Forage for Horses

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A colleague from Oklahoma is probably correct when he characterized the nutrition and feeding of horses as a livestock management system which has a general lack of research information and is thus dominated by misinformation, misinterpretation, old fables, myths, old wives tales, trade secrets, and just plain guessing. The fact that horses and mules often fall into the 'hobby' or 'pet' category adds an emotional element and lessens the influence of economics in forage and feeding decision-making. He goes on to remind us that a "pasture" may be a holding paddock, a run, or a large pasture. Priorities have to be established. Is the area mostly for exercise, etc.? Is it primarily for forage? Or do you genuinely expect both? The reality is that most of the small, over-stocked exercise areas and runs in Iowa are not usually feasible to manage for significant forage production. It is probably best not to waste time and money trying to make them productive.

Basics of Horse Nutrition

There are many breeds and types of horses maintained and used in many ways. The majority of these horses are owned and managed for recreation or sport and not for profit by the owners. One of the greatest expenses in owning horses is feed. Feed costs can be minimized by feeding a balanced ration that meets the horse’s nutritional needs.

While complete and balanced feeds can be formulated for horses and fed from a bag, economics and a horse’s eating and digestive anatomy make them very well suited to using large quantities of forage as hay or pasture. Long-stem forage fiber is a basic necessity for normal functioning of the horses digestive system, but horses have a smaller digestive tract than most ruminants and cannot handle as much bulk in their diet. Lack of long-stem forage in a horse’s diet can lead to digestive disorders and excessive ‘wood chewing’. Simply providing hay or pasture does not tell the whole story. The forage component(s) in the diet must be of sufficiently high quality to maintain good passage through the digestive tract and still provide good nutritive value. If high-fiber, low-quality forage is being fed, horses can be nutritionally deficient even when plenty of forage is available to them. Depending on the nutritional needs of the type of horse being fed, extra energy and nutrient needs may need to be supplemental in forage-based rations using grain, vitamin and mineral mixtures.

Mature horses will generally consume up to 2 to 2.5 percent of their body weight in total feed each day. For example, a 1,000 pound horse should consume approximately 20 to 25 pounds of air-dry feed per day, or about 2 to 2 1/2 pounds of air dry feed per 100 pounds of body weight. Mature horses performing minimal or no work can be maintained on high quality forages without supplementing their diet with grain. Ideally, horses should consume a minimum of 1 percent of their body weight in hay or pasture dry matter each day.

As a general rule then, forages should supply one half or more of the total weight of the feed consumed daily for optimum horse growth and development. On well-managed pasture some
horses can obtain nearly all of their nutritional needs. Growing, breeding, or working horses often require supplementing the forage with a grain or concentrate to meet their additional nutrient requirements, even with high-quality hay. Supplementing with grain is often necessary if hay quality is poor. Consult with an equine nutritionist for more exact dietary needs for different classes of horses or those in different use categories.

**Forage Quality**

Feeding high-quality hay and pasture forage for horses is usually the most economical approach. Both forages and grains provide energy and protein. High quality forage, either pasture or hay, additionally provides vitamins (A, C, and B) as well as minerals such as calcium. Thus the higher quality the forage fed, the less supplemental grain, vitamins and minerals that will be needed.

Most pasture or hay forage contains grasses, legumes, or a mixture of several. Within each type, the growth stage or maturity when cut or grazed determines its nutritive quality. Protein, energy, minerals and vitamins all decrease in forage as it matures into bloom or heading stage.

The nutrient content of the forage and concentrate in the horse's diet must be known to properly balance the diet. Feed constituent and forage quality can be determined by many public and commercial forage testing laboratories. Once the quality of the feedstuffs is known, then proper amounts of each can be calculated to meet the nutrient requirements. Again, consult with an equine nutritionist for help in balancing and formulating the ration needs for different classes of horses or those in different use categories.

Visual inspection for leafiness and freedom from weeds, mold, or other contaminants will also yield a quick but less accurate estimate of forage quality.

