Pasture Legumes: Establishment and Management

Chris Agee, Forage Specialist

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Natural Soil Fertility Aid
Worldwide there are some 19,000 leguminous species ranging from giant tropical trees and woody vines to annual and perennial shrubs and herbs. Legumes are valued for timber, dyes, resins, gums, insecticides, medicines, and animal and human feed. As permanent and temporary cover crops, legumes reduce soil erosion; improve surface water and groundwater quality; and increase soil organic matter, water infiltration, and soil nitrogen availability.

Farmers used legumes as a soil fertility aid for thousands of years. This particular plant family developed a symbiotic relationship with nitrogen- harvesting bacteria that takes advantage of the unlimited supply of nitrogen in the earth's atmosphere. Legumes are more than just an efficient influx of nitrogen into the nutrient cycle of the pasture. When grown with a companion grass, legumes are a source of high-quality forage capable of increasing animal productivity, animal gain per day, and animal gain per acre and of extending the grazing season. Legumes added to a tall fescue paddock reduce fescue toxicosis. They are an excellent tool for the grazing manager to increase pasture productivity by promoting diversity.

Site Preparation
Take a soil sample. Instructions are available from the Kerr Center or your local Extension office. Indicate on the sample container or order form that you will be growing a legume with a grass and request a micronutrient analysis.

Seedbed preparation can range from primary and secondary tillage to a light discing. The soil should have enough moisture to crumble when worked. The best time to work soil is after a rainfall. If you're establishing legumes in a crop field, use deep discing instead of moldboard or chisel plowing. If there is a hardpan, deep chiseling may be necessary. After deep discing, a spring-tooth or spike-tooth harrow drag followed by a roller or cultipacker should provide a sufficient seedbed. When seeding directly into existing sod, disturb the soil slightly to obtain the best results. A harrow or light discing works well.

Lime Application
Most pasture legumes require a soil pH of between 5.8 and 6.5. The soil pH of most pastures in southeastern Oklahoma is between 5.5 and 5.0 or less; too acid for good legume productivity. Lime applications raise the pH level. Apply lime in a split application: six months and one year before planting. For example, your test results indicate you need two tons of lime per acre. Apply one ton in the fall and one ton the following spring. Test the soil again before planting the following fall.

Lime sweetens soil slowly and performs best when it is worked into the soil to plow layer depth. If you're using primary tillage, apply the lime before these operations, so it can mix throughout the root zone. When broadcasting lime on an existing pasture, a light discing-in is advisable.

Once the soil reaches the proper pH level, it remains within an acceptable range for at least three years in most areas of southeastern Oklahoma. However, soil samples should still be taken every other year so that pH changes can be monitored.

Fertilization and Weed Control

A soil test indicates the amount of available nitrogen, phosphorus, potassium, and micronutrients in the soil. While legumes will eventually provide their own nitrogen source, a small application of nitrogen at planting is often recommended to encourage seedling vigor until the nitrogen-fixing bacteria are established. Phosphorus, like lime, takes some time to become effective. Mix in phosphorus when the second application of lime is being worked into the soil. Potassium can be applied with the nitrogen at planting. Apply the recommended amounts and any micronutrients as indicated on the soil test.

Adequate soil fertility is an important part of a weed control program. Weeds usually cannot compete with good stands of improved forage species that have been provided with lime, fertilizer, and proper grazing management. Good fertility keeps weeds from becoming established but is less effective once they become a problem. Clipping pastures provides some control by preventing weeds from setting seed. If annual weeds are cut below their growing points, most will die. Another alternative control measure is multispecies grazing with sheep, goats, and cattle. Herbicides can also control some common pasture weeds. However, herbicides are expensive, and only a few are labeled for use on pastures. To establish legumes into cropland, consider a preplant herbicide, because tillage operations have probably incorporated some weed seed. An alternative is to prepare the seedbed several weeks before planting and allow the weed seeds to germinate and emerge before plowing them under. Try the less expensive, alternative methods first, and use herbicides as a last resort.

