

# **PRINCIPLES OF FORAGE LEGUME MANAGEMENT**

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## FORAGE LEGUME SPECIES

Forage legume species grown in Texas are as diverse as the soils and climates found across the state. They differ in their growth habit, growing season, cold tolerance, and adaptability to soil texture, pH, and drainage. Good stands, maximum growth, high N<sub>2</sub>-fixation rates, and persistence are dependent on the forage legume species being well adapted to the soil and climate. The basis for successful legume production is to know your soil types and select legume species that are adapted to those soil types. The local USDA Natural Resource Conservation Service can provide assistance in identifying the soils on your farm or ranch. Following is a discussion of most legume species grown in Texas that includes their strengths and weaknesses and where they are best adapted. Preferred soil characteristics, plant characteristics, and seed rates are condensed in Table 1.

### Alfalfa

Alfalfa is the best-known forage legume in the United States and is referred to as the "Queen of the Forages". It is the only forage known to have been cultivated before the era of recorded history. Although classified as a cool-season legume, it grows throughout the summer if moisture is available. Because of this long growing season it has the capacity to produce large yields of high quality forage. It is best adapted and grown most extensively in the mid-west US. However, varieties have been developed that are adapted to most climates in the United States.

Alfalfa does best on deep, well-drained loam to clay loam soils with a pH near 7.0. In the eastern half of Texas, the optimum sites are river bottoms of the Brazos, Colorado, and Red Rivers. Alfalfa can be grown on any soil with good internal drainage and a subsoil pH of 5.5 or higher. Lime can be added to raise the surface soil pH to near 7 and nutrients limiting for optimum growth can be applied. When sandy acid soils are limed to pH 7, boron is critical for alfalfa if soil boron is less than 1.0 ppm. Autumn planting dates are preferred over spring because of fewer weed problems. Recommended seeding rates are 16 to 20 lb/acre planted at ¼ in. depth in clay soils to ½ in. depth in sandy soils in a clean, firm seedbed.

Alfalfa can be a very profitable forage crop, but it requires a high level of management. Chemical weed control is required to obtain good clean stands. Most disease problems have been solved by selecting for resistance. Alfalfa weevil and three-cornered alfalfa hopper are the main insect problems but all can be controlled with insecticides. Its primary use is hay for dairy cows and horses. With the development of grazing tolerant varieties, more alfalfa is being used for grazing.

### **Arrowleaf Clover**

Arrowleaf clover is one of the major annual clover species grown in the southeastern USA. It is native to the Mediterranean region, Balkan Peninsula, and areas west and north of the Black Sea. It has large white flowers with a pinkish cast and can grow over 4 ft tall if not grazed or cut. Arrowleaf clover is more sensitive to soil pH than some of the other legumes. It is best adapted to loam and sandy soils with a pH of 6 to 7 but does not grow well on clay or poorly drained soils. Seedling emergence is delayed on soils with a pH below 6 and can be affected by iron chlorosis on soils with a pH above 7. Seedling growth is poor with seedlings staying in a rosette stage until late February. This results in very little forage production until early March. Arrowleaf clover is the latest maturing, and therefore the highest yielding, annual clover with growth continuing through June and early July if moisture is adequate.

Arrowleaf clover seed are small with 400,000 seed/lb. Because up to 90% of the seed are hard only scarified seed should be planted at 8 to 10 lb/acre. Fall planting should be delayed until night temperatures drop to the low 60's for the best seed germination. Arrowleaf clover is an excellent reseeder but the volunteer stand may be poor the first autumn because of the high hard seed percentage. Planting an additional 4 to 5 lb/acre of scarified seed the first reseeding year will ensure that an adequate amount of soft seed is present to obtain a good stand.

Virus diseases have become a major problem with arrowleaf clover. Leaves of affected plants will be crinkled, have a light and dark green mosaic pattern, and a chlorotic appearance. Root rots have also been a problem. Early symptoms are poor stands in the autumn because of seedling loss. Surviving plants will do poorly during the winter because of root damage and may die when grazing begins. Leaves of arrowleaf clover may turn red because of stress due to disease, low temperatures, or other environmental factors. Plant breeding efforts at the Texas A&M University Agricultural Research and Extension Center at Overton have resulted in new germplasm that has tolerance to bean yellow mosaic virus. Arrowleaf clover seed coated with a fungicide has provided some protection against the root diseases. Early planting from mid-September to mid-October has also improved seedling survival against these diseases.