**Winter Feed - Hay**

High quality hay is the most important winter feed for horses. However, hay provides varying amounts of the horse's nutrient requirements depending on the forage quality and amount consumed. Growing horses, heavy work and horses in reproduction may require that rations include grain supplementation even with high-quality hay.

**What type of hay should you feed your horses - legume, grass, or mixed?**

There has been longstanding controversy over what is the best hay for horses. Ask ten horse owners which is the best horse hay and you'll probably get ten different answers. For example, some owners/managers will testify that alfalfa is the "best" hay for horses and others will insist that alfalfa is "too rich" for horses. Although these two statements seem completely contradictory, they both have elements of truth. Alfalfa is typically more palatable than orchard grass or timothy hay. Alfalfa is also higher in protein and calcium than most grass hays. In some, but not all cases, alfalfa hay may also be higher in energy and total digestible nutrients than grass hay. In general, if alfalfa hay is selected and used appropriately, it is a very effective nutrient source in horse rations. Similarly, grass hays such as timothy and orchard grass, can be effectively used in horse feeding programs. To make the best use of any type of hay, horse owners and managers must match hay "quality" to the nutrient requirements of the particular horse(s) being fed.
Legume-based hays such as alfalfa, red cover and birdsfoot trefoil are higher in protein, minerals and vitamins and are more palatable than grass-dominant hays. They make excellent horse feed and should be included in the rations of young growing animals, breeding animals and adult working horses.

Grasses such as timothy, bromegrass, and orchardgrass are commonly used for grass-based hay and in mixture with legumes in the upper Midwest U.S. Grasses generally have more fiber and are lower in protein, calcium, and vitamins than legumes. Their production management probably works against grass hays because they are often cut too late to yield top quality hay and are often priced higher than their feed value justifies.

Mixtures of hay containing legumes and grass produce an excellent combination suitable for almost any type of horse feeding program.

Some cereal grains such as oats, barley, and wheat may be cut at an early growth stage, field cured, and stored as hay. Oat hay is fairly common, but barley and rye hays are used only in selected regions and on a limited basis. These grain hays should be cut no later than early heading stage of development to provide satisfactory feed value for horses.

Growing your own Hay

There is probably more 'art' than 'science' involved with making good hay. There are several manageable practices and some less manageable ones. Selecting a well adapted forage legume, grass or mixture of species is an important first step. There are some minor quality benefits associated with variety selection within species. Following recommended fertilization and planting practices helps to produce and maintain a dense, productive, weed-free stand.

Time of cutting is the most important single factor in determining hay quality. The leaves of forage plants contribute approximately 80% of the nutritional value; as a result, a high proportion of leaves is desirable. Only young plants contain a low percentage of stems and a high proportion of leaves. Obviously, as much of the nutritive value as possible should be retained, which means that a minimum amount of weathering and handling of hay should occur. After the forage has been cut, almost everything that is done to the hay often makes it worse.

Timing of hay harvest also involves some weather management. Weather forecasts are not particularly accurate, but 2- to 3-day periods close to the ideal crop maturity period are desirable. Light rain will not cause much damage if the hay gets a chance to dry appropriately before harvest. Heavy rain, wet soil and the high humidity after cutting, often lead to mold development, extra raking, and leaf shatter losses during drying, and at harvest.

Moisture content at baling time is also a tricky management step. The objective is to dry the forage enough (to less than 20% moisture) to prevent excessive heating and mold in storage, but not too dry that excessive leaf shatter losses occur during harvest (shatter losses increase greatly at less than 15% baling moisture).

Hay problems can also occur with improper storage management. If possible, hay should be stored inside or under cover. This reduces 'weathering' losses during storage. There will often be some minor heating and 'final moisture loss, during the first week or two of storage. This is normal. Good, dry hay (12-16% moisture) becomes stable in storage. Hay that was baled and stored 'too wet' will heat excessively (to greater than 120F for several weeks). This hay is often
‘heat damaged’ with resulting lower feeding value, and discoloration. Some animals actually find this ‘caramelized’ hay more palatable. Forage testing after the heating period is recommended to better assess the nutritive quality decline.