Legume Selection

Planting a solid stand of a legume is not recommended, unless you are planning to sell high-quality pure legume hay. Bloat and other animal health problems occur more often with a pure legume stand. The most productive pastures are a mixture of diverse grasses and legumes. Plant one-half to two-thirds the recommended seeding rate of each legume and grass in the mixture to establish pasture on bare soil. Table 1 lists the most commonly grown legumes in this area.

Table 1. Legumes best adapted for use in southeastern Oklahoma			
Legume species	Seeding rate (lb/ac)	Seeding date	Production period
Winter Annual			
Arrowleaf clover	5 – 10	Sept. – Oct.	Mar. – May
Crimson clover	20 –30	Sept. – Oct.	Nov., Mar. – Apr.
Hairy vetch	15 – 20	Sept. – Oct.	Apr. – May
Summer Annual			
Korean lespedeza	15 – 20	Mar. – Apr.	May – July
Perennial			
Red clover	8 – 10	Sept. – Oct.	Mar. – May Sept. – Nov.
Ladino clover	3 – 5	Sept. – Oct.	Mar. – May Sept. – Nov.

Other warm-season annuals include cowpeas, Alyce clover, and fine-stemmed soybeans. Illinois bundleflower is a warm-season perennial receiving a lot of attention. Bundleflower, which is virtually indistinguishable from prairie acacia before flowering, is palatable to cattle and has a high protein content similar to alfalfa. The cultivar "Sabine" is recommended for this area; however, seed is expensive and hard to locate.

Selecting a persistent legume for a site can be frustrating. Start with small plots (half an acre) of several legumes and observe them during a grazing season. Gradually plant the legumes that performed well on more acreage until you have as much legume as needed.

Seed Inoculation

For a successful stand, the legume seed must be inoculated with the proper *Rhizobium* strain of bacteria. The bacteria actually scavenge the atmospheric nitrogen for the legume, and without bacterial colonization of the roots, the legume fails to thrive. The bacteria or inoculum are species specific, that is, the strain of bacteria that colonizes clover roots will not colonize alfalfa roots and vice versa. Some bacteria are even specific within a species. The effective bacteria for arrowleaf clover may not work as well on subterranean clover. Most legume seed is sold with the inoculum already on it (preinoculated) or with a packet of

inoculum included with the seed. An expiration date, indicating when the bacteria will be dead, appears on the preinoculated seed and on the packets of inoculum. If there is any doubt about the inoculum's condition, reinoculate the seed, even if it is preinoculated. The cost of the inoculum increases 5¢/lb on preinoculated seed and $1/acre on seed you inoculate.

Inoculating planted seed is difficult and usually unsuccessful. To apply the inoculum, moisten seed in a water solution of 20% table syrup or sugar in a large container. The syrup or sugar makes the seed sticky enough for the powdery inoculum to remain attached. Do not use a water solution with preinoculated seed that has a lime coating. One-half ounce of mineral oil per pound of seed works best. Keep inoculated seed and inoculum packets away from heat and direct sunlight and plant seed immediately. Store inoculum packets and preinoculated seed in a cool dry place. Proper inoculation will do more to ensure a good stand than any other practice.

Planting

If you're planting into a prepared seedbed, use a drop seeder with a packer roller. A grain drill with a small seed box can be used with a packer wheel or if the site is rolled afterwards.

When drilling into existing sod, graze it down heavily or mow it prior to planting. Before broadcasting seeds, a light discing followed by a harrow will ensure good seed to soil contact. (The same operation can be used to incorporate lime, fertilizer, and seed.) Never mix fertilizer with seed in a hopper. The salts from the fertilizer can quickly kill the bacteria inoculum.

