass start growth as soon as frosts permit in the spring, or during the latter part of March. Increased growth continues on up in the summer. By August these plants slow down in vegetative growth and become tough while seeding. Lespedeza seed germinate in the spring but growth is very slow until hot weather arrives. Usually it is July before the plants are large enough to give considerable grazing. Lespedeza continues to grow and give excellent grazing until frost in mid-November. White clover is a fall and winter growing plant, the growth starting in October and November. Growth is fairly slow during the extreme cold winter weather. Plants are not large enough to graze until late winter, the exact time being determined by the severity of the winter. During some seasons considerable grazing can be had the latter part of February. During severe winters very little grazing can be had before March 15, but this is at least 15 days earlier than carpet grass and Dallis grass will give much grazing under the same conditions.

It should also be borne in mind that lespedeza and white clover are legumes and not only tend to improve the grazing but also enrich the soil. Lespedeza gives valuable grazing, but experiments have shown that being an annual, and also having the same growing season as grass, it is eventually crowded out in a thick permanent sod. White clover has not yet, after ten years, showed any tendency to be crowded out, for it grows in the winter at a time when the grass sod is dormant.

The amount of seed mixture recommended per acre for planting a lowland permanent pasture is 10 pounds carpet grass, 8 pounds Dallis grass, 12 pounds common lespedeza and 5 pounds white clover. Of course this can be varied to meet special requirements.

All of the above seed can be thoroughly mixed and sowed at one time (in March); however, if clover alone is being added to an already estab-

lished sod, these seed should be planted in the fall (September or October) because this is a winter growing plant.

Sowing and Covering Grass Seed: Seed may be sown broadcast by hand or with a mechanical seeder. A quiet day is preferable because grass seed are light and cannot be handled well in wind. Better distribution of seed can be had by sowing one-half of the seed over the entire area, then taking the other half and sowing at right angle to the first seeding.

It is not necessary to cover the small seed, for it is an easy matter to cover them too deep. The first shower of rain or even wind will cover sufficiently. A firm seed bed is very important and rolling with a cultipacker or roller is desirable and to be preferred to using a drag harrow. A satisfactory log roller may be made from a green pine log around 12 inches in diameter and 6 to 8 feet long. Drive a ¾-inch by 10-inch bolt in each end. Hook the ring of an extra trace chain over each bolt so that the traces can be hooked to a 2- by 6-inch board to furnish hitch.

Grazing Newly Planted Pastures: Grazing volunteer weeds or grass can be practiced early in the seeding year without injury to young grass seedlings. Lespedeza is an annual plant and will give capacity grazing through its season during the first year.

Full grazing capacity from a new pasture cannot be expected before the third year. During the first year carpet grass, Dallis grass and white clover are getting established. Good growth occurs during the second year and considerable grazing may be had, but these plants have not become thoroughly established and the sod will still be patchy. By the third year the sod should be well established.

ESTABLISHING UPLAND PERMANENT PASTURES

Land Preparation: Preparing land for the upland pasture is usually a simple matter of converting a cultivated field into pasture. In such cases clearing and probably stumping are not involved. The land can be turned with a turn plow and harrowed level without trouble. If the land is rolling and tends to wash it should be terraced. If gullies are already present they should be manured and plowed in. Eroded and gullied land should never be expected to grow a good pasture any more than one would expect corn to grow without some soil improving practice. After all, corn and pasture grasses belong to the same family of plants so that land which makes a poor yield of corn will obviously make a poor yield of grass where fertility is the limiting factor.

Experiments at this Station have shown that Bermuda grass with lespedeza is one of the best upland pasture combinations yet found. Bermuda grass is found growing over most of the South and under widely different conditions. It is highly palatable to all livestock and is nutritious. Considering the widespread adaptation of Bermuda grass it is the most valuable grass in the South for upland permanent pastures, erosion control, lawns and, under certain conditions, as a hay crop.

On many poorly managed farms in the South, erosion has been retarded for a generation because Bermuda grass has crept in.

Bermuda grass requires special management for best results as a pasture. In the Coastal Plain soils it requires cultivation at intervals, otherwise it will eventually disappear. Tests conducted on plowing Bermuda grass show that it should be turned every two to four years. Sods left intact for seven years almost completely disappeared. Where the sod is turned every three years the following benefits have been derived:

(1) The Bermuda grass sod is kept in good condition and the roots kept deeper so that droughts will not seriously damage growth.

(2) Turning the soil increases water holding capacity.

(3) Manure droppings are turned under which improves the grass sod and prevents patch grazing.

(4) Turning the land reduces the number of mowings that are required to keep out undesirable weeds. A study of weeds growing in plowed vs. unplowed fields showed that the most common weeds growing in plowed fields were crab grass, *Digitaria* sp., pursley, *Richardia scabra,* ragweed, *Ambrosia* sp., sandspur, *Cenchrus echinatus,* primrose, *Oenothera lanceolata,* hogweed, *Erigeron* sp., toadflax, *Linaria* sp., coffee weed, *Cassia tora, C. occidentalis,* etc. Practically all of these weeds with the exception of hogweed and coffee weeds are palatable and therefore are grazed and not so objectionable. On the other hand in the unplowed area the dominant weeds in the area studied were bitterweed, *Helenium tenuifolium,* dog fennel, *Eupatorium* sp., camphor weed, *Heterotheca subaxillaris,* carpet grass, *Axonopus affinis,* wormseed, *Chenopodium* sp., and many others. It will be noted that most of these weeds are entirely or partially unpalatable with the exception of carpet grass. Carpet grass in an upland pasture of Bermuda grass is an undesirable plant and therefore a weed because it is not as palatable or nutritious as the Bermuda grass and also because carpet grass, although it will live on upland soils, gives an extremely low yield. Weeds of the unpalatable type are decidedly objectionable because in addition to not being palatable to cattle so that mowing for control is necessary, they compete with the palatable plants for sunlight, moisture and plant food. Palatable grasses cannot long stand this competition in addition to being grazed.

A plan worked out and suggested for handling Bermuda grass-lespedeza pasture is to divide the pasture into three parts and to turn one part each year about March 1. This plan is suggested because of labor distribution and also for a better distribution of grazing. Turning Bermuda grass delays grazing the following spring about one month. By turning only one-third of the field at a time, cattle have two-thirds of the pasture to graze while the turned area is becoming re-established. After growth gets under way cattle prefer to graze the turned area because there is no mixture of old dead grass to hamper grazing.

It is further suggested that where fertilizer is applied that it be made heavier and applied every third year instead of light applications every year and that the fertilizer be applied on the area to be plowed immediately preceding the plowing. After the land has been turned it is a sound practice to make a seeding of Common or Kobe lespedeza over the turned

area of about 12 to 15 pounds of seed broadcast per acre. This means that the lespedeza is seeded every three years to insure having a stand in the pasture and the seeding comes after flat breaking which covers volunteer seed too deep for them to come up.

Various experiments have been conducted on plowing, disking, subsoiling and scarifying a Bermuda-lespedeza sod. These tests have shown that while disking and scarifying a sod may benefit the Bermuda grass and allow a fair natural reseeding of lespedeza, it does not in any way control objectionable weeds, and also does not cover manure droppings or help the Bermuda grass as much as a thorough breaking with a turn plow.

The question often comes up about planting Dallis grass as a mixture with Bermuda grass. Dallis grass and Bermuda grass cannot be grown as a mixture satisfactorily because Dallis grass does not have rootstocks and would therefore be destroyed when the field is plowed as recommended for management of Bermuda sod.

Establishing Upland Sod: Bermuda grass can be planted from seed in March or early April using 8 to 12 pounds of seed per acre. Germination percentage of the seed should be known, for seed grown locally are usually of poor quality. Generally speaking, the best Bermuda grass seed come from the Southwest. When planted the seed should not be covered, but it is very desirable to roll them in and thus firm the soil so that the extremely small plants can obtain necessary moisture. At best it is difficult to get a uniform, complete stand from seed.

One of the best ways to insure a stand of Bermuda grass is by transplanting runners or rootstocks. Rootstocks may be planted by turning the land and following the turn plow every third or fourth round and dropping runners in the furrow at each step or about three feet apart. The following list of the turn plow will cover the rootstocks very satisfactorily. Rootstocks may be obtained from some cultivated field where they are not desired, thereby doing two jobs at one operation.

After trying various methods of establishing a Bermuda grass sod the following method is being recommended where a good sod is wanted in a short time:

Break and harrow the field level. Lay off rows 2½ to 3 feet apart with four-inch scooter plow. Drop runners in the furrow at every step or about three feet apart and step on the dropped runner in passing, thus firming it in the furrow. List on the furrow with double foot plow, throwing the dirt to center and covering runners completely.

The Bermuda grass rows are then cultivated about two times during the summer similar to any other crop. The cultivation not only stimulates Bermuda plants but controls weeds while the young grass plants are becoming established. It is further suggested that the grass be top dressed with nitrogen two times during the first summer. Top dressing can be applied, a teaspoonful to each plant, as fast as a man can walk and requires only about 75 to 100 pounds of nitrate of soda or similar material per acre for the two applications. This method, although tedious sounding, is not so

troublesome or expensive because it can be done rapidly. By following this method, a complete sod can be had in one year.

Whether starting Bermuda grass from seed or runners it is generally desirable to defer planting lespedeza until the following spring because it would compete with small Bermuda seedling plants or would be destroyed where rootstocks are cultivated.

When plants like Bermuda grass are set by runners or rootstocks, the plantings can be made either in April or during the latter part of June and in July. The latter months will usually be the beginning of the summer rains. April plantings are preferred because plantings made at this time get an entire summer's growth.

WEEDS

As previously stated, some weeds are palatable. Such weeds are not serious pests because they can be partially controlled by grazing and they tend to go out as cultivation ceases. Some plants representative of this class include pursley, *Richardia scabra,* crab grass, *Digitaria* spp., ragweeds, *Ambrosia artemisiifolia,* etc.

The seriously objectionable weeds are those which are not palatable and have to be controlled by mowing, pulling, etc. In upland pastures representative weeds of this type are bitterweed, *Helenium tenuifolium,* dog fennel, *Eupatorium* sp., camphor weed, *Heterotheca subaxillaris,* etc. In lowland pastures weed pests most commonly observed include water ivy, *Dichondra* sp., perennial dock, *Rumex* sp., thistles, *Cirsium* sp., smartweed, *Persicaria* sp., nettle, *Solanum* sp., sedges and rushes of the families *Cyperaceae* and *Juncaceae.* Some of these are extremely difficult to eradicate.