**Managing Established Hay Meadows.** After the seeding year, alfalfa and alfalfa-dominant meadows should be fertilized annually, based on the recommendations from a regular soil testing program. Rates needed are related to the soil test level, crop being grown, and the yield being harvested.

Expect at least three cuttings from established alfalfa-grass meadows. Yields will range from 3.5 to 5 tons per acre. Make the first harvest at first flower; this usually occurs in late May or early June. The second and third harvests can be taken at 35 to 45 day intervals, again at about first flower stage of development. Try to time the last summer cut for late August. Cutting at earlier stages of development will produce higher nutritive value hay with finer stems, but often at the sacrifice of total yield harvested and stand longevity.

Alfalfa and alfalfa-grass hay meadows should be ‘rested’ from early September through mid-October each year to provide for the build-up of winter food reserves in the plant roots and crowns. These reserves are necessary for winter survival and strong plants for the following year. If growth is adequate after the fall rest period, a ‘fall hay harvest’ or grazing is often possible in mid- to late October.

Grass hay meadows are usually cut 2 or 3 times per season. The timing of the first harvest is the most important because grasses mature very rapidly in the spring. Delays in harvest lead to high-fiber, low-quality, stemy forage. The 2nd and 3rd harvests are often of higher average quality because summer regrowth forage is predominantly leaves.

**Buying hay for Horses?**

If you are not directly involved in producing your own hay, then it is important that you become a feedvalue-conscious consumer.

Hay quality can be evaluated in several ways. Cleanliness of the hay is the first characteristic that should be evaluated. All horse hay should be free from mold, dust, weeds and debris. In particular, moldy or dusty hay should be avoided. Repeated exposure to mold and dust may predispose horses to heaves, a chronic lung disease that permanently affects the ability of the horse to breathe normally. All other quality criteria should be considered after the hay has been accepted or rejected based on cleanliness and freedom from dust and mold.

Whether you prefer alfalfa, grass or mixed hay, look for hay that was harvested at an early stage of maturity. For legumes, that is when the individual legume plants are still leafy, and before a lot of open bloom is observed. For grasses, that is when there is a high proportion of grass leaves with few fully developed stems or seedheads. Look for leafiness in the bales and whether the leaves are still attached to the stems. If legume-based hay is very dry or was baled very dry, leaf shatter and feeding waste may be excessive.

Ask the seller to open a bale or two for you to make closer observation of maturity, leafiness, and evidence of mold, weeds or other undesirable foreign material. Your senses of sight, smell and touch are very useful when evaluating hay.
Color is one of the most deceiving factors. Good green color usually goes along with good nutritive quality hay but don't buy only on the basis of color alone. Greenness can also simply indicate a lack of weathering of a low-quality hay. It is generally believed that horses are color-blind and cannot distinguish green from brown. So also pay close attention to other factors such as soft texture (not brittle) and a good aroma. Many horse owners feed hay that is dusty and moldy with relative success, but the risk is much too high for the savings that may result. Avoid musty, moldy or dusty hay.

If you are not sure about a particular lot of hay, but are interested, ask the seller to let you feed a few bales first. Most sellers will usually not object. A local seller who wants your repeat business may even encourage it. They want you to be satisfied with the product.

DO NOT buy bales directly from the field that were just baled. Buy hay that has been in a well-protected shed or barn for at least two weeks. Before you load them, open one or two bales and look and smell for mold. If it is dry and not moldy, it will not start molding at your place when properly stored.

The only way to definitively know the nutritional value of hay is with a forage test. Feed constituents and forage quality can be determined by many public and commercial forage testing laboratories. Once the quality of the feedstuffs is known, then proper amounts of each can be calculated to meet the nutrient requirements. Again, consult with an equine nutritionist for help in balancing and formulating the ration needs for different classes of horses or those in different use categories.

Tips for Buying Hay

Hay for horses should be:
(1) high in legume content to provide a high intake
(2) cut at an early or immature stage of growth when harvested,
(3) relatively fine-stemmed and leafy (Leaves make 80% of the nutritional value)
(4) leaves attached to stems – minimal ‘leaf shatter’
(5) free from weeds and excessive foreign material,
(6) bright green in color
(7) dry, properly cured and free from rain damage -- reject if it feels damp or warm
(8) free from dust, mold and spoilage, and have a good aroma
(9) a quality forage at least cost.