After broadcasting, animals can be used to tread-in the seed. This method is used quite frequently in New Zealand. An area is broadcast seeded, and then the herdsman uses his dog to work animals back and forth over the area. Regardless of the planting method used, the most important factors are to get good seed to soil contact and to not plant too deep. A good rule of thumb is to plant a seed twice as deep as its diameter and never more than eight times its diameter.

Estimating Establishment Costs

Table 2 provides an estimate of the costs associated with establishing a legume into an existing pasture. Since the operations listed are optional, the costs are separated. Establishing legumes into a pasture is an investment, and each operation must be done correctly or the entire investment could be lost. The costs of bare soil establishment of pasture will be about the same except for an additional cost of grass seed and tillage.

Table 2. Establishment cost/acre for legumes based on custom rates		
Item	**Range of estimated cost ($)**	**Conditions**
Soil Fertility and pH		
Soil test	8	Cost negligible
Nitrogen[a]	0 – 6	20 lb @ 30¢/lb
Phosphorus[a]	0 – 20	100 lb @ 20¢/lb
Potassium[a]	0 – 13	100 lb @ 13¢/lb
Lime[a]	0 – 40	2 tons @ $20/ton (applied)
Fertilizer application (1 pass)	0 – 5	
Site Preparation		
Deep disc (1 pass)	0 – 12	Mix fertilizer
Light disc (1 pass)	5 – 8	Mix fertilizer
Spring-tooth (1pass)	4 – 5	Seed furrow/cover
Spike-tooth		Seed furrow/cover

harrow (2 passes)	4 – 8	
Cultipacker	0 – 7	
Seed	20 – 30	Incl. inoculum
Planting		
Seed drill	0 – 6	
No-till drill	5 – 12	
Broadcast	0 – 5	
Pest Control		
Herbicide		
Weedy grasses	0 – 15	1 post application
Broadleaf weeds	0 – 8	1 post application
Insecticide	0 – 8	1 application
Total	**29 – 193**	
[a] 1996 prices for eastern Oklahoma		

Grazing Management of Legumes

Managing and maintaining a legume does not require a higher level of management, only a different management philosophy. Many producers go through the expense of planting a legume and still practice grass management, nitrogen fertilization, and broadleaf weed spraying programs and then wonder what happened to the newly planted legume. Some producers successfully establish a legume but fail to adjust grazing pressure to fit the growth habit of the legume, and it fails to persist. Generally, light competition, growing point height, and grazing frequency are the most important considerations when managing a grass-legume

mixture. If the pasture manager compromises between the grasses and legumes, all will survive, and a productive pasture with increased forage diversity will result. A pasture of diverse grasses and legumes is better able to resist drought, insects, and diseases than a monoculture of grass or legumes, and therefore, more likely to persist.

The grass-legume compromise is best accomplished through controlled grazing. Grazing animals are moved through a scheme of paddocks removing most of the available forage in each paddock in a short period, usually several days. Animals are then moved to a new paddock, and the process is repeated until the animals complete the cycle back to the original, and now rested, paddock. Controlled grazing reduces selective or spot grazing, equalizing grazing pressure among forage species allowing grasses and legumes to persist. Time in a paddock is determined by forage growth rate, grazing pressure, and experience. The key to a successful cycle is to allow enough of a rest period for each paddock. This ensures adequate regrowth of a paddock for energy storage before being grazed down, enabling regrowth after the grazing cycle.

Whether you practice controlled grazing or not, some control over paddocks is necessary to ensure first year survival of any perennial grass or legume. Perennial species need rest during the first year so they can develop deep, strong root systems. Well-developed root systems promote drought tolerance, winter hardiness, disease and insect resistance, and quicker regrowth after grazing. The ability to remove animals from a paddock is also important for successful annual reseeding. Most annuals need 30 to 60 days to complete seed production.

Some light grazing can take place during this period. The reward is realized the next season when seedling volunteers appear in the pasture at no cost.

