

Georgia Forages:

Legume Species



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Georgia Forages: Legume Species

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Legume species add significantly to forage systems in Georgia. They are an excellent source of high quality forage. Legumes are generally very digestible and contain high levels of crude protein (CP). Many legumes also provide substantial forage yields. Perhaps most importantly, however, legumes and the rhizobium bacteria that colonize nodules on their roots provide an important source of biologically-fixed N. This publication presents information about the most important legume species grown for forage in Georgia.

Cool Season Annual Legumes

Cool season (winter) annual legumes are generally planted in the fall and provide forage in late fall and spring. These plants flower and produce seed in late spring and die soon after seeds mature. Cool season annual legumes differ substantially in their preferred soil characteristics, growth distribution, cold tolerance, bloat potential, and reseeding potential (Table 1). Grazing is typically the best method for utilizing these species, but hay or silage can be made from these species or grass-legume mixtures. Most cool season annual legumes are susceptible to several disease problems, nematodes, and insects. When available, species and varieties with good pest resistance should be chosen to minimize management problems.

Arrowleaf Clover

Arrowleaf clover is a highly productive winter annual clover grown from East Texas to Georgia. It is most productive when grown on well-drained loam or sandy loam soils but can do well on well-drained clay soils. It will not tolerate acid soils. This clover generally produces less forage in late fall and winter than crimson clover but can produce six weeks (or more) longer in spring. In most areas of the state, it will provide excellent quality grazing until late May. Digestibility remains high until maturity. Arrowleaf is a good clover to include in grazing mixtures. It has a very low bloat potential, and its late spring production extends the grazing season while providing excellent quality forage.

Arrowleaf is a prolific seed producer, much of which will be hard seed. As a result, arrowleaf is considered a good reseeded if it is allowed to



Arrowleaf Clover (*Trifolium vesiculosum*)

Table 1. Minimum soil characteristics and management traits of selected cool season annual legumes.[†]

Species	Soil			Management Traits			
	Min. pH [‡]	Texture	Drainage	Maturity	Cold Tolerance	Bloat Potential	Reseeding Potential
Arrowleaf clover	6.0	sand, loam	good	late	good	low	high
Ball clover	6.0	sand, loam, clay loam	fair	medium	good	high	high
Berseem clover	6.5	loam, clay	poor	medium	poor	low	low
Crimson clover	5.5	sand, loam	good	early	good	medium	low
Medics, annual	7.0	sand, loam, clay	fair	early	poor	high	high
Persian clover	6.0	loam, clay	poor	medium	fair	high	high
Red clover [§]	5.5	loam, clay	good	late	good	low	low
Rose clover	6.0	sand, loam, clay	good	medium	good	low	high
Subterranean clover	6.0	loam clay	fair	medium	fair	medium	low
Vetch, hairy	5.5	sand, loam, clay	good	medium	good	low	low
Winter pea	6.0	loam, clay loam	good	medium	poor	low	low

[†] Adapted from Evers, 2005.

[‡] Minimum soil pH value (water pH equivalent) for acceptable yields.

[§] Red clover is a perennial clover species, however it is often used as a late maturing cool season annual legume in the Coastal Plain Region. When used as a perennial, it has a medium to high potential for reseeding.

reseed. To allow reseeding, remove animals from the paddocks or reduce stocking rates in late April or early May when the clover starts to flower. **WARNING:** If arrowleaf has been grown in a pasture for several years, the ability of arrowleaf to reseed dependably is seriously compromised by a *Fusarium* spp. disease complex.

Sod-seeding arrowleaf into warm season perennial pastures is an excellent way to achieve spring grazing and to introduce biologically-fixed N into the system. Unchecked vigorous spring growth can reduce early spring growth of the perennial grass. In overseeded pastures, closely graze arrowleaf clover during the spring to avoid a full canopy developing over the perennial grass.

Arrowleaf will continue to produce new leaves and remain productive until late spring/early summer, if grazing is managed to keep it 2 – 6 inches tall. This management also will help improve light and air movement into the canopy, thus reducing disease problems. Arrowleaf will often exhibit symptoms of stress (e.g., purpling of the leaves) in response to fertility problems, cold stress, or disease.

Several varieties of arrowleaf clover are available in the Southeast. However, many of the varieties are affected by a virus complex that can drastically reduce yields. Some cultivars are now available that have demonstrated improved resistance to these viruses.

Ball Clover

Ball clover has long, highly-branched stems that support white to yellowish-white flowered seed heads that look similar to white clover seed heads. Ball produces most of its growth about one month later in spring than crimson and generally does not produce as much total forage as crimson. However, its advantage over crimson is that it is an excellent reseeder, even under close grazing. When grazed heavily, ball clover produces seed heads close to the ground. It is more tolerant of wet soils than crimson, but it does not do well if soil pH drops below 6.0.

