

# Annual and Perennial Forage Clovers for Arkansas

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## Introduction

Clovers (the genus *Trifolium*) and other legumes are highly desirable species in pastures and hay meadows for many reasons. First, legumes can obtain nitrogen from air through their symbiotic relationship with *Rhizobium* bacteria and, therefore, are not dependent on nitrogen fertilizer. The fixed nitrogen is primarily used to support clover growth, but parts of it become available to neighboring grass plants when clover tissue dies. A second valuable role of clovers is to increase forage quality of pastures, hays or silages. Legumes are higher in crude protein and digestibility than most grasses commonly used in Arkansas. Animals usually consume diets higher in quality than grass alone when pastured on grass/legume mixtures or fed grass/legume hays. As a result, animal performance often improves when a clover is included in pastures, even though total forage yield may not increase. Adding clovers to toxic endophyte-infected tall fescue pastures also improves performance of cattle by diluting the toxicity of the endophyte. A third advantage is that clovers can help even out the forage supply over the grazing season by providing grazing time when other forages are not as active or are dormant.

Clovers are implicated in some health problems for livestock. Many clovers can cause bloat in grazing ruminants. Not all clovers cause bloat, and the problem is unlikely even with bloat-inducing types unless the proportion of clover in the stand is greater than 50 percent. A few clovers synthesize estrogen-like compounds called

phytoestrogens that can cause reproductive problems in livestock, especially sheep. Sheep should not be grazed on these clovers during the breeding season. On rare occasions, some clovers can become infected with a fungus that causes “slobbers” or excessive salivation in cattle and horses. If this occurs, animals should be removed from the offending forage.

In summary, clovers are beneficial additions to many forage programs because of improved forage growth distribution, increased forage yield, increased forage quality and reduced nitrogen fertilizer costs. These benefits lead to increased animal performance and profitability of the livestock enterprise. Winter annual clovers are considered better adapted to soil and environmental conditions in southern Arkansas than perennial clovers. Perennial clovers are slower to establish than annuals and are not very long-lived in the hot, humid Coastal Plains region of southern Arkansas.

In this fact sheet, the characteristics of annual and perennial clovers are described. Additionally, procedures for selection and establishment are presented for interested producers.

## Perennial Clovers

### Alsike Clover (*T. hybridum*)

Alsike clover is better suited for the very northern tier counties of Arkansas. This species is widely adapted in the Midwestern United States, but very sparingly south of the I-70 or I-64 corridors. It has better tolerance of wet and

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acid soils than most clovers. Alsike clover is not tolerant of shade. It should not be used for horse pastures because it tends to cause photosensitization, or sun scald, in that livestock species. Seeding rate is 4-6 lb/acre. Alsike clover is not as commercially available as red or white clover nor many of the annual clovers.

## Red Clover (*T. pratense*)

Red clover is classified as a short-lived perennial with a useful stand life of only two to three years. In southern Arkansas, it often acts like an annual and does not survive through extremely hot summers. It has excellent cold tolerance. Like white clover, it will go dormant during the summer heat, but it flowers later than white clover during a more defined period. Red clover is not tolerant of frequent close grazing and is best suited to hay meadows or paddocks that are rotationally stocked. Red clover is reasonably shade-tolerant and is particularly well-suited to mixtures with tall grasses like tall fescue and dallisgrass. It has the best seedling vigor of any perennial clover, which makes it a good choice for overseeding into cool-season perennial grasses. Natural reseeding is unlikely to be sufficient or cost-effective to maintain stands. It has excellent forage quality and contains a higher proportion of bypass protein than most other forages. As a result, cattle sometimes perform surprisingly well on this forage.

Red clover can cause bloat. It contains phytoestrogens that can impair the fertility of sheep but is not likely to cause fertility problems if grown in mixed grass/legume stands. Red clover is the clover most commonly implicated in cases of slobbers, but this is an unusual problem that should not discourage its use. Planting rate for red clover is 10-12 lb/acre. 'Cherokee', 'Kenland', 'Kenstar' and 'Redland II' are proven varieties for Arkansas. There are many others that may also work well.