The growth cycle of each pasture species needs to be considered when making management decisions. The companion grass is most important. In this area, tall fescue and bermudagrass are the dominant species. Legumes can be successfully grown with each one.

Companion Grasses

Tall fescue is a cool-season perennial that makes most of its growth during the fall, spring, and early summer. It is semidormant during the hot summer months, but productive if moisture is available. Tall fescue is a bunch grass that tolerates soil acidity, poor drainage, drought, and abusive grazing. Winter annual legumes will survive with tall fescue if the tall fescue is hayed or grazed short and receives little or no nitrogen fertilization. Animal performance on endophyte-infected tall fescue grown with a legume will be improved.

Bermudagrass is a warm-season perennial productive from May to September and completely dormant during winter. If nitrogen application is restricted and a five-inch height is maintained through grazing or haying, annual and perennial summer legumes can compete and persist in a bermuda stand, increasing forage quality. Winter dormant bermudagrass sod makes an excellent seedbed for annual grains, grasses, and annual legumes for winter pasture.

Winter Annual Legumes
Arrowleaf clover produces from March to mid-June with some growth occurring during fall. It reseeds well with flowering and seed production occurring over a long period during late spring and summer. A high percentage of hard seed is produced, allowing for reseeding in the fall for three to four years from one season of seed production. For successful reseeding, the grass sod must be kept short during September and October to allow adequate light to reach the soil surface for seed germination. Arrowleaf will produce more leaves and remain productive longer if kept grazed to a height of two to four inches than when allowed to accumulate. For hay or seed production, grazing can continue until mid-May before being deferred. Arrowleaf responds extremely well to phosphorus and will produce 2.5 tons/acre of dry matter with 40 lb of additional phosphorus.

Crimson clover is earlier maturing and more tolerant of soil acidity and low fertility than arrowleaf. Crimson reseeds well and while not as productive as arrowleaf can fill in some forage gaps that occur during late winter.

Hairy vetch produces heavily during March and April and blooms in early May with seed maturing by late May. Vetch is a dependable reseeder if seeds are allowed to mature. It is tolerant of soil acidity and has a high phosphorus requirement. Grazing should not begin until the plants are at least 6 in. tall. Close grazing will destroy buds needed for regrowth.

Summer Annual Legumes
Annual lespedezas produce from July to September and are tolerant of soil acidity, low soil phosphorus, and drought. They reseed easily with seed production in September and October. Light grazing will allow some seed production at this time. Annual lespedezas fill a forage gap during the summer months when cool-season forages are producing little and the quality of warm-season grasses is low.

Perennial Legumes
Red clover is a cool-season perennial with most of its production occurring from March to June and during the fall months. Some summer production occurs if moisture is available. Red clover is a short-lived perennial, and overseeding 2 lb/acre on an annual basis may be necessary to maintain stands. It will not tolerate continuous close grazing as well as ladino clover. When planted with a companion grass, bloat is usually not a problem.

Ladino clover is a cool-season perennial that is productive from March to June and during the fall months. Ladino tolerates moderate soil acidity and wetter soils. It has low growing points which allow it to be grazed close. Companion grasses should be grazed down and maintained at 1 to 4 in. for good ladino productivity. When planted with a companion grass, bloat is usually not a problem.

Pasture Surveying
Before buying seed, survey your pasture for existing legumes and identify them. An increase

in the legume population in your paddocks may be possible with a change in pasture management. Allow any annual legumes, such as arrowleaf clover or annual lespedeza, to flower and seed. It is not necessary to do this every year; most annuals produce enough seed at one time to last several years. Defer grazing or haying of different paddocks yearly to allow seed production. This works well in combination with forage stockpiling. When cutting and baling hay, note areas that have a good legume stand. Feed the bales harvested from the legume area in another paddock. If any legume seed was harvested during baling, the cattle will do the planting while feeding. If you buy hay, ask the dealer for bales that might contain legume seed. Feed the bales throughout your paddocks.