Maintenance costs will vary from year to year, depending on the soil type, the need to lime, and the production goals of the producer. The production costs for introduced-forage pastures, however, is generally less than other feed programs.

Herbivores, which include horses, are well suited to harvesting their own forage. The challenge is to provide adequate pasture of acceptable quality as inexpensively as possible. A forage enterprise budget may be used to estimate the costs of establishing and maintaining forage for pastures. A software tool to assist producers in evaluating costs of forage production is available at www.agecon.okstate.edu/budgets. Information on the cost of pasture rental is available in Extension Current Report CR-216, Oklahoma Pasture Rental Rates. This can be obtained through local county extension offices or on-line at http://osuextra.okstate.edu/dept/econ/farmmgmt.shtml. -

Animal Performance

Many recommendations on expected animal performance are based on subjective observations because formal research is lacking. Yearling growth rates of about one pound per day have been achieved on bermudagrass at stocking rates that allow more than 60 pounds of forage dry matter per 100 pounds of animal. Mares have adequately maintained body condition through late gestation on a solid, dense stand of wheat pasture when forage is unlimited, but accurate performance data is limited. Generally, proper fertilization and grazing management is necessary if improved pastures are expected to provide required levels of nutrients to any class of horse.

The most common way horse owners determine how well a pasture is providing nutrients is by assessing body condition on the horses grazing the pasture. Body condition refers to the observable fat cover. When energy supplies in the diet are less than the horse's need, they loose body condition. When adequate or above the animal's needs, the body condition is maintained or above an acceptable level for animal performance and health. Read Extension Fact Sheet ANSI-3920, Body Condition of Horses for a description on how to assess body condition of horses. How well other needs are being met, such as protein and minerals, requires a more detailed knowledge of the horse's needs and expected amounts in the forage.

It is not difficult to estimate the amount of forage in a pasture. One method for estimating forage dry matter is to clip all the forage to ground level inside a known area, such as a 1-ft x 2-ft sampling frame. Place the forage from inside the sampling frame inside a large paper sack and allow the forage to air dry. The dried forage is then weighed and the weight is converted to express the forage dry matter in lbs/ac. This information serves as the basis for forage production records. Historical records relative to precipitation, dry matter production, and fertility inputs provide valuable information that enables producers to make sound decisions regarding stocking rate adjustments and whether or not to plan to purchase off-farm sources of hay.

Grazing Management

Sound grazing management strategies consider both animal performance and resource conservation. There are several different management strategies available to improve animal distribution and the harvest efficiency of forage that is produced. Manipulation of livestock to achieve management goals generally results from the use of either continuous or rotational stocking. The most important aspect of grazing management, however, is stocking rate. Too heavy a stocking rate will result in decreased animal performance, forage stand life and the profitability of the enterprise. For additional information on grazing systems, see Extension Fact Sheet ANSI-3981, Managing Grazing of Horses.

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Forage for Horses

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http://osufacts.okstate.edu

Forages supply energy, crude protein, minerals, and vitamins at varying levels, depending on forage species and nutritive value. Forage nutritive value and the resulting effect on animal performance are greatly influenced by forage stage of maturity and soil fertility. Unlike ruminants, such as cattle, horses are limited in their ability to utilize forages that are low in nutritive value. Therefore, forage production for horses demands a higher level of management than is generally required for other livestock operations. When managed to optimize forage nutritive value and production, improved pastures can generally meet the nutritional requirements of mature, nonproductive horses with little or no supplementation during most months of the year.

Forage Nutritive Value

Forage nutritive value is determined by chemical analysis for crude protein, digestibility, and minerals. Visual assessments of forages may be made for foreign materials, leafiness, and color. Forage nutritive value is most strongly influenced by aspects under the direct control of the producer. These include choice of forage species, stage of maturity when harvested, and soil fertility. Grazing management can also affect forage nutritive value by influencing forage stage of maturity and leaf: stem ratios.