All of the above weeds are troublesome in the permanent pasture. Frequent mowings to keep these plants from shading the grass and prevent the weeds from forming seed is the cheapest method of control of most weeds. Weeds should be mowed when in the early flower stage. It is best to follow the mower the following day with a hoe and cut any scattering plant left by the mower, for a few plants left will reseed the pasture. Where weeds are exceptionally bad, three or four mowings a year may be necessary. Weeds like the treadsalve or bull nettle and smartweed are impossible to control with the mower alone. These weeds have to be destroyed with the hoe following the mowing operation.

SCATTERING MANURE

On intensely grazed pastures, manure droppings may become so thick that grazing is considerably reduced, for cattle will not graze close around them. On Bermuda grass sod the land may be turned to advantage. On carpet grass and Dallis grass where turning would be injurious to the grass the pasture may be gone over with a weighted drag harrow and the droppings scattered. This can be accomplished best after a rainy period when the droppings have softened enough to be torn up.

EXPERIMENTAL METHODS

Grass Nurseries: The Coastal Plain Experiment Station maintains a nursery or "grass garden" for introduced grasses. Hundreds of grasses of all types from various parts of the world are planted and grown. The object is to determine their value in the Coastal Plain. The first problem is to find if they are hardy and, if so, later tests include the effects of fertilizing, burning and clipping. Records are kept on growth, winter hardiness, freedom from disease and insects, the plant's reaction to drought, and whether or not seed are produced which germinate satisfactorily.

In the grass garden a great number are discarded as unworthy of further tests, but those showing promise are increased and transferred to a larger area, a part of which is grazed. Many grasses are grown in plots side by side. At intervals throughout the summer, cattle are allowed to graze the fenced area. Animals are observed and records kept on the grasses which they prefer as well as those refused. This is done on each grass for three to four years. At the end of this time a comparison is made of grazed and ungrazed areas to determine if the grass will stand up under grazing. Grasses that show up well under these tests are further increased and later planted in a regular pasture on which animals are weighed and actual gains in pounds of beef recorded.

Pasture Experiments: The grazing test pastures at the Experiment Station are divided into upland and lowland pastures. The upland pastures are Norfolk sandy loam and Tifton sandy loam soils. Lowland pastures which have been cleared, stumped and drained are principally Plummer sandy loam, drainage consisting of both open and tile ditches.

All land to be planted is thoroughly prepared by plowing or disking and harrowing. Only enough trees are left to furnish shade. Clean water is provided for all pastures. The plots are divided into six-acre blocks, unless otherwise stated. Some areas are necessarily larger or smaller as determined by the limited layout of land.

Plantings are made in the early spring, broadcast by hand or by planting out vegetatively in furrows when seed are not available. Seed are never covered.

Pastures are mowed when necessary one to three times a season to keep down undesirable weeds.

Cattle used are grade Herefords as near uniform in size and type as can be obtained. Heifers are used only when steers are not available. The weight of animals selected is around 400 to 500 pounds. When weights vary considerably, each pasture is given some large and some small animals in order to balance the total weight.

Since the soil, and therefore plants, are deficient in some minerals, a mineral mixture is kept before grazing animals at all times. This mixture consists of 20 per cent salt, 40 per cent ground limestone and 40 per cent ground bone meal, or 2 pounds salt, 4 pounds limestone and 4 pounds bone meal. Covered boxes with one side open are placed in the pasture and about 10 or 15 pounds of the mineral mixture kept available. Less

than 20 pounds per animal per year is consumed, though this varies on the different pastures and from one season to another.

The actual grazing period on permanent pastures extends from about April 1 until frost in November (see table 1). Grazing animals are not given any supplemental feed except in very unusual cases where it is specifically stated.

Cattle are collected and selected for the grazing tests, when possible, two to three months before grazing begins. These animals are placed in a feed lot and fed uniformly a maintenance ration to reduce individual variation to a minimum.

At the beginning of the grazing period, cattle are divided and weighed individually for three days in succession and the average of these three weighings is taken as the animal's weight when put on grazing. They are weighed once every four weeks, or 28 days, during the grazing period. When taken from the test, three more weighings are made for three successive days and this average taken as the final weight. Weighings are made as near the same time of day as possible.

The number of animals placed in a pasture is determined by observations made of the sod. Sometimes it is necessary to add or take off one or two animals because of seasonal variations in pasture growth. It is made a point, however, to slightly under-graze rather than over-graze the pastures.

On pasture fertilizer tests the fertilizer is applied about the middle of March or 10 days to two weeks before the animals are put on. Where split applications are made, a part of which has to be applied in the summer, the fertilizer, especially the nitrate of soda, is finely ground and evenly scattered so as to keep the animals from getting enough to become poisoned. The animals are not removed from the pasture when it is being thus fertilized.

LOWLAND PERMANENT PASTURE FERTILIZER TEST

These tests are located along a branch bottom of mostly Plummer sandy loam soil. Originally the land was covered with dense swamp growth consisting of pine, black gum, poplar, gallberries, groundsel, briars and wiregrass.

Clearing and draining was started in 1926. At that time only one pasture was completed, namely, the carpet grass-lespedeza pasture which has been used as a check, or unfertilized area.

In 1928 and 1929 continuation of this work was carried on north of and adjoining the original area, and in the spring of 1929 four more pastures were seeded. The new seeding consisted of a mixture of carpet grass 8 pounds, Dallis grass 4 pounds, lespedeza 10 pounds and white clover 3 pounds per acre. Later data indicate that a better stand and quicker sod is secured by planting carpet grass 10 pounds, Dallis grass 8 pounds, common lespedeza 12 pounds and white clover 5 pounds per acre. Fertilizer was applied but no grazing was possible the first year for lack of fence. In 1930 grazing was carried on but no records kept except for pasture number 1

(table 1). Pastures were gone over and re-seedings made on bare spots the following spring.

Fertilizer was applied as indicated in succeeding tables numbers 2, 3, 4 and 5 for each pasture. All of the superphosphate and potash and one-half of the nitrogen was put on about the middle of March. The other half of the nitrogen was applied around July 20. The materials used were superphosphate, muriate of potash and nitrate of soda without making comparisons with other sources of fertilizer.

It will be noted from table 1 that grazing was started in May 1930 and from tables 1 through 5 that grazing was started in June 1931. This delay was caused by not having fences built and being unable to obtain cattle when wanted rather than to the condition of the pasture.

The number of steers on a pasture was kept the same throughout the year when possible. Sometimes weather conditions made it necessary to add or remove an animal or two. Under these circumstances weights were taken and the pasture given credit for the gain or loss.

Pasture upkeep consisted of the fertilizer application and two or three mowings each year.

For the five-year period previous to 1936 the lowland pastures, except the check, received fertilizer every year as indicated below. In 1936, only nitrate of soda was applied to pastures where nitrogen was in the formulas, the plan being to apply nitrogen every year, but phosphate and potash only every third year. Fertilizers are expressed in ammonia, phosphorus and potash (NPK) in the order named. Nitrates are figured on ammonia basis. (Ammonia is equivalent to 82.3 per cent nitrogen.)

The series of lowland pastures is numbered as follows:

1. Lowland permanent pasture of carpet grass and lespedeza which received no fertilizer. (Check pasture.)

2. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 6-12-6 fertilizer per acre each year through 1935. After 1935 complete fertilizer was applied every three years except the nitrogen part of the formula which was applied every year.

3. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 6-12-0 fertilizer per acre each year through 1935. After 1935 phosphate fertilizer was applied only every three years and nitrogen was applied every year.

4. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 6-0-0 fertilizer per acre each year.

5. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 0-0-6 fertilizer per acre each year through 1935. After 1935 it was applied every third year.

Pasture number 1 which received no fertilizer was principally carpet grass. The sod was so compact that very little lespedeza remained after

1931. No tests were conducted in this pasture in 1935 because part of the pasture was plowed to destroy patches of sedges and wire-grass. The average gain in liveweight of steers from 1930 through 1940, with 1935 omitted, was 81.76 pounds per acre as shown in table 1.

Pasture number 2, fertilized with a 6-12-6 (complete fertilizer) contained an excellent mixture of carpet grass, Dallis grass and white clover. Lespedeza gave way steadily after 1933 or after the grass sod had become thoroughly established. Originally white clover started on the damp muck soil along the ditch but spread steadily each year until it occurred over practically all of the pasture. The average gain in liveweight of steers from 1931 through 1940 was 320.3 pounds per acre as shown in table 2.

Pasture number 3, fertilized with a 6-12-0 (nitrogen and phosphorus) developed about the same as number 2, the average gain for the ten-year period being 290.9 pounds liveweight per acre as shown in table 3.

Pasture number 4, fertilized with a 6-0-0 (nitrogen only) started like numbers 2 and 3 but white clover which grew well for two or three years tended to become thinner each year until there were only scattering patches left. The grass also appeared to be less vigorous than numbers 2, 3 or 5, and swamp sedges were more abundant. This pasture gave an average gain of 140.3 pounds per acre for the ten-year period as shown in table 4.

Pasture number 5, fertilized with an 0-0-6 (potash only) had a good stand of carpet grass and Dallis grass. Lespedeza was plentiful up to 1935 but later tended to become thin. White clover was scattering and not as vigorous as in pastures numbers 2 and 3. The average yield for the 10-year period was 152 pounds liveweight gain per acre as shown in table 5.

All of the pastures contained six acres with the exception of number 5 which was 3½ acres, due to lack of land.

TABLE 1

FERTILIZER TEST ON LOWLAND PERMANENT PASTURE NUMBER 1
Carpet Grass and Common Lespedeza
Six Acres—Not Fertilized

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight (Lbs.)	Average Final Weight (Lbs.)	Total Gain Liveweight (Lbs.)	Av. Gain per Steer (Lbs.)	Gain in Animal Liveweight per Acre (Lbs.)
1930	May 1	Dec. 1	4	381	577	784	196.0	130.7
1931	June 2	Nov. 17	4	443	518	300	75.0	50.0
1932	April 30	Nov. 14	4	580	674	376	94.0	62.7
1933	April 4	Nov. 14	5	413	514	507	101.4	84.5
1934	April 4	Nov. 13	6	389	480	548	91.3	91.3
1936	April 8	Nov. 11	5	479	546	333	66.6	55.5
1937	March 30	Nov. 2	5	501	557	283	56.6	47.2
1938	March 22	Nov. 1	5	404	514	551	110.2	91.8
1939	March 29	Nov. 1	5	487	616	646	129.2	107.7
1940	April 3	Oct. 16	5	382	497	577	115.4	96.2
Ten-year average			4.8	445.9	549.3	490.5	103.6	81.76

NOTE: Lespedeza practically choked out by dense carpet grass sod since 1931 (pasture seeded 1927), therefore the results are for all practical purposes from grazing carpet grass. Grazing results for 1935 were not obtained. Centipede grass crept in from an adjoining pasture and constituted from 12% to 15% of the plant population for the last three years.