### **Ball Clover**

Ball clover, which was introduced from Turkey, has small ovate leaflets and small white to yellowish-white flowers. If not cut or grazed, stems can grow up to 3 feet and are prostrate to partially erect, often forming a thick mat. This prevents using ball clover for hay and makes harvesting seed difficult. Seed are very small (approximately 1,000,000 per lb) with a



recommended seeding rate of 3 lb/acre. Ball clover does best on loam and clay soils but has done well on relatively level sandy soils near creek or river bottoms that maintain good soil moisture. It does not have good drought tolerance, and growth will be reduced in a hot, dry spring. It prefers a soil pH of 6 or higher. Ball clover cannot tolerate wet soils as well as white clover. It is medium maturity, flowering about a month later than crimson with yields usually slightly less than crimson.

Ball clover has excellent reseeding. Hard seed content is about 60% and it will produce some flowers even under close grazing. In 1966, there were an estimated 100,000 acres of ball clover in Alabama. Ball clover does have a high bloat potential and should be managed accordingly.

### **Berseem Clover**

Berseem clover, also called Egyptian clover, is believed to have originated in Syria. It was introduced into Egypt in the 6<sup>th</sup> Century and is now grown on half the cultivated land in that country as a winter cover and green manure crop. Berseem clover is also a prominent legume in India. It has oblong leaflets, hollow stems, large white flowers, and can grow up to 2.5 ft. tall. Berseem clover was evaluated throughout the southeastern United States in the early 1950's. Although high yielding, berseem clover lacked cold tolerance. Bigbee berseem, a joint release by the USDA and the Mississippi Agricultural and Forestry Experiment Station in 1984, has improved cold tolerance. However, even Bigbee berseem is considered less cold hardy than most of the other annual clovers. Berseem clover is well adapted to river bottoms and clay soils with a pH of 6 to 8. It has persisted in river bottoms that are subject to temporary flooding. If inundated for 4 to 5 days, top growth will die. But after the water drains off, new shoots will develop from the crown. Berseem clover has medium size seed with 207,000 seed/lb. Recommended seeding rate is 12 to 16 lb/acre. Bigbee berseem has excellent seedling vigor with growth 8 to 10 inches tall by December if planted on a prepared seedbed in late September or early October along the Gulf Coast. Grazing should begin when it is 6 to 8 inches tall to stimulate tillering and limit frost damage. Bigbee berseem clover begins flowering in late April. It does well under irrigation in southern California and is used as a summer green manure crop in crop rotations in the mid-west. Bloat potential of berseem clover is low but animal losses due to bloat have been reported.

### **Crimson Clover**

Crimson clover is native to Europe and is the most widely adapted annual clover species grown in the southeastern United States. It has scarlet or deep red flowers and is used extensively

for roadside stabilization and beautification throughout the southeastern United States. Crimson clover grows on soils ranging from sands to well-drained clay soils with a pH of 5 to 7. Best growth occurs at a pH of 6 to 7. Iron chlorosis has been a problem on calcareous soils at a pH of 7.3 or higher. Recommended seeding rate is 16 to 20 lb/acre. Crimson clover seed is one of the larger seeded annual clovers with 150,000 seed/lb and has excellent seedling vigor. If planted early, it can produce a substantial amount of forage in the autumn and has earlier forage production than the other clover species. However, winter temperatures about 15°F or lower have caused some top kill that will reduce early spring growth.

Crimson clover is the earliest maturing annual clover. The combination of good seedling vigor and early maturity makes it ideal for overseeding warm-season perennial grasses. Crimson clover is considered a poor reseeder because of hard seed levels of only 10%. Most soft seed germinate with the first rain after seed maturation. Range in maturity of present varieties is about 12 days. Columbus crimson, which is not available at this time, is about 4 weeks later. Early forage production of Columbus is probably lower than the other varieties. Another variety is being developed at the Texas A&M University Agricultural Research and Extension Center at Overton for growing with annual ryegrass and managed as an annual reseeding pasture. It will flower about 2 weeks later than available varieties and the same time as TAM 90 annual ryegrass. Hard seed percentage will be from 60 to 80% which should provide excellent reseeding.

### **Persian Clover**

Persian clover is native to Asia Minor and the Mediterranean region. The actual time of introduction to the United States is not known, but it was found growing in Wilcox County, Alabama in 1923. Common Persian clover has small leaves and reaches a height of 12 to 18 in. with small, light purple flowers. It is found on loam and clay soils, especially in low-lying areas with soil pH of 6 to 8. Seedling growth is best at a pH of 7 to 8. Persian clover spreads during flooding because the calyx swells at seed maturity and serves as a float, allowing the seed to move to other flooded areas. Recommended seeding rate is 6 to 8 lb/acre. The seed are small with 600,000 seed/lb.