Visual appraisal of hay is the oldest and most widely used estimate of forage quality in hay. Forages have historically been evaluated on physical factors that include color, leafiness, maturity, smell, softness, and purity. Leafiness is a good indicator of forage nutritive value because nutrients in the leaves are more digestible, and leaves contain about twice the amount of nutrients as stems. Generally, if the forage is leafy with dark green leaves, contains few stems and seed heads, and is free of weeds, dust, and mold, consider this to be high-quality forage. Although these factors are important, they are difficult to quantify and communicate. By far, the largest single factor that affects forage quality is stage of growth at harvest or plant maturity. Forage that is more mature is less nutritious. For additional information on how these factors affect forage quality, see Extension Fact Sheets PSS-2117, Forage Quality Interpretations. The only sure way to determine forage quality is by submitting a sample for chemical analysis from a reputable laboratory. For additional information on the process and benefits of forage testing, please see the Oklahoma State University Soil, Water, and Forage Analytical Laboratory website at http://www.soiltesting.okstate.edu/.

Stage of maturity may be the single most important aspect of management relative to forage nutritive value. Forage maturity and nutritive value are inversely correlated— as the forage increases in maturity, the nutritive value declines. This is due to an increased level of both cell wall (fiber) contents and indigestible lignin, most notably in warm-season grasses. Immature plants are highest in both nutritive value and digestibility. Dry matter production increases with stage of maturity and a balance between nutritive value and production must be achieved (Table 1). Harvest schemes for hay should be timed to obtain an optimum quantity of forage of acceptable nutritive value.

Pasture Management

A common question is: "I have a pasture full of weeds and want to plant something that is good for my horse(s). What's next?" The decision-making process for pasture improvement practices is easy, but it does require some thought. First, it is necessary to identify the weeds and forages. The decision should be made whether or not the pasture can be managed without reseeding. As an example, if the forage or forages are adapted to the site on which they are growing and desirable, then the recommended soil fertility requirements along with grazing and harvest management should be evaluated. For additional information on basic forage and pasture fertility see Extension Fact Sheet PSS-2225, OSU Soil Test Interpretations.

If soil fertility is low and the grazing and harvest management is incorrect, these should be addressed before using additional pasture improvement practices. If these are not

Table 1. Influence of maturity on yield and nutritive value of bermudagrass.

Week	Yield (tons/ac)	Leaf (%)	Crude Protein (%)	Lignin (%)
1	6.3	>90	21.4	<5.0
2	7.8	87.6	20.8	9.4
3	8.6	81.3	18.8	9.6
4	9.7	74.8	17.0	10.3
6	12.5	57.7	13.8	11.2
8	12.5	51.4	12.2	12.0

correct, then it may be appropriate to consider methods of weed control. For additional information on pasture management please see Extension Fact Sheet NREM-2869, Management Strategies for Rangeland and Introduced Pastures.

If the forages are not adapted to the site or are undesirable, then methods for pasture renovation or reseeding should be considered. For additional information on renovation and reseeding practices see Extension Fact Sheet NREM-2581, Seeding Marginal Cropland to Perennial Grasses.

Soil Fertility

Producers often decide to take advantage of the high productive capability of introduced forages. These forages are planted and best managed with high fertility inputs as opposed to native plant communities, which typically receive no fertility inputs. By default, producers have decided to provide the necessary fertility inputs required by the various forages. The first step in the soil fertility program is to obtain a soil sample for analysis. A soil analysis is used to determine the levels of nitrogen, phosphorus, and potassium in the soil and the soil pH (soil acidity). Under certain circumstances, analyses for other nutrients may be required. Based on the yield goal for specific forage crops, written recommendations for the level of each fertilizer nutrient required are furnished to the producer by the laboratory conducting the analysis.

Nitrogen is second only to moisture in relative importance for maximum plant growth and is positively correlated with both dry matter production and crude protein (Table 2). Although the data in Table 2 is specific to bermudagrass performance, most grass species respond in a similar manner. Proper application of nitrogen fertilizer is generally a good investment in forage production systems.

Numerous research studies have shown that forage legumes have the ability to provide the equivalent of 50 to 200 pounds of actual nitrogen per acre to other non-nitrogen-fixing plants under good growing conditions, thus reducing the need for nitrogen fertilizer. Legumes also contribute to the overall nutritive value of the forage base and help to maintain animals on a high nutritional plane; even when nutritive value of grasses is declining.

Other nutrients such as phosphorus, potassium, and sulfur are applied as required based upon the soil test recommendations. Only a soil analysis will provide this critical information.