Berseem Clover

Berseem clover is a non-bloating winter annual that is adapted to the southern part of the state. Stands in north Georgia are frequently winterkilled. Berseem has a longer grazing season, a lower bloat potential, and produces higher yields than crimson clover. Berseem is not tolerant of acid soils, but typically does better than many other winter annual legumes in poorly drained sites. Berseem also has a higher boron requirement than other annual clovers and often does better on soils with more organic matter. Berseem is not a good reseeder.

Crimson Clover

Crimson clover is an excellent winter annual legume and often serves as a benchmark by which other cool season annual legumes are compared. Crimson furnishes some grazing in late fall and winter and abundant grazing in early spring. Crimson matures (flowers) earlier in spring than the other annual clovers, produces high yields even in cool winters, and has a shorter grazing season. Several varieties are now available that mature very early. This allows it to grow, be utilized, add biologically-fixed N to the soil, and die with minimal competition with warm season perennial grasses. It grows best on well-drained soils and is frequently used in mixtures with ryegrass and small grains for winter grazing. It is also commonly used to overseed bermudagrass and bahiagrass pastures. Unfortunately, crimson produces relatively few hard seed



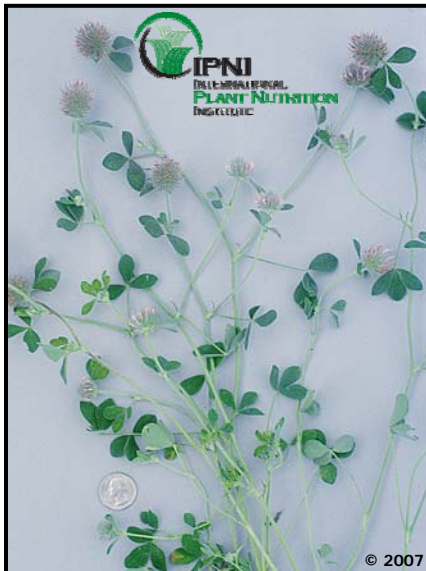
Ball Clover (*Trifolium nigrescens*)

Berseem Clover (*T. alexandrinum*)

Crimson Clover (*T. incarnatum*)



Red Clover (*Trifolium pratense*)



Rose Clover (*T. hirsutum*)



Subterranean Clover (*T. subterraneum*)

and its seed heads are often damaged by clover head weevils. As a result, crimson clover usually does not reseed well in a grazing system.

Red Clover

Red clover is a short-lived, cool season perennial in north Georgia and is commonly used as an annual in south Georgia. Red clover is often confused with crimson clover. While crimson clover produces dark red and elongated seed heads, red clover seed heads are typically round and a lighter red or lavender in color. Though it produces good yields (often over 2 tons per acre), red clover matures much later than crimson clover. This later maturity fits better with annual ryegrass. Red clover does not recover from defoliation as quickly as arrowleaf and crimson and therefore may be easily damaged by overgrazing or selective grazing. Red clover fits well in management-intensive grazing systems where animals are prevented from grazing it too heavily.

Rose Clover

Rose clover is commonly grown in California, but it had not been widely grown in the Southeast until recently. It has hairy leaves and stems and a growing season similar to crimson. It is winter dormant and produces forage later and flowers later than crimson (though it matures earlier than arrowleaf). It is more drought tolerant, more tolerant of acid soil conditions, and a better reseeded than crimson. It generally stands up well under heavy-grazing, but animals should be removed in mid-April to allow the stand to produce seed.

Subterranean Clover

Subterranean clover (sub clover) is native to the Mediterranean and the Near East and well-adapted to areas with

relatively warm moist winters and dry summers. Sub clover is low growing (less than 1 ½ ft tall), but will create a very dense forage mat.

Its inconspicuous flowers will form burs after fertilization. The stiff-forked bristles of the seed bur allow it to peg or bury itself into the soil (much like peanuts), hence the name “subterranean” clover. It also produces hard seed with high temperature requirement for seed to emerge from dormancy. However, in most management systems it is not feasible to allow the stand to progress to this advanced maturity stage. Thus, it is capable of good reseeding, but its reseeding potential is poor in practice.

Sub clover is best adapted to overseeding on perennial grass pastures. It provides forage in late winter and early spring. In a stocker program, sub clover overseeded on permanent summer pastures can serve as a reserve feed source. The productive season is similar to crimson clover.