## Sweetclover (*Melilotus officinalis* and *M. albus*)

The two sweetclover species (yellow and white) are not true clovers. These are biennial plants that reseed well to form "perennial" stands. Sweetclover is extremely tall, up to 8 feet. They are winter-hardy throughout Arkansas and tolerant of drought but do not tolerate acid soils. Sweetclover contains a bitter compound called coumarin which is extremely distasteful to animals. In moldy sweetclover hay, coumarin is converted into the toxic compound dicumarol which causes sweetclover poisoning in cattle. Low coumarin sweetclover varieties are available (white 'Polara' and yellow 'Norgold'). Planting rate is 10-15 lb/acre.

## White Clover (*Trifolium repens*)

Dutch white, intermediate, and Ladino clover are varieties within the same species. White clover is an allotetraploid, which means that there is ample genetic diversity to create variability in growth and performance. The Ladino cultivars have been selected for a taller plant and higher yields. These traits make Ladino more suitable for hay

than common or wild-type white clover (also called Dutch white clover). Intermediate white clovers have been developed that balance the persistence of Dutch types and the productivity of Ladino types. Common white clover grows very close to the ground and is perfectly adapted for use in continuous grazing systems or for livestock species that can graze close to the ground, such as sheep or horses. It is difficult for animals to kill common white clover through over-grazing.

White clover is cold-tolerant throughout the state and is among the most tolerant clovers for wet soil conditions. However, it will not tolerate summer heat and drought very well. In northern parts of the state, plants go dormant during summer. In southern parts of the state, they likely will die in summer. However, common white clover is a prolific reseeder, so stands will probably regenerate each fall. White clover is generally a very good reseeder, but some Ladino types are poor reseeders. White clover is shade-tolerant but can be shaded out of mixtures by taller grasses if canopy height is not carefully managed by hay cutting or grazing management. It does not generally persist well in mixtures with dense sods like bermudagrass or bahiagrass. White clover spreads laterally via aboveground stems or runners called stolons. Bloat potential of white clover is considered high.

White clover is often recommended for food plots for whitetail deer and turkeys. Clover plots can be challenging to maintain, as weedy grasses will often compromise clover monocultures within a few years. Pastured poultry producers might prioritize utilizing stands with a lot of white clover to reduce feed needs for chicken, poultry, and geese flocks.

Planting rate is 2-3 lb/acre. Proven white clover varieties for Arkansas include 'Osceola', 'Louisiana S1', 'Regal', 'Patriot' and 'Durana', and there are many newer varieties that may also work well. When testing newer, unproven varieties, producers should start by seeding a small area to check for local adaptability.

## Annual Clovers

In Arkansas, all the annual clover species are generally grown in the dormant season, meaning that they germinate in fall, grow through the winter, flower and set seed in spring or early summer and then die. For some species, the seeds that were naturally produced will continue the cycle in the following year, while others must be replanted every year. Annual clovers are frequently overseeded onto dormant warm-season grasses, either alone or in combination with small grains and annual ryegrass.

Because annual clovers complete their life cycle each year, they must be reestablished from seed. The clover stand can be reestablished either by replanting each year or relying on natural reseeding. Reliance solely on natural reseeding increases risk of establishment failure, because the producer depends on good conditions in late spring for clover seed production as well as in the fall for

seed germination and seedling development. For natural reseeding to occur, grazing and hay harvest should be managed to allow some of the clover to mature in late spring for seed production. Natural reseeding is seldom successful under common producer practices.

### **Arrowleaf Clover (*T. vesiculosum*)**

Arrowleaf clover is a tall clover that holds its quality well for a longer period of time than most annual clovers. It is among the latest-maturing clovers and may produce forage into June. Its late maturity makes it a good match to be grown with annual ryegrass. Arrowleaf clover will germinate at cooler temperatures than crimson clover. It is not tolerant of infertile, acid soils. Animals rarely bloat on arrowleaf clover. Periodic grazing to a height of 2 to 4 inches promotes new growth and reduces plant disease outbreaks. The purplish-red color of arrowleaf clover leaves is a symptom that the plant is stressed by something such as nutrient deficiency, insects, diseases or weather. Arrowleaf reseeds well under grazing, but much of the seed it produces is hard, which makes year-to-year stand regeneration somewhat unpredictable. Regrowth (and reseeding) should not be expected after a hay crop is harvested. Planting rate is 5-7 lb/acre. Standard varieties are 'Yuchi' and the disease-tolerant 'Apache.'