Acidic soils generally do not have direct negative effects on the growth of most forage plants; however, indirect effects can hamper plant production. Soil nutrients, particularly phosphorus, are most available at near-neutral pH levels. Many producers, therefore, apply crushed limestone (lime) to increase soil pH to enhance nutrient availability for optimum forage production.

Close attention to basic soil fertility fundamentals will ensure the dry matter production and forage nutritive value desired by horse owners. Poorly managed pastures, on the other hand, can result in high-cost forage that is low in nutritive value. Lack of attention to basic soil fertility will result in the producer purchasing more off-farm-produced feed and forage, decreased animal performance, and a reduced level of profitability for the enterprise.

Table 2. Effect of nitrogen (N) on bermudagrass.

N rate (lbs/ac)	Yield (tons/ac)	Crude Protein (%)
0	0.8	6.9
50	2.1	7.3
100	3.2	8.2
200	4.7	8.8
400	8.4	13.1

Choice of Species

When considering forage species for first time establishment, producers should realize that not all forage species produce forage of high nutritive value (Table 3). Legumes are generally higher in nutritive value than grasses (e.g., alfalfa versus bermudagrass). A producer should also remember that given equal nutritive value, some species produce more dry matter than others, thus representing a better choice for a pasture program. For first time establishment, check with your County Extension Educator to determine which forage species are adapted to the soil and climatic factors present at your location, then choose accordingly.

Forage Species for Horses

Several forage species are available for horse producers. In many instances, the species selected will be a function of what is best adapted for the area and management situation. Decisions regarding forage species will largely depend on factors such as the management philosophy and expertise of the producer, the land resource, and the capital available for producing or purchasing hay and/or grain rations. Typically, the combined use of cool-season and warm-season forages will result in the lowest cost to feed a horse on a year-round basis.

Warm-season Forages

There are several warm-season grasses that are adapted for Oklahoma horse pastures. Introduced warm-season grasses will require nitrogen fertilization to produce the quantity of forage and nutritive value that is desired. The warm-season introduced grass that is most utilized is bermudagrass. Bermudagrass, if managed properly, can produce large quantities of dry matter, can have high nutritive value that results in good animal performance, can tolerate considerable abuse, and responds well to nitrogen fertilizer. For more information on bermudagrass management see Extension Fact Sheets PSS-2591, Bermudagrass Pasture Management; PSS-2263, Fertilizing Bermudagrass Hay and Pasture; PSS-2583, Choosing, Establishing, and Managing Bermudagrass Varieties in Oklahoma. The Old World bluestems are another group of perennial warm-season introduced forage grasses that are best adapted to clay or finely textured soils, especially west of Interstate 35. Old World bluestems are somewhat more sensitive to trampling and overgrazing than bermudagrass, but can respond well to nitrogen fertilizer and produce large quantities of dry matter with good nutritive value under proper management. Weeping lovegrass, another warm-season perennial grass, is used on sandy soils, but its rapid growth generally requires rotational stocking following an annual late winter burn if it is to remain high in nutritive value.

Regarding warm-season annual grasses, crabgrass has proven to be a very acceptable forage grass for horses and cattle alike. Crabgrass is generally higher in nutritive value and digestibility than bermudagrass or the Old World bluestems, but typically will not produce as much dry matter during the growing season. A higher level of management that involves attention to grazing pressure and tillage practices is also required to ensure a good stand of crabgrass each year. Forage sorghums and the sudangrasses are generally not used because of the occurrence of **cystitis**, a malady that occurs under grazed conditions. Several producers use one of the various millets for pasture and/or hay with pearl millet as the millet of choice because of the ability to produce large quantities of dry matter. Kleingrass is not recommended for horses because it produces a condition termed **photosensitization.** Moreover, kleingrass is not adapted to most areas of Oklahoma.

Alfalfa is the most universally utilized legume hay fed to Oklahoma horses. Alfalfa can also be grazed, but it usually is not an economically feasible alternative. If grazed, it appears that rotational stocking may provide for extended stand life. A grazing program that mimics a typical haying situation may be best since alfalfa varieties have been selected on this basis (i.e., graze 3 to 7 days, rest 20 to 35 days). Alfalfa hay that is fed to horses must be free from the presence of blister beetles to be a safe forage (see Forage Toxicity section). Alfalfa, like most other legumes, is generally higher in crude protein, digestibility, and minerals when compared to grasses.