Vetch

Various species of vetch (hairy vetch, bigflower vetch, common vetch) are sometimes used in Georgia forage systems. Their viney stems support compound leaves with narrow leaflets. Species are generally most easily distinguished by flower color (hairy: purple; bigflower: yellow-white; common: white). Hairy vetch is the vetch species most commonly grown in Georgia.

Vetches are usually seeded in combination with a small grain and/or ryegrass on a prepared seedbed for winter grazing or silage. Grazing must be carefully managed because close grazing will result in the loss of the bud (growing point).

Hairy and common vetch mature later in spring than crimson clover, but are cold-hardy, more tolerant of low soil pH than most clovers, and have a low bloat potential. Some common vetch varieties have been developed that are resistant to root-knot nematodes.



Hairy Vetch (*Vicia villosa*)

Bigflower Vetch (*V. grandiflora*)

Common Vetch (*V. sativa*)

Winter Pea

Winter pea or Austrian winter pea produces a viney stem that will extend from 2 – 4 ft in length and produce white, yellow, or purple flowers. Winter peas are not well-suited for pastures, as their stems are often damaged by treading. However, winter peas are frequently seeded with rye, wheat, or oats for silage production. Winter peas should not be planted north of the lower Piedmont region because they are not cold hardy. Diseases can also substantially reduce yields.

Information about specific varieties of recommended cool season annual legume species may be found on the web page entitled “Forage Species and Varieties Recommended for Use in Georgia” (<http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html>).



Winter pea (*Pisum sativum*)

Other Minor Cool Season Annual Legumes

Hop Clover

Hop clover is a small, fine-stemmed winter annual that grows best on upland soils. It reseeds readily and furnishes some grazing in late winter and early spring. Seed are not commercially available, but it volunteers in many pastures. Yields are usually quite low and it contributes relatively little biologically-fixed N to the soil.

Medics

Several annual medics, including black medic, are commonly found in forage systems in Georgia. Like hop clover, they are rarely planted intentionally. Medics are excellent reseeders, thus they usually are volunteers that fill into thin areas of the pasture. The yields of most medics are less than one-third that of other winter annual legumes. Southern or spotted burclover (a type of medic) grows in late winter and spring, but animals generally do not readily graze burclover once it begins to mature. Burclover produces seed in abundance and reseeds readily. The burclovers have not been used extensively in Georgia because of poor yields.

Persian Clover

Persian clover is quite productive during a short growing season. Despite being a relatively low-yielding cool season annual legume, persian clover performs well under close grazing. It tolerates poor drainage and soil acidity down to pH 5.5, but it has a high bloat potential. Its pink seed head produces a fair amount of hard seed and it has the potential for good reseeding.

Lupine (or Lupin)

Lupines are best adapted to sandy loam and loamy sand soils. Since they generally are not cold hardy, they should not be planted north of the lower Piedmont region. Lupines were used relatively extensively prior to World War II as a supply of nitrogen for cotton in the

Coastal Plain region. Lupine grows slowly in fall and winter, but grows vigorously in the spring. Plants will flower from late March – early April. The relatively short productive season limits lupine's use in forage programs. Lupines also commonly contain bitter alkaloids that make them less palatable to livestock than most legumes, but low-alkaloid “sweet” varieties are available that are suitable for forage use.

Establishment of Cool Season Annual Legumes

Cool season annual legumes can either be established on a prepared seedbed or they can be overseeded on warm season perennial grass pastures. Planting with a drill (using the small seed box) or by broadcasting the legume seed can result in satisfactory stands. However, the seeding rate needs to be adjusted to compensate for the differences in these planting methods (Table 2). Information on broadcasting legume seed is detailed in the inset “Seeding Methods for Small-Seeded Legumes.”

Table 2. Seeding rates for achieving a solid stand of selected cool season annual legumes.

Species	Solid Stand [†]	
	Drill	Broadcast
	(lbs of pure live seed/acre)	
Arrowleaf clover	5-7	8-10
Ball clover	---	2-3
Berseem clover	10-15	18-20
Crimson clover	15-20	20-30
Red clover	8-10	12-15
Rose clover	15-20	20-25
Subterranean clover	8-10	10-20
Vetch, hairy	15-20	20-25
Winter pea	20-25	30-35

[†] When only one legume is seeded and not in a mixture with grasses or other legumes (e.g., sod-seeding into bermudagrass).

When planting into dormant warm season grass sod, one or more legumes may be used to achieve a solid legume stand. When planted in a prepared seedbed, one or more of these legumes are often mixed with a small grain crop or ryegrass. Seeding rates for the legumes used in such mixtures need to be adjusted to minimize seed costs and prevent excessive competition (Table 3).