TABLE 2

FERTILIZER TEST ON LOWLAND PERMANENT PASTURE NUMBER 2

Six Acres of carpet grass, Dallis grass, common lespedeza and white clover mixture. 600 pounds complete fertilizer per acre 6-12-6 applied in spring annually 1931 through 1935. Starting in 1935, plan called for complete fertilizer every three years (1938, 1941, etc.) except the nitrogen part of the fertilizer, one-half of which was applied in spring and one-half in summer each year.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight (Lbs.)	Average Final Weight (Lbs.)	Total Gain Liveweight (Lbs.)	Av. Gain per Steer (Lbs.)	Gain in Animal Liveweight per Acre (Lbs.)
1931	June 2	Nov. 17	5	472	676	1020	204.0	170.0
1932	April 30	Nov. 14	5	579	858	1393	278.6	232.2
1933	April 4	Nov. 14	7	420	685	1852	264.5	308.7
1934	April 4	Nov. 13	9	451	649	1787	198.6	297.8
1935	April 3	Nov. 5	9	432	727	2656	295.1	442.7
1936	April 8	Nov. 11	9	492	662	1536	170.7	256.0
1937	March 30	Nov. 2	9	528	746	1964	218.2	327.3
1938	March 22	Nov. 1	12	423	574	1958	150.6	326.3
1939	March 29	Nov. 1	12	462	707	2939	244.9	489.8
1940	April 3	Oct. 16	12	400	575	2111	175.9	351.8
Ten-year average			8.9	465.9	685.9	1921.6	220.1	320.3

TABLE 3

FERTILIZER TEST ON LOWLAND PERMANENT PASTURE NUMBER 3

Six acres of carpet grass, Dallis grass, common lespedeza and white clover mixture. 600 pounds fertilizer per acre 6-12-0 applied in spring annually 1931 through 1935. Starting in 1935, plan called for application of phosphate every three years (1938, 1941, etc.) but nitrogen each year, one-half applied in spring and one-half in summer.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight (Lbs.)	Average Final Weight (Lbs.)	Total Gain Liveweight (Lbs.)	Av. Gain per Steer (Lbs.)	Gain in Animal Liveweight per Acre (Lbs.)
1931	June 2	Nov. 17	5	473	622	743	148.6	123.8
1932	April 30	Nov. 14	5	573	835	1306	261.2	217.7
1933	April 4	Nov. 14	7	421	652	1616	230.8	269.3
1934	April 4	Nov. 13	8	382	599	1736	217.0	289.3
1935	April 3	Nov. 5	9	421	693	2448	272.0	408.0
1936	April 8	Nov. 11	9	511	658	1324	147.1	220.7
1937	March 30	Nov. 2	9	478	724	2215	246.1	369.2
1938	March 22	Nov. 1	12	446	595	1791	149.25	298.5
1939	March 29	Nov. 1	12	465	665	2399	199.9	399.8
1940	April 3	Oct. 16	12	410	566	1876	156.3	312.7
Ten-year average			8.8	458.0	660.9	1745.4	202.8	290.9

TABLE 4

FERTILIZER TEST ON LOWLAND PERMANENT PASTURE NUMBER 4

Six acres of carpet grass, Dallis grass, common lespedeza and white clover mixture. 600 pounds fertilizer per acre 6-0-0 (nitrogen alone) applied annually 1931 through 1940, one-half applied in spring and one-half in summer.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight (Lbs.)	Average Final Weight (Lbs.)	Total Gain Liveweight (Lbs.)	Av. Gain per Steer (Lbs.)	Gain in Animal Liveweight per Acre (Lbs.)
1931	June 2	Nov. 17	5	467	586*	555	111.0	92.5
1932	April 30	Nov. 14	5	587	775	940	188.0	156.7
1933	April 4	Nov. 14	7	416	554	964	137.7	160.7
1934	April 4	Nov. 13	8	411	489	629	78.6	104.8
1935	April 3	Nov. 5	6	411	660	1495	249.2	249.2
1936	April 8	Nov. 11	6	532	635	617	102.8	102.8
1937	March 30	Nov. 2	6	491	639	892	148.7	148.7
1938	March 22	Nov. 1	6	427	561	806	134.3	134.3
1939	March 29	Nov. 1	6	429	600	1026	171.0	171.0
1940	April 3	Oct. 16	6	422	504	491	81.8	81.8
Ten-year average			6.1	459.3	600.3	841.5	140.3	140.3

* One animal died and another was added during this period.

TABLE 5

FERTILIZER TEST ON LOWLAND PERMANENT PASTURE NUMBER 5

Three and one-half acres of carpet grass, Dallis grass, common lespedeza and white clover mixture. 600 pounds fertilizer per acre 0-0-6 (potash alone) applied in spring annually 1931 through 1935. Starting in 1935, plan called for application of potash every third year (1938, 1941, etc.).

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight (Lbs.)	Average Final Weight (Lbs.)	Total Gain Liveweight (Lbs.)	Av. Gain per Steer (Lbs.)	Gain in Animal Liveweight Per Acre (Lbs.)
1931	June 2	Nov. 17	3	395	549	463	154.3	132.3
1932	April 30	Nov. 14	3	592	784	576	192.0	164.6
1933	April 4	Nov. 14	4	409	516	430	107.5	122.8
1934	April 4	Nov. 13	4	413	528	458	114.5	130.9
1935	April 3	Nov. 5	4	432	638	822	205.5	234.8
1936	April 8	Nov. 11	4	472	593	482	120.5	137.7
1937	March 30	Nov. 2	4	497	630	533	133.3	152.3
1938	March 22	Nov. 1	4	432	501	274	68.5	78.3
1939	March 29	Nov. 1	3	512	782	812	270.7	232.0
1940	April 3	Oct. 16	4	406	528	487	121.8	139.1
Ten-year average			3.7	456.0	604.9	533.7	148.9	152.5

TABLE 6

FERTILIZER TEST ON LOWLAND PERMANENT PASTURES

Consolidation of tables 1 through 5 with the pastures listed in ascending order of the gain in liveweight per acre.

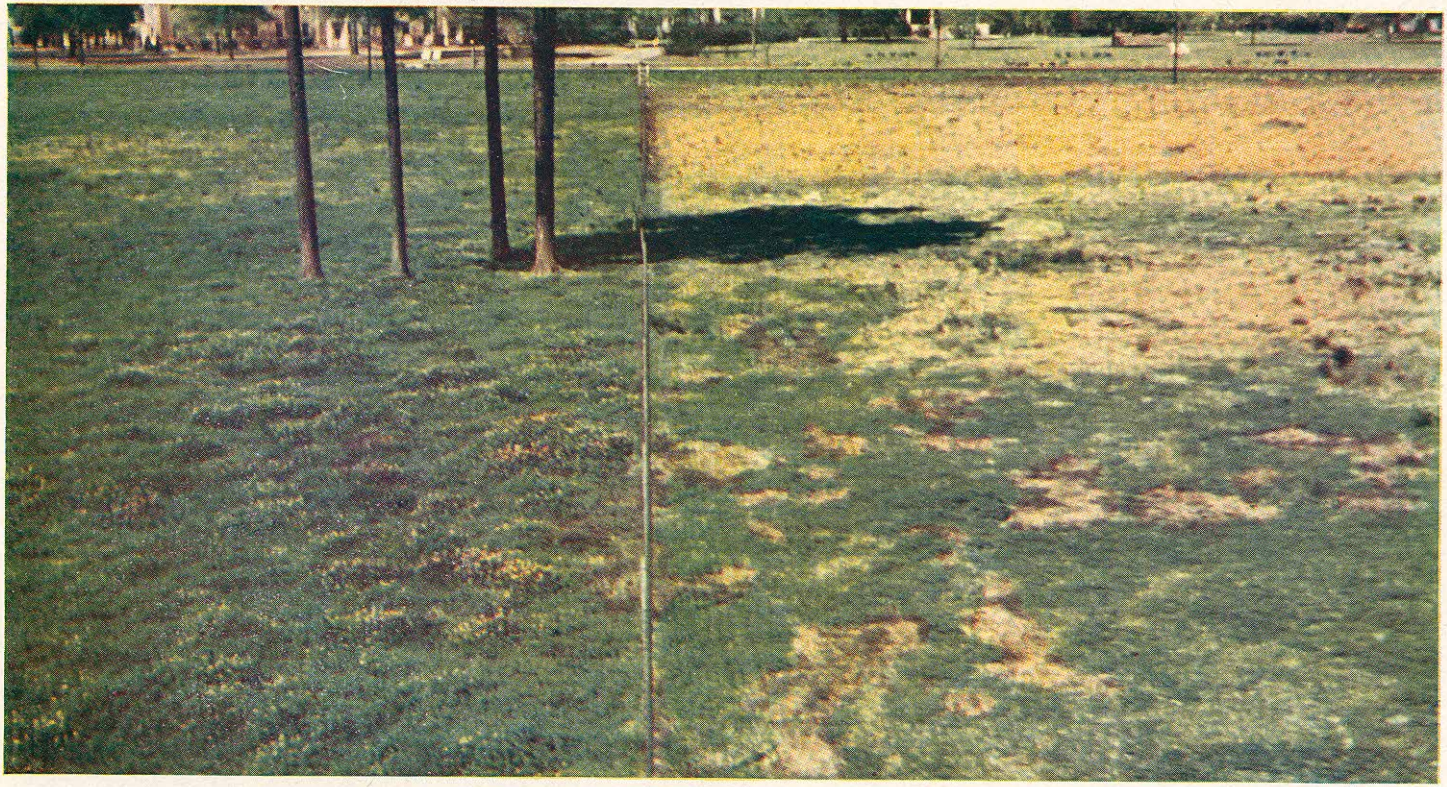
Ten-year average, 1931 to 1940, inclusive.