### **Balansa Clover (*T. michelianum*)**

Balansa clover is an extremely productive species well-adapted to wet soils common across southern Arkansas. This species is quite complementary with annual ryegrass in systems where multiple harvests or grazing events are expected. Trials conducted between 2020-2021 in central and southern Arkansas in warm-season sods have found balansa clover especially suited to water-logged soils. Additionally, a Faulkner County producer involved in the trials found that cattle were willing to graze balansa clover further into maturity than arrowleaf clover. Seed is often expensive as most is produced outside of the United States; however, the seeding rate of 5-8 lb/acre is lower than some other annual clovers. 'Viper' and 'FIXatioN' are popular varieties.

### **Ball Clover (*T. nigrescens*)**

Ball clover is another low-growing clover with excellent tolerance of close grazing. It also has good tolerance of wet, clay or loam soils. Ball clover tolerates lower soil acidity than crimson clover. Ball clover has poor cold tolerance and is best suited to southern Arkansas. Bloat is a serious concern with this clover, and it should not be used in pure stands. Reseeding capability under grazing is excellent because flowers are produced close to the ground. Much of the seed is hard. Seeding rate is 2-3 lb/acre. Improved varieties include 'Grazer', 'Select', and 'Don', but most seed is sold as VNS (variety not stated).

### **Berseem Clover (*T. alexandrinum*)**

Berseem clover is a relatively new addition to the list of clovers that can be grown in Arkansas. Older varieties

lacked enough cold tolerance for even southern tier counties. The variety 'Bigbee' has enough cold tolerance to be worth risking in the southern half of the state, although it will likely winterkill in a severe winter. It is not suitable for northern Arkansas. 'Bigbee' berseem clover has excellent tolerance of wet soils and poor drainage. 'Frosty' berseem clover has been widely used in Tennessee and Mississippi for deer food plots and as well as a cover crop. This new variety offers improved cold tolerance. 'Lightning' is another variety presently available. It does not tolerate acid soils well, doing better on near neutral and slightly alkaline soils. Berseem clover requires good soil fertility and will respond to boron fertilizer. It matures about a month later than crimson clover. Bloat is very unusual on berseem clover pasture. Berseem performs well under grazing if not grazed closer than 34 inches. Berseem clover has potential to reseed itself but is likely to be undependable. Planting rates are 10-20 lb/acre.

### **Crimson Clover (*Trifolium incarnatum*)**

Crimson clover is the standard against which other annual clovers are compared across the southeastern United States. Crimson clover is one of the most widely planted annual clovers in North America. It has the best seedling vigor of the annual clovers. It is the earliest to mature of the commonly used annual clovers, flowering in early April in south Arkansas and about three weeks later in northern regions. This limits its usefulness as a hay crop, but it is widely used to overseed bermudagrass. Crimson clover is not tolerant of wet, poorly drained or alkaline soils but has good tolerance to soil acidity. Bloat is usually not a severe problem but can occur. Its reseeding potential is fair if heads are allowed to ripen and if clover weevils do not destroy the seeds. Seeding rate is 10-30 lb/acre. 'Dixie' is the standard historic variety but constitutes more of a trade name than a true variety. 'Tibbee' is a good forage variety. 'Kentucky Pride' is an increasingly popular variety.

### **Hop Clover (*T. aureum* and *T. campestre*)**

There are two species of hop clover, large hop clover and small hop clover. Hop clovers are actually medics and are closely related to alfalfa. Both hop clovers are naturalized throughout Arkansas and are most often found on infertile, acid, unproductive ground. Often hop clovers are limited to lawns or closely grazed waste areas. These species were popular forages in the early 20th century but abandoned in favor of more productive forages by the end of World War II. Hop clovers do not compete well with other forages when fertility is high. Dry matter production is low, maturity is very early and plants do not regrow well after being grazed. As a result, hop clover is not planted in pastures, but it can contribute some forage for grazing and limited amounts of recycled nitrogen. Natural reseeding capability is excellent. Planting rate was historically 3-4 lb/acre. Improved varieties are not available. Seed is not currently available, but you may have these plants in your fields.