Planting too deep is not usually a problem when legumes are broadcast on dormant warm season perennial grass sod. However, when the legumes (especially small-seeded species) are being drilled or broadcast onto a prepared seedbed, special care should be taken to ensure that the legume seeds are not planted more than ¼ - ½ inches deep (see the inset “Seeding Methods for Small-Seeded Legumes”). Large-seeded legumes such as lupine or common vetch can be planted up to 1 in. deep.

Table 3. Seeding rates for selected cool season annual legumes used alone or in combination with other legumes in a mixture.[†]

Species	Single Clover	Multiple Clovers
	in Mixture [‡]	in Mixture [§]
	(lbs of pure live seed/acre)	
Arrowleaf clover	6-8	5-6
Ball clover	2-3	1-2
Berseem clover	15-20	10-15
Crimson clover	15-20	10-12
Red clover	8-12	6-8

[†] Use lower seeding rates when planting into a prepared seedbed or no-tilled into existing sod (overseeding). Use higher seeding rates when seed is broadcast.

[‡] Winter annual clovers are typically grown with one or more winter annual grasses.

[§] Often two or more clover species will be grown with the grass. The seeding rate of an individual clover species can be reduced if multiple clovers are included in the mix.

Seeding Methods for Small-Seeded Legumes

Ideally, small seeded legumes should be planted using a cultipacker-seeder (prepared seedbeds only) or the small-seed box on a no-till or conventional drill. This provides the most accurate control of the seeding rate. However, the use of a no-till or conventional drill often results in small-seeded legumes being planted too deep (i.e., deeper than ½ inch). Some drills cannot be adequately adjusted to maintain a consistently shallow planting depth. Planting depth is harder to control when planting into wet soil, a soft seedbed, or rough ground.

If these equipment or condition limitations exist, successful seed placement can occur if the seed are broadcast directly behind the drill's shoes and in front of the press wheels. To do this, disconnect the tubes from the small seed box where it enters the drill's shoes and secure the tubes behind the shoes or in front of the press wheels with wire or cable ties. This should allow the seed to be metered out on the soil surface and the press wheels (with proper down-pressure) should firm the soil around the seed. This practice will ensure that the seeds are not planted too deep.

Accurately broadcasting small-seeded legumes (i.e., legumes with seeding rates less than 8-10 lbs/acre) is difficult with large spinner-spreaders. If the available equipment cannot be adjusted to apply the low rate that is required, the inoculated seed can be mixed with coarse sand or some other inert material that is similar in size and weight to the seed. Smaller seeds should not be mixed with larger seeds in the hopper or seed boxes, since the small seeds will settle to the bottom. Also, legume seeds should not be mixed with fertilizer, since the fertilizer may kill the inoculant.

Broadcasted seed may not have sufficient seed-soil contact. Conventional-till seedbeds should be firmed with a cultipacker before seed are broadcast. Footprints left by an average person on a properly prepared seedbed should not be more than ¼ inch deep. Broadcast seeding on a prepared seedbed should be followed with adequate firming of the seedbed with a cultipacker.

When planting into an existing sod, broadcasted seed should be "scratched-in" to the soil by using a chain drag or spike-toothed harrow. Some producers have also successfully used a pasture aerator. However, the aggressive use of a drag, harrow, or aerator can damage the sod and/or expose areas to soil erosion or weed encroachment.

Cool Season Perennial Legumes

Cool season perennial legumes are most productive in the spring and fall. During these times of the year, temperatures and rainfall usually provide very favorable growing conditions. These species slow down or even go dormant during the summer (especially if not irrigated) and have the potential of surviving for more than one year.

Alfalfa

Alfalfa is often referred to as the “Queen of Forages” because it produces high yields that are highly digestible and high in protein. Alfalfa can be effectively utilized in managed grazing, hay, or silage systems. It is often used in rations when nutritional needs are very high.

Alfalfa requires a combination of proper soil characteristics (well-drained, fertile, low acidity, etc.) with outstanding management (appropriate variety selection, timely harvests, pest control, etc.) to maintain long-lived, productive stands. Alfalfa requires deep, well-drained soils. It develops a deep root system if root growth is not restricted by hardpans, high water tables, or acid subsoil.

Alfalfa can be grown throughout the state where suitable soils occur. In general, well-drained bottomlands in the Limestone Valley/Mountains and Piedmont regions will provide the best results. Within the Coastal Plain region, the sandy loam soils provide good sites, especially if irrigation is available. Most sites in the Atlantic Coast Flatwoods and Tidewater areas will not be sufficiently well-drained to successfully produce alfalfa.

Alfalfa requires a relatively neutral soil pH (6.5-6.8) and non-limiting levels of essential nutrients. Alfalfa is especially sensitive to potassium (K), phosphorus (P), boron (B), and molybdenum (Mo) deficiencies. Close adherence to soil test recommendations during and after establishment are critical.