Pasture	Average No. Steers Grazed	Average Initial Weight (Lbs.)	Average Final Weight (Lbs.)	Average Gain per Steer (Lbs.)	Average Gain in Animal Live-weight per Acre (Lbs.)
6 Acres, Carpet grass* No Fertilizer (Pasture No. 1)	4.8	445.9	549.3	103.6	81.8
6 Acres, Mixture** 600 Lbs. 6-0-0 Fertilizer*** per Acre (Pasture No. 4)	6.1	459.3	600.3	140.3	140.3
3½ Acres, Mixture** 600 Lbs. 0-0-6 Fertilizer*** per Acre (Pasture No. 5)	3.7	456.0	604.9	148.9	152.5
6 Acres, Mixture** 600 Lbs. 6-12-0 Fertilizer*** per Acre (Pasture No. 3)	8.8	458.0	660.9	202.8	290.9
6 Acres, Mixture** 600 Lbs. 6-12-6 Fertilizer*** per Acre (Pasture No. 2)	8.9	465.9	685.9	220.11	320.3

* Ten-year average, 1930 through 1940; no record for 1935.
** Pasture mixture consists of carpet grass, dallis grass, lespedeza and white clover.
*** Ammonia, phosphoric acid and potash in the order named. Fertilizer applied annually through 1935. Fertilizer applied since 1935 every third year except plots containing nitrogen which is applied every year.

Graph 1 gives a picture of the results of tables 1 through 5. In this graph it will be noted that the year 1931 was the outstanding poor year for beef gain, while 1935 and 1939 were the best grazing years. No grazing test was conducted on the check pasture in 1935. The pasture sod continued to become better established, but this can hardly account for all of the variation from one year to another. While either phosphorus, nitrogen or potash increased the yield it should be noted from shaded portion on right of graph that the greatest gain was in the pastures receiving 6-12-6 and 6-12-0. Note in graph the trend of divergence or widening difference between lines representing pastures containing phosphate and those without it, as age of the pastures increased. From this test it appears that on virgin lowland soils and with a pasture mixture including legumes, phosphorus is the first limiting factor in pasture production. This benefit is in two ways: direct to the plants, and indirectly by increasing the white clover and lespedeza growth. Indirectly these legumes improve the soil and, hence, the grasses as well. Shaded columns at the right of graph 1 show the average gain in beef per acre per year for each fertilizer treatment.

Table 7 shows the total rainfall for 11 years, 1930 through 1940, and rainfall at 15-day intervals through the pasture growing season, March 1



Pastures receiving 6-12-0 and 6-0-0 fertilizers showing response of white clover to phosphate. April 1, 1940.

through October 31. The average rainfall for this period was 31.99 inches through the pasture growing season and 44.3 inches per year.

Generally speaking, the rainfall in the Coastal Plain is ample except during extremes like possibly 1938. Despite the plentiful annual rainfall, dry weather frequently occurs during May which sometimes seriously hampers seed germination and damages or destroys young pasture plants on a new pasture before they are well established. Also fall droughts frequently occur during October and November which reduces grazing considerably and at a season when pasture plants develop slowly even under ideal conditions. Fall dry weather delays germination of winter growing plants like white clover, also oats and rye in temporary pastures. It appears that the fall dry weather can be blamed partially at least for the low gains and even losses secured near the end of the grazing periods as shown in table 11.

Referring again to graph 1, lines representing liveweight gains from 6-12-6 and 6-12-0 fertilizers not only indicate the greatest yield but the separation from the other lines tends to be wider, as the pastures become older, therefore these pastures are increasing in grazing value. The development of the pasture plants and sod, as previously stated, shows that these two best pastures contain a good stand of white clover, therefore white clover must be responsible in large measure for good gains recorded on 6-12-6 and 6-12-0 fertilizer treatment.

Table 8 gives the yearly and average yield in green weight of grass per acre determined by clipping plots in 1934 through 1940 inclusive. The clipped plots were one rod square and were moved to new locations in the lowland pasture every 28 days which corresponded to the cattle weighing periods throughout the grazing season. On being located, the plot was mowed and a fence set up surrounding it to prevent any grazing. At the end of the 28-day period the plot was mowed and weights taken. Weights represent the actual growth that occurred during the previous 28 days. Plot locations were selected at random so that the constant moving gave a cross section of the pasture. Table 9 gives a four-year average yield of both green and dry weights of grass yields per acre. Dry weight yields were not kept previous to 1937.

Table 10 gives the average 1934 through 1940 acre yield of grass clippings at progressive cutting dates through the grazing season. The dates represent the day the cuttings were made, therefore the yields represent growth made during the previous 28 days, or as near this date as weather would permit cuttings to be made. Results show that vegetative growth was decidedly most on the 6-12-6 and 6-12-0 fertilized pastures.

Graph 2 gives the seven-year average green weight yield of grass per acre for the various fertilizer treatments. It also gives the seven-year (1934-1940) average distribution of yield through the grazing season at 28-day intervals. The 28-day intervals correspond to the 28-day periods when cattle were weighed.

Graph 3 gives the cattle gains per acre at 28-day intervals for the same seven-year period. Graph 2 showing grass yields may be compared to

graph 3 of cattle gains as both are averages over the same years and the same 28-day intervals.

The yield of forage and the yield of beef per acre are given in graphs 2 and 3 on corresponding dates progressively through the grazing season. By taking a pasture's yield in pounds of forage per acre and dividing by the yields in pounds of beef per acre, the ratio of pounds of forage to produce a pound of beef is obtained. The ratios given below are not conclusive in that there are several discrepancies probably due to lack of data but it is of interest to note that the forage-beef ratio is closer during spring and tends to widen late in the season to even loss if extended into November. The average of these figures for the whole season gives significant data. The theoretical ratio of check or no fertilizer plot being 99.5 pounds of grass to produce one pound of beef and for 6-12-6 complete fertilizer 53.4, 6-12-0 pasture 52.5, 6-0-0 pasture 68.4, for the 0-0-6 pasture 54.6 and for the Bermuda grass pasture the ratio is 54.0, as shown in table 12. From this it appears that the complete fertilizer pasture is roughly nearly twice as efficient as the check or no fertilizer pasture. Further it is indicated that any fertilizer increases the forage efficiency. All of this efficiency can not be attributed to grass alone for considerable credit must be given to the entering in of white clover especially in pasture number 2 and number 3. While these figures can not be construed as absolutely final, they are of great importance as indicators in the grazing problems.

In all of the results obtained in these grazing tests there is an underlying inference that our grazing period of profitable gains is far too short, much shorter than our long growing season would indicate. These data suggest remedies by finding new plants or mixtures of plants that will give earlier grazing in the spring, and particularly those that will extend the profitable gains into late summer and fall. Undoubtedly winter and summer temporary pastures as a supplement to the permanent pasture will play an important part in extending the grazing period which produces satisfactory liveweight gains.

TABLE 7

RAINFALL IN INCHES AT TIFTON, GEORGIA, DURING MARCH THROUGH OCTOBER FOR YEARS 1930 TO 1940 INCLUSIVE

Semi-Monthly Periods

Period	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	Average
March 1–15	2.24	1.09	2.08	1.01	4.82	2.43	.85	.32	.18	1.16	.92	1.55
March 16–31	3.46	1.75	1.42	4.19	1.35	.18	2.32	4.51	1.77	.57	1.93	2.13
April 1–15	3.33	1.30	.48	3.00	.14	1.04	5.54	4.05	2.10	5.55	2.35	2.63
April 16–30	2.62	1.62	1.34	1.44	1.57	1.29	2.33	2.47	.33	1.89	1.68	1.69
May 1–15	.36	3.06	.14	0	5.82	1.57	0	.63	.31	1.64	.98	1.32
May 16–31	.84	.18	3.54	2.08	6.60	1.21	1.40	.02	1.98	.90	.39	1.74
June 1–15	4.46	.98	2.21	2.96	2.27	.08	2.30	1.46	1.61	2.74	3.59	2.24
June 16–30	2.76	1.50	1.42	1.37	1.16	.05	.54	2.42	2.61	3.20	1.87	1.72
July 1–15	.20	3.33	2.63	1.85	2.01	7.57	1.33	3.98	.47	1.40	5.88	2.79
July 16–31	5.42	3.78	2.16	7.47	1.22	4.01	1.02	3.78	2.45	1.47	5.14	3.45
Aug. 1–15	1.74	4.24	3.62	.57	4.26	.77	8.78	4.17	1.86	3.44	3.91	3.40
Aug. 16–31	2.08	.53	3.89	2.17	1.95	3.92	.15	4.24	.31	6.61	1.34	2.47
Sept. 1–15	1.53	1.56	3.89	3.92	.86	5.70	.59	1.65	.18	.20	.07	1.83
Sept. 16–30	2.25	0	1.58	.06	.65	.31	.21	2.48	2.28	4.02	1.56	1.40
Oct. 1–15	0	1.45	3.06	0	2.39	0	3.72	.80	0	0	.69	1.10
Oct. 16–31	.23	.02	1.94	.14	0	.04	.31	2.12	1.01	0	.10	.53
Totals March 1 through Oct. 31	33.52	26.39	35.40	32.23	37.07	30.17	31.39	39.10	19.45	34.79	32.40	31.99
Totals for Year	48.05	34.41	48.34	44.94	45.26	42.11	46.46	53.90	26.20	52.58	45.02	44.30

TABLE 8

TOTAL AND AVERAGE YIELD OF GREEN WEIGHT PER ACRE CLIPPED FROM THE PASTURES FOR THE YEARS 1934 TO 1940 INCLUSIVE

PASTURE	POUNDS GREEN WEIGHT OF GRASSES AND LEGUMES							
	1934	1935	1936	1937	1938	1939	1940	7-Yr. Average
Lowland Permanent Pastures:								
No. 1 Carpet grass (not fertilized)*	5942	-----	8654	8107	5926	12310	8009	8158
No. 2 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 6–12–6 fertilizer	15080	15193	18323	18397	16591	25330	24134	19007
No. 3 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 6–12–0 fertilizer	14661	13976	15061	19618	15770	22291	19206	17226
No. 4 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 6–0–0 fertilizer	9320	5743	8278	10741	9415	14945	9539	9712
No. 5 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 0–0–6 fertilizer	7074	8188	10597	9901	7290	11862	5506	8631
Upland Permanent Pastures:								
No. 6 Centipede grass (not fertilized)**	1982	1943	1038	1456	-----	-----	-----	1605
No. 7 Centipede grass 400 Lbs. 6–12–6 fertilizer**	3882	4181	2811	3045	-----	-----	-----	3480
No. 8 Bermuda grass and lespedeza	3156	4652	8666	9102	6568	9008	6846	6857

* No results for pasture No. 1 were recorded in 1935.
** Pastures No. 6 and No. 7 were discontinued in 1938.