## Persian Clover (*T. resupinatum*)

Persian clover is one of the best clovers for wet, poorly drained soils. It does not tolerate acid soils, and cold tolerance is poor. It is best suited for southern Arkansas. Persian clover is one of the most dangerous clovers for causing bloat and should never be grazed if stands are more than 50 percent clover unless a bloat preventative is being fed. Persian clover should be grown with small grains or ryegrass to reduce bloat risk. It tolerates close grazing well and has excellent seed production, but a high proportion of hard seeds can make stand regeneration unpredictable from year to year. Seeding rate is 3-5 lb/acre. 'Nitro' is an available improved variety. 'eNhance' is another improved variety.

## Rose Clover (*T. hirtum*)

Rose clover is a drought tolerant species that has been widely used in California for many years. Rose clover has gradually become commercially available in the southeastern United States but is not widely planted. A newer variety, 'Overton' (also often referred to as R18), was developed by Texas A&M University and has better adaptation to the rainfall and humidity conditions in Arkansas than do other available varieties. Rose clover is tolerant of poor soil fertility and alkaline soils but does not like acid or wet soils. Overton rose clover is a late-maturing clover with good reseeding ability if heads are allowed to mature. It makes a high proportion of hard seeds. In Hope, Arkansas, it appears to be resistant to clover weevils. Rose clover tolerates grazing well, and bloat is not usually a problem. Seeding rate is 15-20 lb/acre.

## Subterranean Clover (*T. subterraneum*)

Subterranean clover, or sub clover, is so named because it buries its seed pods underground. This trait results in excellent reseeding potential. Sub clover is a low-growing clover with excellent tolerance to close grazing and continuous stocking management. It has poor cold tolerance and is best suited to use in the southern half of Arkansas. Sub clover has a relatively high rate of N fixation under ideal conditions. It is too short in stature to contribute yield to hay crops but can be used to fix N for hay crops. It is a mainstay of the Australian grazing industry, and most available varieties were developed there. A limiting factor to its usefulness in Arkansas is that light August rain often triggers seeds to germinate too early, before adequate moisture is available for growth. As a result, seedlings die. Harder seeded varieties are being introduced into this country to address this problem. This is the most shade tolerant of the clovers and tolerates some wetness and soil acidity. This species has the potential to maintain a stand and spread across closely grazed or mowed fields. One of strongest stands in Yell County has been growing for more than 20 years. Sub clover can cause bloat. It is the clover most likely to be implicated in phytoestrogen fertility problems in sheep. However, most newer varieties have been bred for lower phytoestrogen

content to reduce this problem. Planting rates are 10-20 lb/acre. Varieties with proven track records for Arkansas are 'Mt. Barker' and 'Denmark', and new varieties are continually being introduced from Australia.

## Native Clovers

At least four native clovers are known to the state of Arkansas. These native clovers include annual species such as Carolina (*Trifolium carolinianum*), buffalo (*Trifolium reflexum*), and Bejar (*Trifolium bejariense*) clovers, as well as the perennial running buffalo clover (*Trifolium stoloniferum*). Buffalo clover was the most widespread of the native clovers in the eastern United States and is the least threatened. Carolina clover is widely distributed on the Coastal Plain of the United States. Bejar and running buffalo clovers are only known from herbarium specimens in the state.

These species declined in the eastern United States over the course of the 19th and 20th centuries primarily from land use change as well as the removal of landscape level fire and wildlife. However, many of these were common enough to be listed as seed lot contaminants and roadside curiosities in the 1950s and 1960s by the USDA. Their agronomic potential has been evaluated since at least 1976 in Kentucky, if not as early as 1928 at the University of California-Davis.

Buffalo and running buffalo clovers have been evaluated as potential forage crops in Ohio, Kentucky, Tennessee, Virginia, and Arkansas. A Virginia study found that buffalo and running buffalo clovers have similar if not improved nutritive value over available red and white clovers. The limited amount of plant material has limited efforts to breed improved cultivars of these species. Commercial interest seeks to have these species marketed to the public in the 2030s.