Alfalfa stands eventually thin to a point where the land must be rotated out of alfalfa. However, the lack of sufficient soil fertility is the most common contributor to accelerated stand declines. Disease pressure, insect damage, poor weed control, overgrazing, and improper cutting management also contribute to poor persistence. Stands in the Coastal Plain region generally have a shorter life (two – five years) than stands on the heavier soils in north Georgia. It is not uncommon for stands to persist for four – seven years (or longer) in the Piedmont and Limestone Valley/Mountains regions.

Establishing Alfalfa

For monoculture stands, it is best to seed alfalfa on a well-prepared, firm seedbed. On prepared land, plowing and disking operations should be done as needed to incorporate pre-plant applications of lime and fertilizer and to ensure a good firm seedbed. A preemergence application of a labeled herbicide, such as EPTC (Eptam) or benefin (Balan), is desirable (for



Alfalfa (*Medicago sativa*)

currently labeled herbicides, see the Georgia Pest Management Handbook at <http://www.ent.uga.edu/pmh/>). Alfalfa may be seeded with a cultipacker-seeder (best) or a grain drill with a small seed attachment. Cultipacking or rolling before and after seeding will give a firm seedbed and improve stands.

When seeding alfalfa with a grass such as tall fescue or orchardgrass, drill the grass in rows and immediately overseed the alfalfa with a cultipacker-seeder. For seeding into existing cool season grass sods (e.g., tall fescue, orchardgrass), suppress the grass by closely mowing or grazing, follow with a contact herbicide, and then plant with a no-till drill.

When planting alfalfa into a bermudagrass sod, ensure that the grass is dormant and closely mowed or grazed. If the stand is to be primarily an alfalfa stand, use a row-spacing of 15 in. or less. If the stand is to be managed as a mixture of bermudagrass and alfalfa, use a row-spacing of 21 in. or more.

Alfalfa should be seeded at a rate of 18 – 25 lbs per acre (Table 4). Rates at the high end of this range should be used when planting with a no-till drill. Regardless of the system used to plant the alfalfa, the seed should not be placed too deep (1/8 – 1/4 in. in loamy or clay loam soils; 1/4 – 1/2 in. in sandy loam or sandy soils). Soil should be firm around the seed to provide proper seed-soil contact. An insecticide application after initial germination may be needed to control insects such as field crickets.

In the Limestone Valley/Mountains region and the upper half of the Piedmont, a fall

Table 4. Seeding rate of selected cool season perennial legume species when broadcast, drilled, or planted with a cultipacker-seeder (CPS).

Legume Species	Method[†]	Seeding Rate (lbs of pure live seed per acre)
Alfalfa	Broadcast	22 - 25
	Drilled or CPS	18 - 25
Red clover	Broadcast	12 - 15
	Drilled or CPS	6 - 8
White clover	Broadcast	2 - 3
	Drilled or CPS	2 - 3

[†] CPS: cultipacker-seeder.

seeding in mid-September – late October is recommended. In the lower two-thirds of the state (Lower Piedmont and Coastal Plain), a mid-October – late November seeding is recommended. Plantings made in early March – mid-April are much less desirable, but may be successful in north Georgia if there is a very aggressive defense against weeds and irrigation is available. When planting into cool or warm season perennial grass sods, do not plant in the spring.

Additional information about the management and use of alfalfa can be found in “Alfalfa Management in Georgia.” Specific information about alfalfa varieties that are currently recommended may be found on the web page entitled “Forage Species and Varieties Recommended for Use in Georgia” (<http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html>).

White Clover

White clover is one of the most widely-grown forage legume crops in the world. It is adapted to a wide range of soils and climates and is grown for forage from Florida to the northeastern United States. White clover is a relatively low growing legume that spreads by stolons and can tolerate close grazing. It furnishes grazing in fall, late winter, and spring. Yields of white clover are usually not sufficient for it to be grown alone or in a hay crop, but it contributes a substantial amount of high quality forage when produced with cool season perennial grasses, such as tall fescue. White clover is also compatible with some bermudagrass varieties, when grown in pastures.

White clover grows best on moist soils and can die during hot, dry summers. However, some new varieties of white clover are more persistent and will either survive these conditions or return from seed. This legume is generally most productive on fertile soils along streams. In the upper Piedmont and Limestone Valley/Mountains region, white clover does well on upland soils.

There are three basic types of white clover: large (e.g., Ladino clover, 'Patriot,' 'Regal'), intermediate (e.g., 'Durana,' 'Osceola'), and low growing (e.g., Dutch clover). Large or ladino types are higher yielding than other types, but they do not reseed as well as the other types and are generally more short-lived.