TABLE 9

TOTAL AND AVERAGE YIELD OF GREEN AND DRY WEIGHTS PER ACRE CLIPPED FROM THE PASTURES FOR THE YEARS 1937 TO 1940 INCLUSIVE

PASTURE	POUNDS OF GRASSES AND LEGUMES PER ACRE									
	1937		1938		1939		1940		4-Yr. Average	
	Green	Dry	Green	Dry	Green	Dry	Green	Dry	Green	Dry
Lowland Permanent Pasture:										
No. 1 Carpet grass (not fertilized)	8107	2770	5926	2361	12310	4132	8009	2649	8588	2978
No. 2 Carpet, Dallis, Lespedeza and white clover 600 Lbs. 6–12–6 fertilizer	18397	5575	16591	4990	25330	6977	24134	5971	21113	5878
No. 3 Carpet, Dallis, Lespedeza and white clover 600 Lbs. 6–12–0 fertilizer	19618	5631	15770	5072	22291	6368	19206	5056	19221	5532
No. 4 Carpet, Dallis, Lespedeza and white clover 600 Lbs. 6–0–0 fertilizer	10741	3283	9415	3423	14945	4975	9539	3055	11160	3684
No. 5 Carpet, Dallis, Lespedeza and white clover 600 Lbs. 0–0–6 fertilizer	9901	3490	7290	2824	11862	4180	5506	2022	8640	3129
Upland Permament Pastures:										
No. 8 Bermuda grass and Lespedeza	9102	2556	6568	2499	9008	3369	6846	2530	7881	2739

TABLE 10

AVERAGE YIELD OF GREEN WEIGHT PER ACRE AT VARIOUS TIMES OF THE YEAR CLIPPED FROM THE PASTURES ON THE APPROXIMATE DATES INDICATED FOR YEARS 1934 TO 1940 INCLUSIVE

PASTURE	April 30*	May 31	June 24	July 21	Aug. 18	Sept. 16	Oct. 13	Nov. 5*	Total Yield
Lowland Permanent Pastures:									
No. 1 Carpet grass (not fertilized)**	647	897	1215	1113	812	1603	1578	481	8346
No. 2 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 6-12-6 fertilizer	2874	1633	3233	3344	3870	2308	1669	568	19499
No. 3 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 6-12-0 fertilizer	1895	1732	2138	3538	3737	2396	1555	589	17580
No. 4 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 6-0-0 fertilizer	1018	846	1129	1956	1639	1828	1098	401	9915
No. 5 Carpet, Dallis, Lespedeza and White Clover, 600 Lbs. 0-0-6 fertilizer	726	472	672	1941	2274	1281	949	490	8805
Upland Permanent Pastures:									
No. 6 Centipede grass (not fertilized)***	216	189	172	315	268	296	111	93	1660
No. 7 Centipede grass*** 400 Lbs. 6-12-6 fertilizer	752	405	243	697	585	625	209	153	3669
No. 8 Bermuda grass and Lespedeza	1008	381	368	1483	2050	1107	452	179	7028

* Cuttings in 1934 were not made as early as April 30. In 1940 no cuttings were made as late as November 5.
** Pasture No. 1 results are omitted for 1935, giving a six-year average.
*** Pastures No. 6 and No. 7 were not clipped in 1938 through 1940, therefore average is for four years.
NOTE: Fertilizer formulas are expressed in terms of ammonia, phosphoric acid and potash in the order named.

TABLE 11

SEVEN-YEAR AVERAGE IN BEEF LIVEWEIGHT GAIN OR LOSS PER ACRE PER YEAR AT GIVEN DATES, 1934 TO 1940, INCLUSIVE.

PASTURE	Fertilizer	April 30	May 31	June 24	July 21	Aug. 18	Sept. 16	Oct. 13	Nov. 5	7-Year Average
No. 1	None	24.0	13.0	7.7	13.6	13.9	14.1	5.0	— 9.5	81.8*
No. 2	6–12–6	117.2	90.2	55.5	30.3	38.2	31.8	3.9	—11.2	355.9
No. 3	6–12–0	117.9	63.6	43.5	38.8	43.7	30.8	2.0	—12.4	327.9
No. 4	6–0–0	53.7	24.7	12.8	18.0	17.3	16.2	1.5	— 2.3	141.9
No. 5	0–0–6	43.0	26.1	14.1	16.6	21.5	26.7	9.4	.3	157.7

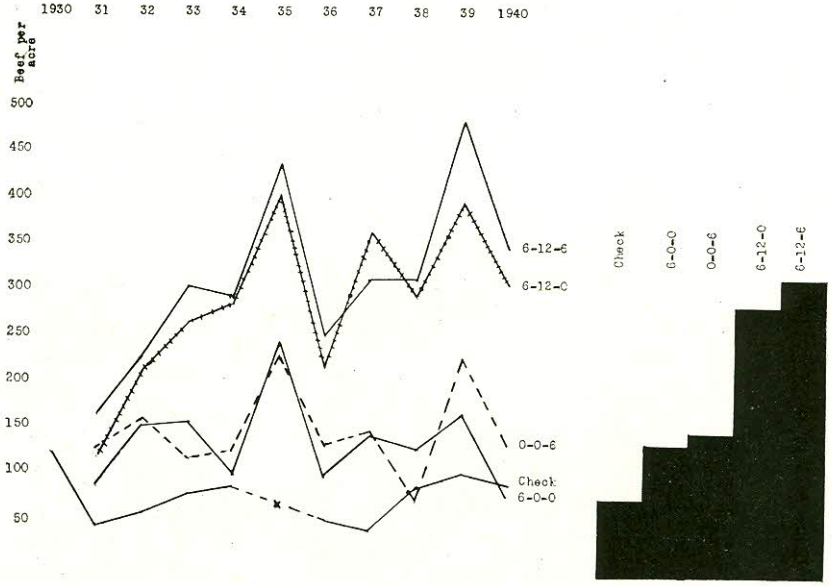
* Six-year average (1935 omitted).

TABLE 12

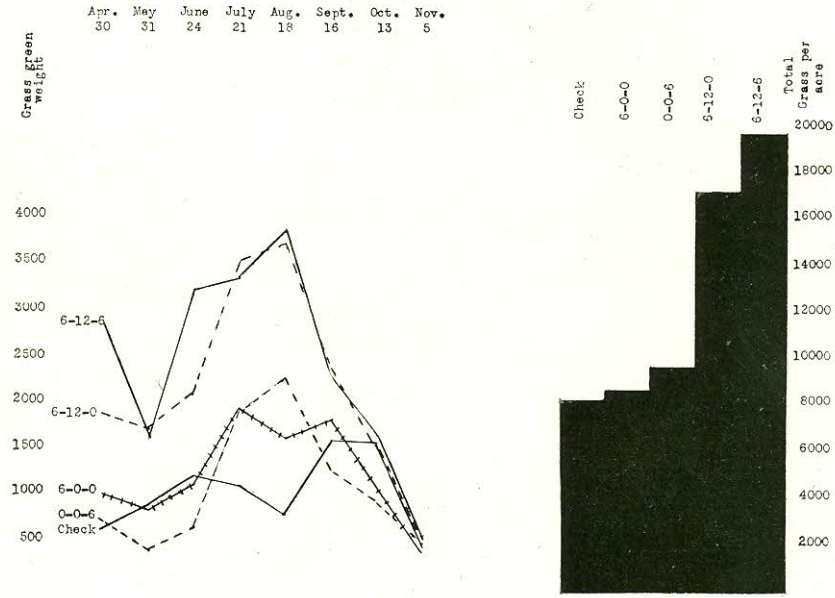
TABLE SHOWING COMPARISON OF YEARLY YIELD IN BEEF PER ACRE TO YIELD OF GRASS IN GREEN WEIGHT PER ACRE, OBTAINED FROM CLIPPINGS IN THE PASTURE

PASTURE	1934	1935	1936	1937	1938	1939	1940	7-Yr. Average	Beef-Grass Ratio
	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	
No. 1 Av. beef per acre	91	----------	56	47	92	108	96	82	
Av. grass per acre	5942	----------	8654	8107	5926	12310	8009	8158	99.5
No. 2 Av. beef per acre	298	443	256	327	326	490	352	356	
Av. grass per acre	15080	15193	18323	18397	16591	25330	24134	19007	53.4
No. 3 Av. beef per acre	284	408	221	369	298	400	313	328	
Av. grass per acre	14661	13976	15061	19618	15770	22291	19206	17226	52.5
No. 4 Av. beef per acre	105	249	103	149	134	171	82	142	
Av. grass per acre	9320	5743	8278	10741	9415	14945	9539	9712	68.4
No. 5 Av. beef per acre	131	235	138	152	78	232	139	158	
Av. grass per acre	7074	8188	10597	9901	7290	11862	5506	8631	54.6
No. 8 Av. beef per acre	60	134	132	156	116	162	130	127	
Av. grass per acre	3156	4652	8666	9102	6568	9008	6846	6857	54.0

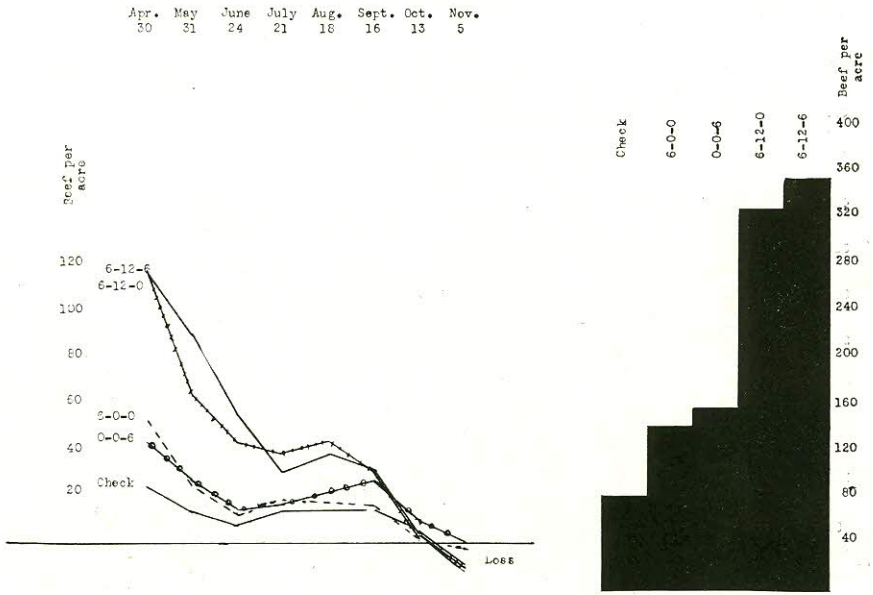
GRAPH NO. 1 - SHOWING GAIN IN BEEF PER ACRE EACH YEAR FOR VARIOUS FERTILIZER TREATMENTS (NPK)



GRAPH NO. 2 - SEVEN-YEAR AVERAGE GREEN WEIGHT YIELD IN POUNDS GRASS PER ACRE PER YEAR ON LOWLAND PASTURES AT GIVEN DATES FOR DIFFERENT FERTILIZER TREATMENTS AS INDICATED.