Abon Persian clover, a joint release of the USDA and the Texas Agricultural Experiment Station, was developed at the Texas A&M University Agricultural Research and Extension Center at Beaumont in the early 1960's. Abon Persian clover was selected for improved hard seed production and higher yields. Grazing can begin 4 to 8 weeks earlier in the fall and extend 4 weeks later in the spring than common Persian clover. Abon has larger leaves and taller stems than common Persian and in southeast Texas, flowers in May and produces mature seed about



June 10. Persian clover does have a high bloat potential. Abon Persian would probably not survive temperatures below 10°F. There is no commercial seed available of Abon Persian clover, but seed is available of varieties selected in Australia.

### **Red Clover**

Red clover is a weak perennial with stands lasting 2 to 3 years in the northern 2/3 of the United States but usually only 1 year in the Lower South (35° N latitude southward). Red clover is best adapted where summer temperatures are moderately cool to warm with good soil moisture conditions. It prefers loam to clay loam soils as long as they are well drained. It will grow on flat sandy soils (flatwoods) with good moisture. Soil pH needs to be above 6. In the South, red clover reaches a height of 2 to 2.5 ft. with numerous leafy stems rising from the crown. Hairs are present on both leaves and stems. Flower color varies from light pink to rose purple to magenta. It has a tap root that gives it some drought tolerance.

Recommended seeding rate is 10 to 12 lb/acre planted at a ¼ to ½ in. depth. Red clover will grow into June and July if moisture is available. Cherokee red clover is the only variety developed in the South so it begins spring growth earlier than other varieties. Red clover can be used for both hay and grazing but does not tolerate close grazing.

### **Rose Clover**

Rose clover is native to the Mediterranean region and Asia Minor and is one of the few clover species that is adapted to low rainfall areas. Most of the rose clover acreage is on the California rangelands that receive at least 10 in. of rain during the winter growing season. Overton R18 was selected for climatic and soil conditions in the southeastern US at the Texas A&M University Agricultural Research and Extension Center at Overton. It matures 4 weeks later maturing than the early varieties grown in California and Australia with twice the production. Rose clover is adapted to all soil types with a pH of 5.5 or higher but not to poorly drained soils. Some iron chlorosis problems have been reported on calcareous soils with soil pH near 8.0. Optimum pH for seedling growth is 6.0 to 6.5. Recommended seeding rates are 12 to 16 lb/acre. Rose clover has a medium size seed with 164,000 seed/lb. Poor seedling growth and nodulation is a major limitation of rose clover that results in later spring growth than the other legume species.

Its greatest success has been in North Central Texas and Central Oklahoma where the annual rainfall is 25 to 30 in., which limits the growth of most other legumes. The good drought tolerance is due to a deep rooting depth. Rose clover is an excellent reseeder because of a hard

seed percentage of 90%. California data have shown that if volunteer clover stands are lost to drought or insects several years in a row, there would still be sufficient hard seed remaining to reestablish the rose clover stand.

### Subterranean Clover

Subterranean clover, also called subclover, is native to the Mediterranean region. Subterranean clover is the common name for three *Trifolium* species, *subterraneum*, *brachycalcycinum*, and *yanninicum*. Most varieties grown in the United States are *subterraneum* species. Subclover is best adapted to soils ranging from a fine sandy loam to clay with a pH from 5.5 to 7. Like arrowleaf, it usually becomes chlorotic and stunted on soils with a pH above 7.3. The *brachycalcycinum* species of subterranean clover is adapted to soil pH's above 7.0 but has less cold tolerance. Subclover has a low growth habit which forms a dense sod that seldom exceeds a 10-in. height. Its short height is deceiving. Forage yield of a 5- to 6-in. high subclover pasture is similar to a 12-in. high arrowleaf clover pasture.

Flowering and seed development in subclover are different from other clovers. After pollination, the flower develops in a burr. At the same time the stem bearing the burr bends downward, placing the seed in the soil surface. Therefore, grazing can continue during this time without reducing seed production. In fact, seed production is reduced if subclover is not kept grazed down to a 2- to 3-inch height during flowering. The stoloniferous growth habit of subclover makes it well suited for close grazing animals like sheep, goats, and deer.

Subterranean clover is the largest seeded cool-season clover with about 55,000 seed/lb. Therefore, it is quick to emerge and has excellent seedling vigor. Recommended seeding rates range from 16 to 20 lb/acre. However, good stands have been obtained with only 8 lb/ac when planting in a pure stand on a clean, firm seedbed using a drill. Planting depth is critical on subclover. Seed should not be placed deeper than ½ inch. Early forage production is reduced with the lower seeding rates but thick solid stands develop by spring. Near Interstate 10 and south, seedling vigor of subterranean clover is greater than crimson clover. Moving north, crimson clover seedling growth is greater because of better growth at low temperatures. Hard seed percentage can be low because of rainfall during seed maturation that results in unreliable reseeding. Reseeding appears to be better on heavy soils than lighter soils.