The intermediate types are well-adapted to most sites throughout Georgia. They are prolific reseeder and may act as annual plants in south Georgia. Some improved intermediate white clovers are exceptionally tolerant of grazing and persist very well, even in some drought-prone and infertile sites.

Low-growing types are commonly seen growing on roadsides and in yards. Although they also are prolific reseeder, they are not planted for forage because of low yields and a poor ability to compete with grasses.

Red Clover

Red clover is a short-lived perennial legume that is adapted to a fairly wide range of soils. It is deep-rooted and, like alfalfa, does best on well-drained sites. It is more tolerant of lower fertility and soil acidity than alfalfa, but it does best and persists better under good fertility. Red clover stands generally start to thin the second year. Some stands in Georgia have persisted for several years (most likely a result of reseeding). Red clover is best adapted to heavy fertile soils in north Georgia and can be seeded into tall fescue or orchardgrass stands along with white clover.



White clover (*Trifolium repens*)



Red Clover (*Trifolium pratense*)

However, red clover does not tolerate close grazing and will not produce or survive well in continuously stocked pastures. Diseases also may limit stand life during cool, moist springs.

In some areas of south Georgia, red clover is used as an annual to overseed pastures or mix with a small grain or ryegrass. Some varieties are available that are resistant to root-knot nematodes and well-adapted to sandy loam and loamy soils in the Coastal Plain. These varieties are usually less winter dormant and produce more spring and autumn forage than other varieties. Though these more winter-active varieties are well suited to south Georgia, they may be less winter hardy than other varieties and not well suited for north Georgia. Regardless, red clover should not be planted on droughty soils such as deep sands.

Establishing White and/or Red Clover

White clover and red clover are well-suited for use as a companion to tall fescue or orchardgrass. These clovers can be planted along with cool season perennial grasses in new plantings or can be established into existing grass stands (Table 4).

When planted with grass seed, either clover can be very competitive with the grass. Therefore, clover seeding rates should be reduced by 25% when used in new plantings with a cool season perennial grass. In most cases, it is best to interseed the legumes after the grass stand is well-established.

Seeding rates are 2 – 3 lbs of white clover per acre (drill or broadcast) and 6 – 8 lbs of red clover per acre when drilled or 12 – 15 lbs per acre when broadcast. When seeding into tall fescue sods in the fall, closely graze or clip the grass before planting. On thick sods, some seedbed preparation (mild disking) may be needed to thin the sod and to improve the vigor of the clovers during establishment. Contact herbicides may also be used to retard the fescue in the fall to aid in obtaining a good stand of clover. The use of a no-till drill, which can cut through the sod and place the seed into the soil, is the preferred method of seeding (especially for red clover). Broadcasting and dragging seed onto a rough prepared seedbed can also be successful (see the inset “Seeding Methods for Small-Seeded Legumes”).

White clover and red clover should be seeded in the fall (September-October). In the Limestone Valley/Mountains Region, either clover can be planted in the winter (late January to early March). For a late winter seeding (sometimes called “frost seeding”), the seed may be broadcast or drilled into a closely-grazed sod. Where the soil is exposed, the freezing and thawing of soil moisture during the winter will allow broadcast seed to work down into the soil. Many farmers in the Limestone Valley/Mountains Region have had better results with late winter than with fall seedings because of better moisture conditions and fewer insect problems.

Information about red clover and white clover varieties that are currently recommended may be found on the web page entitled “Forage Species and Varieties Recommended for Use in Georgia” (<http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html>).

Other Cool Season Perennial Legumes

Seed of several other cool-season annual legumes (e.g., alsike clover, birdsfoot trefoil, etc.) is available, but are not commonly used. In general, these species are relatively expensive, difficult to establish, provide relatively low yields, are disease-prone and/or are not very persistent. This relegates them to minor production niches, rather than extensive use.

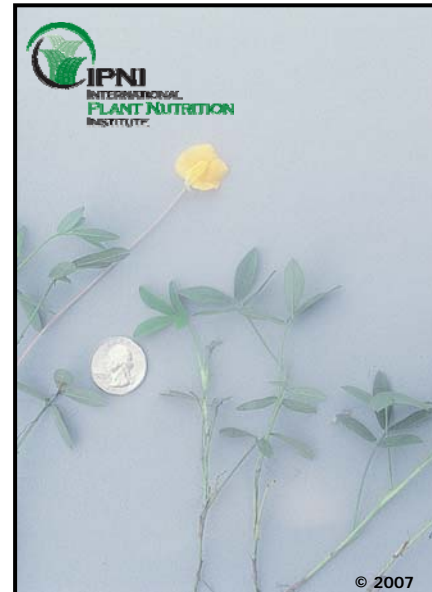
Warm Season Perennial Legumes

Warm season perennial legumes are productive during late spring and throughout the summer months. During these times of the year, temperatures and rainfall usually provide very stressful growing conditions (e.g., drought, disease pressure, etc.). Despite those conditions, these species are quite capable of producing substantial yields of high quality forage during the summer.