Table 3. Approximate yield and nutritive value of various hay crops.

Species	Yield (ton/ac)	Crude Protein (%)	TDN (%)
Alfalfa (early bloom)	3-6	17-22	57-62
Arrowleaf clover	2-3	14-17	56-61
Oat	1-4	8-10	55-60
Red clover	2-4	14-16	57-62
Rye	1-4	8-10	50-55
Ryegrass	1-4	10-16	56-62
Annual lespedeza	1-2	14-17	52-58
Bermudagrass	2-6	9-11	50-56

Cool-season Forages

Small grains such as wheat, rye, oats, barley, and/or ryegrass are used as cool-season forages for horse pastures. These cool-season grasses can be sod-seeded into dormant warm-season grass sods to extend the green grazing season. Rye and wheat are used more than other cool-season forages because they are well adapted to Oklahoma growing conditions. Using ryegrass with one of the small grains can provide for extended grazing later into spring when compared to using a small grain only.

Oats are not used extensively in most of the state because it is not cold tolerant. Spring-planted oats, however, may provide excellent grazing during late winter and spring.

Several cool-season clovers can be utilized for horses. Arrowleaf clover, white clover, red clover, and rose clover are adapted to various regions of Oklahoma and produce forage of excellent nutritive value. Producers should be cautioned, however, against the use of alsike clover for horses. Information from other states indicates severe health problems may develop in horses grazing relatively pure stands of alsike clover, including photosensitization, liver problems, and death. Horses do not care for alsike clover. But even in mixed plantings, horses stocked at heavy rates may preferentially consume other forages at first and wind up grazing pure alsike stands.

Tall fescue is the most common cool-season perennial forage grass in the eastern one-third of Oklahoma. While tall fescue is palatable and withstands heavy grazing, there are a number of reproductive problems that occur in mares that graze endophyte-infected tall fescue pastures or consume endophyte-infected tall fescue hay. Most frequently, mares on endophyte-infected tall fescue suffer from agalactia (decreased milk production). A high incidence of stillborn foals is also associated with mares grazing endophyte-infected tall fescue. Management recommendations for horses currently suggest either using an endophyte-free tall fescue or removing pregnant mares from endophyte-infected tall fescue pasture and/or hay prior to the last trimester of pregnancy (see Current Report CR-3917, Fescue Toxicity and Horses). Unlike cattle, the endophyte toxicity problem **cannot** be diluted with clovers in the pasture mix or by the use of grain rations.

Forage Toxicity

Some forage species are generally not recommended for horses because of associated toxicity problems. Besides the cystitis problem noted previously, members of the genus Sorghum, such as sudangrasses or johnsongrass, may contain prussic acid, which can cause muscle weakness, urinary tract failure, neural degeneration, and death. The problem with mares grazing endophyte-infected tall fescue has been noted in the prior section.

Mold problems can occur in humid environments with clovers and small grains. Hay crops need to be properly field-cured to ensure that mold and their related toxins do not develop in hay that is to be fed to horses. Blister beetles contain **cantharidin**—a toxin that causes irritation of the lining in the digestive tract. Ingestion of blister beetles is usually fatal. Alfalfa hay is the forage most generally associated with blister beetle infestation. There is no level of ingestion of beetles that can be considered as safe. Therefore, it is essential that forage management techniques are conducted to ensure that alfalfa hay is beetle-free. Read Extension Fact Sheet PSS-2072, Blister Beetles and Alfalfa for more information on management of this pest.

There are numerous poisonous plants that produce toxins fatal to horses. Common reports include many ornamental shrubs, nightshade, locoweed, and peavine, but any plant known to cause problems in other livestock species will probably affect horses. Toxic plants are generally not palatable to livestock and horses will usually not graze these plants unless forced to in an overgrazed pasture.

Pasture Costs

Pasture costs may be divided into establishment costs and maintenance costs. Establishment costs may appear high at first glance. However, when the cost to establish perennial pastures is spread over several years, pastures compete quite favorably with feed programs that use hay and grain alone.