Hay Substitutes

Forages such as long stem hay and/or pasture grasses and legumes are the traditional cornerstones of horse rations. Unfortunately, in times of drought and high hay prices, substitutes are sought. Long stem hay and pasture grasses contain over 40% fiber, whereas most grain mixes, even so-called "complete" feeds, contain less than 12% fiber. Horses can adapt to balanced rations that do not contain hay or pasture, but the absolute minimum of fiber necessary has not been well established. Avoid making rapid changes to substitute feed components in rations, to avoid the risk of colic, gastric ulcers, and wood chewing behavior of horses. Complete feeds and hay cubes are relatively expensive ($200 to $300/ton), until the cost of hay begins to approach $200 to $250 or more, these substitutes should probably not be considered.
"Complete" concentrates: Complete concentrates are mixtures of grains, hay or beet pulp, and vitamin and mineral supplements are available in textured, pelleted, or extruded forms. While these may contain sufficient fiber for digestion, they often do not satisfy the horse's need to chew. This may lead to increased wood chewing.

Hay Cubes: Long stem hay, either alfalfa, mixtures of alfalfa and grass hay, or mixtures with straw is dried, chopped, and compressed into 1"x1" cubes. These are usually sold in 50 lb bags which are easy transported and stored. As little as 2 to 6 lbs of cubes can be fed per day as a "hay extender" when only poor quality hay is available or when hay is in limited quantities. Some producers feed up to 12 to 15 lbs of cubes per horse per day. The fiber in cubes is still relatively short and can lead to wood chewing. Some producers report problems with animals choking on the cubes when they were fed dry. The danger of choke can be minimized by soaking the cubes in water for 10 minutes before feeding them.

Straw: Wheat, oat or barley straw has very little nutritional value, but is a great source of fiber. If the horse's energy, protein, mineral, and vitamin needs can be met by a 'complete concentrate' feed, straw can be an inexpensive long fiber substitute. Adapt horses to straw slowly. Straw should not be considered as a source of nutrition for horses other than as a "chew factor" and fiber source.

Beet Pulp: Beet pulp is a dried, by-product of the sugar beet industry. It is a good source of fermentable fiber and can be purchased in a pelleted form or in its loose 'raw' form. Traditionally, the raw form is soaked in water for 1 to 2 hours before feeding. The pellets do not have to be soaked. It is a very common additive in the "complete" feeds. It should not be fed as the sole source of nutrition.

Garden Refuse and Lawn Clippings: Because many ornamental plants, shrubs, and garden plants (tomatoes, potatoes, rhubarb, etc.) are potentially lethal to horses, these are not recommended as forage substitutes or even supplements. Even feeding lawn clippings and garden refuse can lead to colic, laminitis, and/or death and is not recommended.

Pasture for Horses

Good pasture can be one of the best quality, low labor, and least expensive means of feeding a horse. By maximizing pasture, horse owners can enhance the well being and efficient management of their horses. Pasture is a nutritious feed source for horses and can provide an excellent physical and social environment as well. In much of the upper Midwest U.S., the grazing season begins in April and often extends into November. Many horses, particularly horses at maintenance (such as 'open' mares and riding horses receiving little or no regular work), can meet most of their nutrient requirements from well managed pasture alone. Lactating mares, growing horses and horses in moderate to heavy work have higher nutrient requirements and will need grain in their diets.

One of the difficulties of writing an Extension Bulletin about pasture for horses or presenting a 'horse pasture talk' is the great variability in the productivity of different types of pastures and the normal variability in production of the same pasture throughout the grazing season. To meet the nutritional needs of the horse, what is not obtained from grazing must be made up with supplemental feeding.
The amount and type of supplements needed by horses on pasture vary with the availability and quality of the pasture forage. Many Iowa horse pastures are ‘overstocked’ most of the grazing year. A pasture with the same number of horses may provide abundant forage in the spring, and slip to a fair (or worse) condition by late-summer, providing virtually no grazed nutrition and requiring nearly 100% supplementation. Changing the number of horses in a pasture can also affect pasture quality within a few weeks. So, pasture condition must be constantly evaluated, so stocking or feeding adjustments can be made.