GRAPH NO. 3 - SEVEN-YEAR AVERAGE GAIN IN POUNDS BEEF PER ACRE PER YEAR ON LOWLAND PASTURES AT GIVEN DATES FOR DIFFERENT FERTILIZER TREATMENTS AS INDICATED.



PLANT POPULATION

Plant population counts have been made during the past six years to determine the percentage of various plants represented in the pastures. This percentage was based on the amount of vegetative growth. The figures were determined by using a square frame divided into 25 small squares 2x2 inches. Estimates were made for each small square separately. Each count represented the frame of 25 squares times five areas, or a total of 125 separate counts for each 28-day period, which corresponded to the cattle weighing periods. These counts were made in the rod squares set aside for the clipping test. The method used was not entirely satisfactory in that it was based on estimate; however with the large number of counts made the figures are significant in giving a comparison of what was in the pastures. Studies made indicate changes in the sod mixture. Tables 13 and 14 give the results of six years' population counts for the various pastures.

Averages are not given in these tables because this is a study of the flora change.

Points of interest in these tables are the prevalence of weeds and sedges in all pastures excepting the centipede grass pastures, and the persistence of lespedeza in the centipede pastures of dense but short sod while it tends to disappear in the other pastures where competition was with taller plants.

TABLE 13

PLANT POPULATION COUNT IN LOWLAND PERMANENT PASTURES IN PERCENTAGE FOR YEARS 1935 TO 1940 INCLUSIVE

PASTURE	Fertilizer	Year	Carpet	Dallis	Bermuda	Centipede	Other Grasses	White Clover	Lespedeza	Weeds and Sedges
			Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
No. 1	None	1935								
		1936	67.2	3.7		1.2	5.2		0.1	22.6
		1937	71.8	4.5	1.4		2.6	0.1	1.4	18.2
		1938	67.8	1.7	0.2	12.4	2.2	0.3	0.2	15.2
		1939	57.9	6.0		15.7	1.3	1.3	0.1	17.7
		1940	57.8	5.4		15.8	3.6	1.6		15.8
No. 2	6–12–6	1935	47.0	20.9	2.9		2.5	14.7	0.9	11.1
		1936	43.5	20.6	2.9		3.0	20.2		9.8
		1937	41.4	18.6	6.5		1.3	15.1		17.1
		1938	44.2	20.4	5.0		0.7	19.5		10.2
		1939	33.1	25.0	2.1		2.0	23.5		14.3
		1940	40.0	22.9	2.1		5.8	15.5		13.6
No. 3	6–12–0	1935	46.9	35.9	0.1		2.8	4.5	1.3	8.5
		1936	44.3	27.9			1.5	12.6		13.7
		1937	45.6	29.1			1.2	10.4		13.7
		1938	46.1	25.1			2.2	15.2		11.4
		1939	33.0	31.3			1.5	19.1	0.1	14.9
		1940	44.0	27.1			1.5	9.8		17.5
No. 4	6–0–0	1935	61.0	14.3	2.3		6.2	0.4	1.7	14.1
		1936	63.7	9.2			4.8	4.3	1.7	16.3
		1937	59.2	16.4			5.3	2.1	1.5	15.5
		1938	56.7	16.4			3.2	2.8	0.4	20.5
		1939	48.5	19.1			7.3	2.4	1.3	21.4
		1940	53.3	12.5			7.8	1.0	0.3	25.1
No. 5	0–0–6	1935	80.0	9.5	0.4		0.2	1.8	2.6	5.5
		1936	76.3	6.2	0.4		1.6	3.4	2.6	9.5
		1937	74.7	8.3			0.8	3.2	1.2	11.8
		1938	79.3	7.4			0.5	1.6	1.0	10.2
		1939	67.2	11.1	0.4		0.5	2.7	4.1	14.0
		1940*	69.7	11.2			2.9	0.8	1.3	11.4

* **Trifolium procumbens** 2.7 per cent.

NOTE: In pasture No. 1 centipede grass crept in from an adjoining pasture not in this series.

TABLE 14

PLANT POPULATION COUNT IN UPLAND PERMANENT PASTURES IN PERCENTAGE FOR YEARS 1935 TO 1940 INCLUSIVE

PASTURE	Fertilizer	Year	Carpet	Dallis	Bermuda	Centipede	Other Grasses	White Clover	Lespedeza	Weeds and Sedges
			Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
No. 6**	None	1935				94.1			5.9	
		1936				92.1			7.8	0.1
		1937			0.2	84.3			14.2	1.3
No. 7**	6-12-6	1935				94.3		0.3	5.3	0.1
		1936			0.2	93.1			6.6	0.1
		1937			0.1	97.1			2.3	0.5
No. 8	6-12-6	1935	1.6		69.3		3.6		5.8	19.7
		1936	0.1		71.5		9.3		2.9	16.2
		1937	2.1		67.2	0.3	11.9		1.1	17.4
		1938	1.0		70.9	1.2	8.6			18.3
		1939	1.8	1.1	64.5	0.2	8.8			23.6
		1940*	1.8		71.7		7.3		0.9	18.2

* **Trifolium procumbens** 0.1 per cent.
** Pasture discontinued in 1938.

UPLAND PERMANENT PASTURE TESTS

Pastures numbers 6, 7, 8, 9, and 10 were conducted on Norfolk and Tifton sandy loam upland soils. Comparisons can be made with lowland pastures and also determinations made as to the best upland pasture plants in the tests.

Upland pastures are numbered as follows:

Pasture Number 6 — Centipede Grass and Lespedeza Mixture Unfertilized. Table 15 includes consolidated results obtained from two pastures located about one-half mile apart. In both pastures gains made by animals were very unsatisfactory.

Centipede grass is hardy and forms a compact sod. Once the sod is established, few other plants can compete with it. By referring to population counts (table 14) it can be seen that pastures 6 and 7 contained mostly centipede grass with a small amount of lespedeza. Lespedeza plants were small in these pastures because of severity of the competition from the centipede grass sod. There were practically no weeds present. The high yield of pasture 6 for 1930 (table 15) is attributed largely to the mixture of other plants that were present before the centipede sod was well established. The loss in weight of animals in 1933 and 1934 made it necessary to use a supplemental feed of one pound of cottonseed meal daily per steer and on all later tests which continued through 1937. By referring to table 15 it will be noted the average gain in animal liveweight per acre over an eight-year period was only 32 pounds. Because of unsatisfactory gains from grazing, centipede grass pastures were discontinued in 1938.

Pasture Number 7 — Centipede Grass and Lespedeza Mixture Fertilized with 400 Pounds of 6-12-6 Per Acre. The results from this pasture are similar to number 6, with the exception of grass response to fertilizer and heavier yield of grass. No supplemental feed was given to steers in this pasture. The gain in beef per acre, although more than pasture number 6, was by no means satisfactory. It will be noted from table 16 that the four-year average yearly gain in liveweight per acre without supplement was only 33.5 pounds.

Pasture Number 8 — Bermuda Grass and Lespedeza. One-third of this pasture was turned each year to keep Bermuda grass from becoming sod-bound, to control unpalatable weeds and to cover droppings of manure.

In turning this land a two-horse turn plow was used in early March. When an area was turned a seeding of lespedeza—12 to 15 pounds per acre —followed immediately because where land was completely turned lespedeza seed were covered too deep for reseeding.

The above cultural practice means a turning of Bermuda sod every three years and also a seeding of lespedeza every three years immediately after the turning operation.

Flat breaking the land encouraged the growth of some weeds like Florida pursley, *Richardia scabra*, and crab grass, *Digitaria* sp., but these are palatable weeds and cattle grazed them freely. Palatable weeds of this type are not a serious pest and seldom require mowing.

Before the spring of 1936 this Bermuda pasture received no fertilizer. Beginning in 1936 six hundred pounds of 6-12-6 fertilizer per acre were applied. This pasture received phosphorus and potash every third year, while the nitrogen was applied every year, one-half in the spring and one-half in the summer.

In 1934 a very low gain of 59.6 pounds per acre was recorded. It will be noted that 10 steers were used and the pasture was obviously overgrazed before being completely sodded. It appears that 12 acres gave about the right amount of grazing for 8 to 10 animals after the sod was well established, or the carrying capacity was approximately three-fourths animal per acre. Table 17 shows the results over a nine-year period. The average gain in liveweight of steers per acre was 109.7 pounds for the first four years when no fertilizer was used; the average for the last five-year period when fertilizer was used was 139.1 pounds; and the average for the total period of nine years was 126 pounds.

Pasture Number 9 — Kudzu is generally considered a temporary pasture upon which grazing is practiced heavily for short periods with intervening periods of rest for revival of growth allowed. On this test, however, the cattle were put on in the spring and grazing continued all summer. The purpose was to determine the carrying capacity, yield, and also to see if grazing could be practiced without interruption throughout the season.

Kudzu seed were planted at the rate of 1½ pounds per acre in four-foot rows on March 12, 1931. The following May drought damaged the stand so much that transplanting with crowns had to be done the next winter. About one gallon of stable manure was placed around each plant to hasten growth and establishment. The field was cultivated the first year and part of the second year. The pasture was not well enough established to start grazing until the spring of 1933.

Later data indicate that crowns are more desirable than seed for establishing kudzu in the field because the crowns grow off faster and a more uniform stand is secured. Crowns may be set during the latter part of February in 6-foot rows and 6 feet in the drill. When set in checks, cross cultivation may be practiced during the first year. Six by six-foot plantings require 1210 crowns to set an acre.

By the end of 1935, or five years after starting, the kudzu appeared to be losing vigor. During the last week of February, 1936, two tons of stable manure were broadcast per acre, and the land turned deep with a two-horse plow. The turning of the pasture covered the manure, loosened the soil and re-set the kudzu plants. The result was a good stand and renewed growth vigor in 1936. It appears necessary to follow this practice about every five years.

In the fall of 1934 caterpillars destroyed kudzu leaves, and the animals had to be removed on October 16, which was responsible for the low gain in liveweight per acre for that year as shown in table 18. The eight-year average gain in liveweight on kudzu was 243.1 pounds per acre.