Perennial Peanut

Perennial peanut is a rhizomatous peanut species that produces high-quality forage and persists well in the area in which it is adapted. This tropical legume is native to South America in a region that mostly lies north of the 30°S latitude. As a result, perennial peanut generally does not survive well north of the 31.5°N latitude (roughly a line from Albany to Jesup). Within these locations, it is best suited to well-drained sandy or sandy loam soils. Varieties that are currently available do not have good cold tolerance and may winter-kill during severe winters.

Perennial peanuts are established by planting rhizomes during December – early March at 80 bushels per acre (up to 120 bushels per acre, if sprigs are inexpensive or freely available.). Perennial peanut may require two years or more to develop a solid stand after sprigging. The establishment phase will be minimized under irrigation. Once established, the stands do not generally tolerate close or continuous grazing. As a result, perennial peanut is primarily recommended for hay production. As a high-quality legume, perennial peanut is an excellent hay and baled silage crop.



Perennial Peanut (*Arachis glabrata*)



Sericea Lespedeza (*Lespedeza cuneata*)

Sericea Lespedeza

Sericea lespedeza is a long-lived, deep-rooted, drought resistant perennial that will grow on heavy, well-drained soils throughout the state. It grows erect, with stems 2 – 4 ft tall and can be used for grazing, hay, or soil conservation. Sericea is frequently used for cover on road banks to prevent erosion. Sericea can be grown on soils too acidic and infertile to support other forage legumes. However, it will not be very productive unless it is well fertilized.

Sericea can provide moderate quality forage. However, as the stems get taller and the plant matures, the stems become highly lignified and very woody. As a result, late maturity will result in very poor forage quality

and most animals will increasingly avoid areas of mature sericea. Therefore, sericea should be managed in such a way as to keep the plants growing vigorously. Grazing should begin when plants are 8 – 15 inches tall and should not be grazed closer than 4 inches. Hay harvests should be taken when plants reach 15 – 24 inches of height. Sericea provides good quality forage in summer when dry weather has reduced the growth of other forage crops.

Sericea lespedeza also contains high concentrations of condensed tannins. High levels of these tannins will reduce forage digestibility. However, research at Fort Valley State University has shown that these tannins can act as an anthelmintic (dewormer) to help control parasitic worms in small ruminants (e.g., goats, sheep). The use of sericea for this purpose holds significant promise as producers seek ways to reduce the buildup of anthelmintic-resistant populations of internal parasites. Low-tannin varieties of sericea lespedeza are also available, and these are more palatable than high-tannin varieties.

Sericea lespedeza can be seeded on a prepared seedbed in the spring as soon as the last spring frost has passed. A cultipacker-seeder should be used to seed 15 – 20 lbs of inoculated, hulled, scarified seed per acre. Sericea stands are slow to establish, so it is essential to apply a pre-plant incorporated herbicide. Do not cover the seed with more than ¼ in. of soil. Generally, sericea should not be grazed or cut for hay in the establishment year unless weather conditions have been excellent, resulting in rapid growth.

Information about perennial peanut and sericea lespedeza varieties that are currently recommended may be found on the web page entitled “Forage Species and Varieties Recommended for Use in Georgia” (<http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html>).

Warm Season Annual Legumes

The warm season annual legumes are also productive during late spring and summer. They are not frost tolerant and do not survive winters. However, these species can produce high quality forage during the summer when it is needed.

Annual Lespedezas

Annual lespedezas used for forage in the South consist of two species (striate lespedeza and Korean lespedeza) that were introduced from Korea and Japan. They are adapted to a wide range of soils and fertility levels and are used in pasture mixtures to provide good quality grazing from late spring until fall. Annual lespedezas can be cut for hay but yields are relatively low. High levels of soil fertility will result in the lespedezas being crowded out by warm season perennial grasses.

Striate Lespedeza

Striate lespedeza is commonly referred to simply by the variety names ‘Kobe’ or ‘Marion.’ Striate is the most useful of the annual lespedezas in the South. It provides significant grazing and can be cut for hay. Striate has narrower leaflets than Korean varieties and produce seed in the axils of branches directly along the stem. Varieties of this species are prolific seed producers and will reseed in pastures. Improved varieties have superior reseeding potential, yields, and disease resistance.