### Sweetclover

Sweetclover is not a true clover (*Trifolium* sp.) but is a *Melilotus* genus. At one time, it was the most widely grown forage legume in the United States. It is one of the most drought-



tolerant legumes and was grown for forage and soil improvement, particularly in the Great Plains and the Corn Belt. Sweetclover will grow almost anywhere there is a minimum of about 17 in. rainfall and soil pH is neutral to alkaline. The three general cultivated types of sweetclover are biennial yellow flower, biennial white flower, and annual white flower. Hubam and Floranna were annual white flower types that were grown in the southern USA. In the late 1940's and early 1950's, over 9 million pounds of sweetclover seed were produced in Texas annually. The advent of cheap nitrogen fertilizer after World War II and the spread of the sweetclover weevil (*Sitona cylindricollis*) eliminated most of the sweetclover acreage in the United States. However, it is still grown in Canada. Both white and yellow flower types are found growing along roadsides throughout the United States.

Sweetclover can be planted in the southern states in October at 12 to 16 lb seed/acre. Successful stands have been obtained in Central Texas when seeded in late January and February. It has a medium seed size with approximately 260,000 seed/lb. Sweetclover plants are 3 to 7 feet tall at maturity depending on variety. Annual sweetclovers are late maturing, flowering from May through June in the southern United States. Sweetclovers contain coumarin that causes a bitter taste to which animals become accustomed. If sweetclover is baled at too high a moisture level, the coumarin changes to dicoumarol, a blood anticoagulant. Cows eating the moldy hay can die of internal bleeding. Genes for low coumarin have been found in a wild sweetclover type but none of the annual sweetclover varieties contain the low coumarin gene. A breeding program has been initiated at Texas A&M University Agricultural Research and Extension Center at Overton to transfer the low coumarin gene to annuals. At this time, only seed of Hubam sweetclover is available.

### Vetch

There are many different species of vetch including 15 that are native to the US. Cold-hardy vetch species such as hairy vetch are adapted over a wide area of the US. Common vetch is less cold-hardy and is limited to areas with mild winters such as the Gulf Coast area. Vetch is adapted to a wider range of soil types and pH's than most other forage legumes. It grows on sand, loam, and clay soils from pH 5 to 8. It also has excellent seedling vigor because of its large seed. There are approximately 16,000 seed/lb for hairy vetch and 7,000 seed/lb for common vetch. Stems bear leaves with pinnate leaflets and terminate in tendrils that attach themselves to stems of other plants. White or purple flowers, depending on the species, are borne in a cluster or raceme. Hairy vetch flowers during April and May. Seed and pod characteristics vary with species.

The main use for vetch is for a green manure crop in rotation with a summer annual. It



maintains a high nitrogen concentration through plant maturity. A mature crop of hairy vetch will contain about 150 lb nitrogen/acre. Vetch does not tolerate close grazing and should not be grazed shorter than 6 in. Insects are the main disadvantage of vetch. Pea aphids, corn earworm, fall armyworm and spider mites can be problems. The vetch bruchid or weevil destroys the interior of the seed reducing seed yields, which is the main reason for poor reseeding.

Table 1. Soil characteristics for optimum growth of cool-season annual legumes, legume species characteristics and recommended seeding rates (Evers and Smith, Research Center Technical Report No. 98-3, Texas Agric. Exp. Stn.).

Clover species	Preferred Soil Characteristics			Plant Characteristics				Seeding Rate (lb/ac)
	pH	Texture	Drainage	Maturity	Bloat Potential	Reseeding Potential	Cold Tolerance	
Arrowleaf	6.0-7.0	sandy loam	good	late	low	good	good	8-10
Ball	6.5-8.5	loam, clay	fair	medium	high	good	good	3
Berseem	6.5-8.5	loam, clay	fair	medium	low	poor	poor	12-16
Crimson	6.0-7.0	sandy loam, clay	good	early	low	poor	good	16-20
Persian	6.5-8.0	loam, clay	poor	medium	high	good	fair	6-8
Rose (Overton R18)	6.0-8.0	sand, loam, clay	good	early-medium	low	good	good	12-16
Subterranean subterranean sp. (Karridale, Denmark)	6.0-7.3	loam, clay	fair	early-medium	low	poor-med	fair	16-20
brachycalycinum sp. (Clare, Nuba)	6.5-7.5	loam, clay	fair	medium	low	poor-med	poor	16-20
Sweetclover	6.0-8.0	loam, clay	good	late	low	good	good	12-16