Pasture Number 10 — Combination Temporary Pasture Consisting of Oats Planted in November for Late Winter Grazing Followed by

Common Lespedeza for Summer Grazing. The combination was started by planting four bushels of oats per acre in the fall. Oats were grazed in the spring, and about March 1 common lespedeza (20 pounds per acre) was seeded on the oats. The lespedeza was grazed during summer and fall. Oats were seeded at a heavy rate in order to get earlier grazing than could be had by light seeding. Oats give best results when seeded in early October, but it has been necessary to delay plowing until about November 1 to 10 so that lespedeza seed can mature and volunteer the following spring. It is hardly possible to graze oats right on to time lespedeza is ready because oats are grazed out about June 1 and lespedeza is not large enough to give much grazing before July 1 on upland soils where moisture is limited.

By having two crops each year on the same land the total gain per acre was 208.9 pounds over a seven-year average, or the sum of gains on both oats and lespedeza. No grazing test was conducted on oats in 1935, due to a shift of pastures. No fertilizer was used on oats or lespedeza. This test has been conducted on soil too dry for best lespedeza growth. Table 19 gives results of grazing on oats, and table 20 gives results on lespedeza.

The above practice has suggested modifications that are worth consideration where these two crops are grown for maximum yields.

In other field tests it has been definitely shown that phosphate fertilizer is decidedly beneficial to both oats and lespedeza, therefore application of around 300 pounds of superphosphate, or equivalent, per acre in the fall preceding the planting of oats should prove worth while. Under actual practice many farmers prefer to turn the land and plant oats about October 1, disregarding re-seeding of lespedeza. This practice, although a little more expensive, allows the oats to be planted on time. The lespedeza seed, 25 to 30 pounds per acre, are sown on the young oats every spring about March 1. This insures a good crop of lespedeza which is not always had when reliance is placed on volunteer re-seeding. Where this practice is followed, Kobe lespedeza can be used instead of common lespedeza if desired.

TABLE 15

CENTIPEDE GRASS AND COMMON LESPEDEZA—UPLAND PASTURE NO. 6
Not fertilized—the pasture acreage varied during different years as indicated.

Year	Number Acres	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight	Average Final Weight	Total Gain Live-weight	Av. Lbs. Gain per Steer	Gain in Animal Live-weight per Acre
					(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
1930	5	May 1	Dec. 1	4	445	574	514	128.5	103.0
1931	5	June 2	Nov. 17	2	457	496	78	39.0	15.6
1932	17	April 30	Nov. 14*	7	451	590	968	138.3	56.9
1933	12	April 4	Oct. 16	5	386	357	**loss 146**	**loss 29.0**	**loss 12.2**
1934	7	April 4	Nov. 13	2	437	413	**loss 48**	**loss 24.0**	**loss 6.9**
1935	7	April 3	Nov. 5**	3	422	492	210	70.0	30.0
1936	8	April 8	Nov. 11**	3	454	537	247	82.3	30.9
1937	8	March 30	Nov. 2**	2	426	582	311	156.0	38.9
Eight-year average	8.6	----------	----------	3.5	434.8	505.1	266.8	70.1	32.0

* Two pastures of 5 and 12 acres averaged.
** Each animal received one pound of cottonseed meal supplement feed per day.

TABLE 16

CENTIPEDE GRASS AND COMMON LESPEDEZA—UPLAND PASTURE NO. 7

Four acres fertilized with 400 pounds per acre 6-12-6 applied annually in spring.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight	Average Final Weight	Total Gain Liveweight	Av. Lbs. Gain per Steer	Gain in Animal Liveweight per Acre
				(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
1934	May 2	Nov. 13	2	481	561	161	80.5	40.2
1935	April 3	Nov. 5	3	429	504	226	75.3	56.5
1936	April 8	Nov. 11	3	409	440	95	31.6	23.8
1937	Mar. 30	Nov. 2	2	430	457	54	27.0	13.5
Four-year	average		2.5	437	490	134	53.6	33.5

TABLE 17

BERMUDA GRASS AND COMMON LESPEDEZA—UPLAND PASTURE NO. 8

Twelve acres. Not fertilized until 1936. In 1936 a 600-pound rate of 6-12-6 fertilizer was applied and every third year following except the nitrogen in the formulas which was applied as a top dressing every year.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight	Average Final Weight	Total Gain Liveweight	Av. Lbs. Gain per Steer	Gain in Animal Liveweight per Acre
				(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
1932	April 30	Nov. 14	5	407	716	1543	308.6	128.6
1933	April 4	Nov. 14	8	412	588	1402	175.4	116.8
1934	April 4	Nov. 13	10	444	516	716	71.6	59.6
1935	April 3	Nov. 5	9	457	636	1605	178.3	133.7
1936**	April 8	Nov. 11	6	510	729	1316	219.3	131.6*
1937	March 30	Nov. 2	8	552	747	1556	195.0	155.6*
1938	March 22	Nov. 1	11	455	582	1393	127.0	116.0
1939**	March 29	Nov. 1	10	491	686	1944	194.4	162.0
1940	April 3	Oct. 16	10	430	586	1562	156.2	130.2
Nine-year average			8.6	462.0	642.9	1448.6	180.6	126.0

* Ten acres.
** Years in which complete fertilizer was applied.

TABLE 18

KUDZU GRAZED CONTINUOUSLY—UPLAND PASTURE NO. 9
Three acres. Fertilized with stable manure around crowns in 1932 and broadcast in 1936.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight	Average Final Weight	Total Gain Liveweight	Av. Lbs. Gain per Steer	Gain in Animal Liveweight per Acre
				(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
1933	April 4	Nov. 14*	3	388	646	774	258.0	258.0
1934	May 30	Oct. 16**	5	465	539	372	74.4	124.0
1935	April 3	Nov. 5	3	515	862	1039	346.3	346.3
1936	May 6	Nov. 11	3	547	784	711	237.0	237.0
1937	April 27	Nov. 2	3	544	782	714	238.0	238.0
1938	Mar. 22	Oct. 4	3	521	839	953	317.7	317.7
1939	April 26	Nov. 1	3	435	667	695	231.7	231.7
1940	May 29	Oct. 16	3	438	630	576	192.0	192.0
Eight-year	average		3.25	481.6	718.6	729.3	236.9	243.1

* Two animals used during April, the third added April 25.
** Caterpillars damaged leaves and caused animals to be removed early.

TABLE 19

OATS FOR WINTER GRAZING—UPLAND TEMPORARY PASTURE NO. 10
Followed by common lespedeza (results from lespedeza are shown in Table 20).
6 Acres—Not Fertilized

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight	Average Final Weight	Total Gain Liveweight	Av. Lbs. Gain per Steer	Gain in Animal Liveweight per Acre
				(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
1933	Jan. 16	April 25	3	459	655	589	196.3	98.1
1934	Feb. 27	May 29	9	461	579	1061	117.9	176.8
1935*								
1936	Jan. 30	May 19	7	370	483	791	113.0	105.5**
1937	Feb. 4	April 20	7	351	436	595	85.0	79.3**
1938	Feb. 3	May 3	4	398	555	626	157.0	104.0
1939	Jan. 18	May 3	6	493	582	536	89.3	89.3
1940	Feb. 14	May 3	6	491	588	584	97.3	97.3
Seven-year average	Feb. 3	May 6	6	431.8	554.0	683.1	122.2	107.2

* No winter grazing crop in 1935.
** Seven and one-half acres.

TABLE 20

COMMON LESPEDEZA FOLLOWING OATS—UPLAND TEMPORARY PASTURE NO. 10.
(Results from grazing preceding crop of oats are shown in Table 19).
6 Acres—Not Fertilized.

Year	Grazing Started	Grazing Finished	Number Steers Grazed	Average Initial Weight	Average Final Weight	Total Gain Liveweight	Av. Lbs. Gain per Steer	Gain in Animal Liveweight per Acre
				(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)	(Lbs.)
1932	June 28	Nov. 14	3	601	852	752	250.7	125.3
1933	April 25	Nov. 14	4	435	674	959	239.7	159.8
1934	June 26	Nov. 14	6	533	657	746	124.3	124.3
1935	July 9	Oct. 10	10	400	462	619	61.9	82.5*
1936	July 1	Nov. 3	7	517	627	773	110.4	103.1*
1937	June 22	Oct. 5	6	494	590	577	96.0	76.9*
1938	May 3	Oct. 3	4	583	741	633	158.0	105.5
1939	July 7	Oct. 4	5	529	637	538	107.6	89.7
1940	July 10	Sept. 28	4	652	725	291	72.8	48.5
Nine-year average	June 18	Oct. 21	5.4	527.1	662.8	654.2	135.7	101.7

* Seven and one-half acres.

WINTER TEMPORARY PASTURE TESTS

The winter temporary pastures include (1) oats and hairy vetch, (2) oats-lespedeza rotation, (3) abruzzi rye, and (4) Italian rye-grass. Winter temporary pastures are important not only in the gains per acre in beef that they furnish, but in the carrying of cattle during months when they would otherwise have to be fed from the barn.

Winter temporary pastures even of the same crop vary considerably in time of grazing, amount of grazing and carrying capacity. All of the annual temporary pasture plants are affected by rainfall, time of planting and temperature. It can be definitely stated that all of the above crops should be seeded in early October, although this will require seeding lespedeza again the following spring in the oats-lespedeza rotation. Early seeding gives the plants time to become well established and attain some size before severe cold weather. If planted late, and cold weather immediately follows, there is very little grazing furnished before early spring. Rate of seeding is also important. Heavier seedings should be made for grazing than for seed production. Oats or rye seeded at 1½ to 2 bushels per acre for grain should be doubled for grazing.

Table 21 gives average number of steers carried on six-acre pastures, also the average dates the animals were placed on and taken off these pastures, and the average gain in beef per acre. It will be noted that oats and hairy vetch gave an average liveweight gain of 135 pounds per acre, and that the grazing period was from February 1 to May 5 or during a time when feed is generally at a premium.

Oats alone gave liveweight gain of 107 pounds per acre, abruzzi rye 85 pounds and Italian rye-grass 50 pounds per acre.

TABLE 21.

WINTER TEMPORARY PASTURES.
Six-Acre Pastures—Not Fertilized—Broadcast Plantings.

PASTURE	Grazing Started	Grazing Finished	Av. No. Steers Grazed	Gain in Animal Live-weight per Acre
				(Lbs.)
Oats and Hairy Vetch 7-Yr. Av.	Feb. 1	May 5	6.0	135
Oats* 7-Yr. Av.	Feb. 3	May 6	6.0	107
Abruzzi Rye 6-Yr. Av.	Feb. 4	Apr. 14	6.0	85
Italian Rye-grass 5-Yr. Av.	Feb. 1	Apr. 24	3.8	50

* Seven and one-half acres during two years. Oats following lespedeza in the oats-lespedeza rotation.