## Clover Selection

Picking the right clover species for a pasture often comes down to the primary forage base. For tall fescue pastures, red and white clovers are preferred. For warm-season pastures, such as bermudagrass or bahiagrass, annual clovers are preferred and often mixed with cool-season annual grasses.

Improved varieties are almost always preferred over binrun or bargain options. These varieties have up to 20 years of plant breeding and trialing to confirm their potential as well as comparison in many independent variety trials. Consult variety trials from the southeastern United States to compare varietal performance. When considering a new clover, try to plant a strip or small pasture to the new species before planting larger fields. Newer annual clover species and varieties may not be the best fit for a particular farm. Clovers that have been tested in local county demonstrations or field trials are likely to be best suited to your area.

## Clover Establishment

The first step in successful establishment of clovers is proper site selection. Factors such as soil texture and drainage should be considered when matching a clover species to a specific site. The least weedy fields on the farm should be prioritized for clover planting, as broad-leaf weed control options are limited after planting clover. Select a site well in advance so weed management and improvements in soil fertility and pH can take place in the year prior to planting. Weeds should be suppressed using an herbicide with short residual activity such as 2,4D or Weedmaster. Soil samples should be collected and analyzed so that any required phosphorus, potassium or lime can be added well in advance of planting. (Refer to FSA2121, *Test Your Soil for Plant Food and Lime Needs*, for information on soil sampling and analysis.) Soil pH should be near neutral (> 6.0). When clovers are to be planted in acidic soils, lime should be applied at least 6 months before seeding to allow the soil pH to adjust. Most clovers respond to moderate investments in soil fertility. Potassium is a very important nutrient for clovers, and attention should be paid to supplying adequate amounts according to soil test recommendations. Phosphorus should also be applied according to soil tests. Many clover species will respond to boron fertilization at 1-2 lb/acre every one to two years, especially when grown on sandy soils.

Nitrogen fertilizer application to clovers should be avoided as much as possible. When abundant soil N is available, clovers will use that instead of fixing their own N, which reduces one of the benefits of using clover in the first place. Also, when N is applied to grass/clover mixtures, the grass usually responds faster than the clover, which can lead to excessive shading of clover and legume loss from the stand. If N fertilizer must be applied to keep grass productive, rates should be kept to 30 lb N/acre or less at each application.

Clovers can be established by broadcasting or drilling seed into a grass sod or following tillage. Establishing clovers by broadcasting following tillage increased the clover stand counts by 41 percent in southern Arkansas. Stand counts were only 50 percent for clovers broadcast onto a mixed grass sod but increased to 91 percent with tillage. Seed should be planted shallow. It can be drilled to a depth of 1/4 to 1/2 inch or broadcast. Seeding rates should be increased by 20 to 25 percent if clovers are established by broadcasting seed. Please refer to FSA3134, *Interseeding Clover and Legumes into Grass Sod*, for more information. Clover seed should be inoculated with the correct species of rhizobia before planting to ensure good nitrogen fixation potential (see FSA2035, *Forage Legume Inoculation*, for detailed information about legume inoculation).

When interseeding clovers into a sod, it is important to remove existing forage to a height of 3 inches or less.

Competition from the existing sod will affect the success of a clover seeding even more than fertilization. If a golf ball is fully visible when thrown into the stand, then the existing sod is sufficiently grazed or clipped.

Seeding in warm-season grass can be done as early as October 1 in northern Arkansas, otherwise October 15 to November 15 when cool nighttime temperatures (50 to 60 degrees F) slow grass growth and reduce competition. Because fescue grows vigorously in the fall, fescue sod must be grazed short or lightly disked to reduce competition before interseeding clovers. Frost seeding is a practice where seed is broadcast into stands in late winter (February) and then incorporated into the soil through freeze-thaw cycles. Frost seeding is most effective in tall fescue stands that were stockpiled and then grazed closely.