Striate Lespedeza (*Kummerowia striata*)



Korean Lespedeza (*K. stipulacea*)

Korean Lespedeza

Korean lespedeza matures earlier than the striate varieties and provides earlier grazing in summer. However, the growth of Korean varieties declines earlier in the fall than striate varieties. Korean does not volunteer well in south Georgia and is less tolerant of acidic soils than the Striate varieties.

Annual lespedeza can be sown from mid-winter until early spring. Adequate stands in pastures, fallow land, or overtop of small grain crops will normally be achieved by broadcasting seed without covering. When planting in late spring on prepared seedbeds, use a grain drill or cultipacker-seeder to cover seed with about ¼ in. of soil. For a pure stand, broadcast 25 – 30 lbs or drill in 15 – 20 lbs of inoculated, unhulled seed per acre.

Forage Soybeans

Forage soybeans are typically harvested for hay or silage. However, they can be used for late summer temporary grazing. Since they do not regrow once defoliate, strip-grazing (or frontal grazing) is the grazing system that is most likely to result in the most efficient use of the forage. Soybean forage is fairly digestible (up to 60%) and moderately-high in CP (17-19%). Stem size can be reduced, thus increasing digestibility, if seeding rates of 90 – 120 lbs of seed per acre are used. Planting late maturing varieties (maturity groups 6, 7, or 8) in early May through early June



Forage Soybean (*Glycine max*)

will result in forage soybean production best suited for high yields. Shorter periods of growth, such as part of a double- or triple-crop system, can be accommodated with early maturing varieties. However, productivity is expected to be substantially less.

Other Warm-Season Annual Legumes

Several other warm-season annual legumes are available, but are not commonly used. A partial list of those that could provide acceptable forage yields and quality include: alyceclover, annual peanut, cowpeas, hairy indigo, joint vetch, kudzu, lablab (sweet hyacinth bean), and velvetbean. In general, however, these species can be relatively expensive and difficult to establish, provide relatively low yields, and/or are not very tolerant of grazing. This relegates them to minor production niches, such as wildlife food plots, rather than extensive use.

Quantity of Nitrogen Fixed

Each of the aforementioned legumes can fix appreciable quantities of nitrogen (N), though species differ substantially in the amount of N that they will fix (Table 5). In addition to species differences, the amount of N that is fixed also depends upon the rate of plant growth, total forage yield, length of the growing season, and methods of grazing or harvesting.

Since N-fixation requires so much energy from the plant, it is critical that the plant is able to maintain a rapid growth rate. Nitrogen fixation will be drastically reduced by factors that slow crop growth and seasonal yield totals (e.g., drought, water-logged soils, unfavorable temperatures, low light conditions/shading, low soil fertility, low soil pH, competition from weeds or other plants, insect damage, disease, etc.).

The growing season of the legume also impacts the amount of N that is fixed. Legumes with a long growing season, such as alfalfa, will typically fix more N than annual legumes that have a shorter growing season and produce less total forage.

Nitrogen fixation is also affected by grazing and harvesting methods. Almost immediately after legumes are defoliated (either by grazing or mowing), N-fixation will decrease by 60 – 95%. Furthermore, research has shown that it may take 5 – 24 days for N-fixation rates to fully recover. The time it takes to recover, however, depends on how much of the legume was cut (i.e., how severe the defoliation was), the legume species, and the growing conditions. When legume stands are

Table 5. Estimated range in nitrogen fixing potential of several legume crop species.[†]

<u>Legume Species</u>	<u>Amount of Nitrogen Fixed[‡]</u> (lbs of N/acre)
Alfalfa	50 - 300
Arrowleaf clover	50 - 180
Ball clover	50 - 125
Berseem clover	50 - 250
Birdsfoot trefoil	30 - 200
Crimson clover	30 - 150
Lespedezas, annual	30 - 120
Lespedeza, sericea	40 - 100
Lupin	50 - 150
Medics, annual	50 - 150
Perennial peanut	50 - 250
Red clover	50 - 250
Rose clover	50 - 125
Subterranean clover	25 - 175
Vetch, Hairy	50 - 150
White clover	30 - 250
Winter peas	20 - 90

[†] Adapted from Johnson et al., 1997; Havlin et al., 1999; Ball et al., 2007.

[‡] The lower end of this range in nitrogen fixation is expected when the legume species makes up approximately 25% of the stand. The upper end of this range should only be expected in pure stands under excellent growing conditions.

continuously overgrazed or in pastures that are not given adequate time to recover, these legumes may be adding very little (if any) N to the forage system. Thus, legumes must be given time to recover from defoliation if N-fixation is desired.

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