SUMMER TEMPORARY PASTURE TESTS

Cat-tail millet is one of the best temporary summer pastures known for South Georgia. It is a hardy feeder and makes good growth on ordinary soils without using fertilizer. The date of seeding may vary from April to June. In this test 20 pounds of seed were planted per acre in 2½-foot rows. This crop is not troubled with disease or insect pests, is very palatable and sprouts out quickly when grazed down. Grazing should be started on cat-tail millet when plants are 8 to 10 inches high. Delayed grazing will result in the millet going to seed and shortening the grazing period. Plants grazed close tend to stool or sucker out and seeding is delayed.

In tables 21 and 22 the oat-lespedeza combination temporary pastures are listed separately so that they may be compared to the other temporary grazing crops.

Otootan soybeans, although not the highest beef producer, improved the soil for the following crops. Soybeans were an excellent temporary pasture and one reason why the beef yield was not greater was because of occasional late summer attacks by caterpillars. Thirty pounds of seed were planted per acre in 2½-foot rows.

Table 22 gives average results of grazing on the above summer temporary pastures. It will be noted that velvet beans gave the lowest gains in beef per acre when grazed green. One thing in favor of velvet beans handled in this way, however, is its value as a cover crop or soil builder. The land was easily cultivated and the following crops showed marked increase in growth. Planting rate was 35 pounds seed per acre in 2½-foot rows.

None of the temporary pasture was fertilized. All of the summer temporary pastures, with the exception of lespedeza, were planted in 2½-foot rows and cultivated two or three times and divided by a cross fence, and alternate or rotation grazing practiced. This allowed one-half of the pasture to rest and produce growth while the other was being grazed.

By referring to tables 21 and 22 a possible combination of oats and hairy vetch in winter and cat-tail millet in summer gives a combined liveweight gain of 283.2 pounds per acre. Cat-tail millet gave 148.2, lespedeza 101.7, soybeans 98.3 and velvet beans 42.0 pounds per acre. It will also be noted that there is a possible selection of temporary grazing crops that can include legume crops for soil building purposes in addition to grazing.

TABLE 22.

SUMMER TEMPORARY PASTURES.
Six-Acre Pastures—Not Fertilized.
Planted in 2½ foot rows except lespedeza which was broadcast.

PASTURE		Grazing Started	Grazing Finished	Av. No. Steers Grazed	Gain in Animal Live-weight per Acre
					(Lbs.)
Cat-tail Millet	6-Yr. Av.	July 4	Sept. 20	9.2	148.2
Lespedeza*	9-Yr. Av.	June 18	Oct. 21	5.4	101.7
Otootan Soybeans	7-Yr. Av.	July 24	Sept. 29	8.7	98.3
Velvet Beans	4-Yr. Av.	Aug. 6	Sept. 27	7.0	42.0

* Seven and one-half acres during two years. Lespedeza following oats in the oats-lespedeza rotation.

TABLE 23.

FERTILIZER RATES OF APPLICATION TEST ON CARPET GRASS.
On fairly moist upland soil in cultivated field crops previous to 1931.
Average of duplicated plots for 1931, 1932 and 1933.
Yield of grass in pounds per acre, green and air dried.
Fertilizer: 6% ammonia, 12% phosphoric acid and 6% potash.

RATE OF APPLICATION	Pounds Green Weight of Grass per Acre				Pounds Dry Weight of Grass per Acre			
	1931	1932	1933	Av.	1931	1932	1933	Av.
All Fertilizer Applied in Spring:								
Check (no fertilizer)	1762	3205	4815	3261	728	1153	1755	1212
200 pounds	2594	5052	8924	5523	1000	1726	3034	1920
400 pounds	3321	6098	10209	6543	1242	2003	3275	2173
600 pounds	3718	6765	10494	6992	1293	2184	3316	2264
800 pounds	4195	7237	9656	7029	1475	2371	3105	2317
1200 pounds	4766	8654	7066	6829	1621	2835	2387	2281
One-half Fertilizer Applied in Early Spring, One-half in Mid-summer:								
200 pounds	2164	4539	8149	4951	881	1566	2704	1717
400 pounds	2332	5568	8929	5610	926	1829	2916	1890
600 pounds	2916	6829	10980	6908	1055	2147	3381	2194
800 pounds	3300	7183	10320	6934	1192	2173	3111	2159
All Superphosphate and Potash Applied in Spring; Nitrogen Applied in Summer:								
200 pounds	1493	4073	8217	4594	647	1389	2668	1568
400 pounds	2164	4855	8292	5104	873	1589	2706	1723
600 pounds	2777	6792	9298	6289	1037	2036	3002	2025
800 pounds	3639	8454	7779	6624	1320	2385	2579	2095

FERTILIZER FORMULA TEST

A fertilizer formula test based on a 6-12-6 (NPK) fertilizer at a 600-pound rate was conducted on 20 plots each of Bermuda, carpet and centipede grass. The formulas carried one varying element which ranged in ammonia from 0 to 8 per cent, phosphorus 0 to 16 per cent, and with potash 0 to 8 per cent. Top dressing and split applications were also made. Plots were mowed and weights taken at three-week intervals through the summer.

A summary of the results indicates that the response of the three grasses to fertilizer treatments was quite similar. The highest yielding plots were from a complete fertilizer of around 6-12-6. Nitrogen appeared to be the first limiting element, but phosphorus and potash increased the yield after the nitrate deficiency had been supplied. The lowest yielding plots were those without nitrogen.

In lawns where grasses are grown alone it appears that nitrogen is the first limiting fertilizer element. With legumes like lespedeza and white clover, phosphorus is the first limiting element. In pastures it is desirable to have a mixture of legumes and grasses, therefore the addition of phosphorus is most important, because it increases the legumes which in turn release nitrogen in the soil, thus giving an increased yield of legume and grass.

FERTILIZER RATES OF APPLICATION TEST ON CARPET GRASS

Carpet grass was fertilized with a 6-12-6 (NPK) fertilizer in varying amounts up to 1200 pounds per acre. Yields were measured by clipping and weighing the grass every three weeks during the growing season.

By referring to table 23 it will be noted that the greatest yield came from plot receiving 800 pounds of fertilizer applied in the spring. This was followed closely by the 600-pound rate applied in the spring.

Most growth of grass occurred during the latter part of July and early August, the split application plots giving exceptional yields during this period.

From this three-year test it appears that 400 to 600 pounds is the economical amount of fertilizer to use and, further, that there is no advantage in making split applications, or in applying phosphate and potash in the spring and nitrogen during the summer. The 1200-pound rate application caused considerable temporary burning of grass leaves.

SUMMARY

The wide variety of adapted introduced grasses and legumes that are nutritious and palatable is making cattle production in the Coastal Plain of Georgia easier and more profitable.

Native grasses are not as satisfactory pasture plants for improved pastures as those introduced, because of the short grazing season and the tendency for some to disappear when grazed.

The most important introduced grasses in common use at present are carpet, Dallis and Bermuda.

Common lespedeza and white clover are legumes that greatly increase the value of a permanent pasture.

With increased knowledge of the profitable grazing period of various permanent and temporary pastures, a practice of shifting grazing from one crop to another should increase total yield of beef.

Kudzu has given excellent gain in beef per acre when grazed continuously throughout the summer provided it was not over grazed. Best results have been obtained on heavy type soils when stable manure was used at the time of setting out the crowns.

Land should be thoroughly prepared for planting a lowland permanent pasture. Cutting the land several times with a heavy disk harrow and finishing by leveling with a drag harrow seems most practical. Small seed should be packed into the soil with a roller rather than covered with drag harrow which often covers them too deep.

Pastures should be planted in March in the latitude of Tifton.

Because the growing period is extended and grazing better balanced, a mixture of plants is desirable in lowland pastures. Legumes improve a pasture.

A lowland permanent pasture seed mixture of 10 pounds carpet grass, 8 pounds Dallis grass, 12 pounds common lespedeza and 5 pounds of white clover is recommended.

Grazing can be started the first year. The new pasture will not be completely sodded for two to three years, but grazing packs the soil and helps to keep down weeds.

Pastures should be mowed at intervals to keep down weeds and prevent patch grazing.

Fertilizer tests conducted on a lowland pasture mixture of carpet grass, Dallis grass, lespedeza and white clover gave the highest gain in beef per acre on complete fertilizer of a 6-12-6.

White clover and lespedeza growth was best on pastures receiving phosphate fertilizer.

Seed inoculation of white clover is desirable.

Rainfall is usually sufficient. There is little evidence that lowland pastures suffer much from drought.

On lowland pastures, gains in beef per acre were most rapid early in the spring and diminished rapidly in late summer which indicates the desirability of having supplemental summer temporary pastures.

The ratio of grass yield to beef gains varies with different fertilizer treatments.

For upland pasture, Bermuda grass and common lespedeza have given best gains. New selections of Bermuda grass, like the "Tift" Bermuda, are

upright in growth and heavy yielders that are promising for hay when fertilized or for grazing.

Maintenance of Bermuda grass pasture by breaking with a turn plow at intervals is very important.

Centipede grass has not given satisfactory grazing even when fertilized, and is not recommended for grazing.

Oats, mixed with hairy vetch, has given highest beef gains on winter temporary pastures. Oats or abruzzi rye are also good winter temporary pastures. These crops should be seeded in early October and at the heavy rate of three to four bushels per acre for grazing.

The best summer temporary pastures tested are cat-tail millet, lespedeza and soybeans.

Fertilizer formula tests on Bermuda, carpet and centipede grasses indicate that most response of these grasses was from nitrogen on semi-upland soils previously in cultivation. The maximum yield came from complete fertilizer. Pastures on soils that have never been cultivated, respond well to phosphates. This is especially true when legumes are included in the pasture mixture. The phosphate fertilizer increases legume growth which in turn gathers atmospheric nitrogen and stimulates the grass growth.

Tests on rates of application of 6-12-6 fertilizer on carpet grass indicate that 400 to 600 pounds per acre give most economical increase in yield.

Fertilizer, all applied in spring, gave the best distribution of grass growth through the summer. Spring application of fertilizer also gave greater total yield of grass than split applications.

More attention should be given winter and summer temporary pastures for supplemental grazing when the permanent pastures are tough and low in production. Every effort should be made to extend the profitable grazing period.