Late-maturing clovers (red or arrowleaf) overseeded into perennial warm-season grasses will reduce late spring growth of the grasses. Clovers may be shaded out if grasses are allowed to outgrow them but can improve forage quality over grass alone. Early (crimson) and medium-maturing (berseem and rose) clovers can allow earlier grazing of perennial warm-season grass pastures and will supply nitrogen to the grasses under proper management. Late-maturing clovers grown with cool-season grasses (tall fescue or small grains) can lengthen the grazing season, improve forage quality and reduce the toxic effect of fungal endophytes found in fescue. Low-growing or prostrate clovers are generally more grazing tolerant than upright-growing clovers. Preferred site, soils, climate and management of many common clovers are shown in Table 1.

Many clovers produce a percentage of “hard” seeds that do not germinate immediately after planting. The seedcoat of hard seed is impervious to water, which delays germination for long periods, sometimes up to 10 years as has been shown in some germination studies. Hard seed may survive passage through the digestive tracts of animals and still remain viable in soil for 30 years. Delayed germination by hard seed of annual legumes grown in harsh environments helps maintain stands from volunteer seedlings when conditions are not favorable for seed production in a particular year. Clover species that produce a high percent-age of hard seed provide more dependable volunteer stands than those that produce more soft seed, although these stands will often be thinner than those planted with purchased seed.

Good stand establishment depends on a variety of factors including soil fertility, moisture, pH, seed-to-soil contact and inoculation of seed with nitrogen-fixing bacteria. Please refer to FSA2035, *Forage Legume Inoculation*, for information on inoculation of legumes. Good forage production will depend on the subsequent grazing and harvest management that balances grass-legume competition.

Table 1. Plant characteristics and site requirements for annual and perennial clovers commonly grown in Arkansas.

Clover <sup>a</sup>	Plant Characteristics								Preferred Soil Characteristics		
	Common Uses	Seeding Rate (lbs/A)	Reseeding Ability	Cold Tolerance	Relative Maturity	Arkansas Adaptation	Flowering Date	Bloat Potential	pH	Texture	Drainage
Arrowleaf	Hay/Grazing	8-10	High	Good	Late	Statewide	Early June	Yes (low)	5.8-7.0	Sandy Loam to Silt Loam	Good
Ball	Grazing	2-3	High	Good	Medium	Southern	Early May	Yes (high)	> 6.0	Sand, Loam or Clay	Fair
Balansa	Hay/Grazing	5-8	Medium	Good	Late	Statewide	Early June	Yes (medium)	> 6.0	Loam to Clay Loam	Poor-Good
Berseem	Grazing	12-15	Low	Poor	Medium	Southern	Mid May	Yes (low)	6.5-8.0	Loam to Clay Loam	Poor
Crimson	Grazing	15-20	Low	Medium	Early	Statewide	Early April	Yes (medium)	6.0-7.0	Sand to Silt Loam	Good
Persian	Grazing	3-5	Medium	Fair	Medium	Southern	Early May	Yes (medium)	6.0-8.0	Loam to Clay Loam	Poor
Rose	Grazing	15-20	High	Good	Medium	Statewide	Late April	Yes (medium)	6.0-8.0	Sand, Loam or Clay	Good
Subterranean	Grazing	12-15	Medium	Fair	Medium	Southern	Mid April	Yes (medium)	6.0-7.0	Loam to Clay Loam	Fair
Alsike Clover	Hay/Grazing	4-10	Medium	Good	Late	Northern	May-Sep	Yes (medium)	5.8-7.0	Loam to Clay Loam	Good
Red	Hay/Grazing	10-12	Low	Good	Late	Statewide	Mid May - June	Yes (medium)	6.0-8.0	Loam to Clay Loam	Good
Sweetclover	Grazing/conservation	5-15	High	Good	Late	Statewide	May-Sep	Yes (medium)	7.0-8.0	Loam to Clay Loam	Moderate to Excellent
White	Grazing	3-5	Low	Good	Medium	Statewide	May-Sep	Yes (high)	6.0-7.0	Loam to Clay Loam	Poor-Good

<sup>a</sup>Clovers should be planted between September 1 and November 1 in prepared seedbeds or between October 15 and November 15 when seeded in sod.

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