Dr. Laurie Lawrence, Horse Specialist at the University of Kentucky, breaks pastures into 4 categories based on their nutrient-providing capacities.

<table>
<thead>
<tr>
<th>Category</th>
<th>Characteristics</th>
<th>the pasture</th>
<th>Acres / mature horse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lush</td>
<td>dense population, rapidly growing, desirable plants 3 to 6 inches of vegetation on most of the pasture</td>
<td>100% to 150%</td>
<td>Ky Bluegrass 1 ½ - 2 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tall-Grasses 1 ½ -2</td>
</tr>
<tr>
<td>Very Good</td>
<td>2 to 4 inches of vegetation available on ½ of the pasture</td>
<td>100% to 120%</td>
<td>Ky Bluegrass 2-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tall-Grasses 2 -2 1/2</td>
</tr>
<tr>
<td>Good</td>
<td>1-3” of vegetation available on less than ½ of the pasture</td>
<td>70% to 100%</td>
<td>Ky Bluegrass 3 --3 1/2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tall-Grasses 2 1/2 – 3 1/2</td>
</tr>
<tr>
<td>Fair</td>
<td>Closely grazed, only 1-2” of forage over entire pasture very slow regrowth, some bare soil</td>
<td>25% to 35%</td>
<td>Ky Bluegrass 3 ½ -4+</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tall grasses 3-4+</td>
</tr>
</tbody>
</table>

* The information in the table above applies primarily to horses at maintenance (such as barren mares) but will also apply to mares in early and mid-gestation and many horses that are ridden once or twice a week. Horses that perform moderate or hard work, lactating mares and growing horses will require higher levels of hay, grain or other supplements.

** provided by the author

**Types of pasture**

"Horse pastures" are not greatly different than those developed for cattle or sheep. The management, too, is usually much the same, but with a few more cautions and inputs for management as a horse pasture.

‘Permanent, Ky bluegrass’ pastures are quite common because of less work and cost. They have earned a reputation among horse producers for producing a strong turf and nutritious forage. Bluegrass is most productive in May and June and again in September and October. Its primary
problem is that it grows slowly during the hot, dry part of mid-summer. Including a legume such as alfalfa, red or white clover, or birdsfoot trefoil in a bluegrass pasture will improve productivity during the summer months. These pastures often have small amounts of clover. Appropriate stocking management, fertilization, weed control, clipping and controlled grazing often insure a full season of nutritious grazing!

**Tall-growing grasses** such as smooth bromegrass, orchardgrass and timothy make excellent pasture and are more productive than bluegrass. Of the three, orchardgrass maintains a slightly better distribution of growth through the summer months. Reed canarygrass and tall fescue are sometimes used for horse pasture. However, they are considered less palatable. Reed canarygrass is a good choice on wet sites and where flooding occurs. Reed canarygrass remains more palatable when clipping or grazing maintains the pasture height at about 5 to 6 inches. Avoid using tall fescue that is infected with the 'endophyte fungus'. Horses can develop several problems when grazing this forage. Perennial ryegrass has not been a reliable, long-term grass species but can be used as a component. As with Ky bluegrass pastures, these pastures often have small amounts of clover. Appropriate stocking management, fertilization, weed control, and clipping often insure a full season of nutritious grazing.

**Mixing legumes with grasses** often improves productivity, nutritive quality and distribution of forage production compared with all grass pastures. Birdsfoot trefoil and Ladino white clover are most compatible with bluegrass, Orchardgrass, timothy and bluegrass. In mixture, these forages will maintain reasonably good productivity under a 'frequent but not close' grazing program. Or, are better suited to a situation where there are few pastures and continuous grazing is used. If this latter situation is what you have, fewer animals on the limited acreage are suggested to prevent overgrazing and loss of the legume component. Alfalfa and red clover are most compatible with bromegrass and reed canarygrass or mixtures of these with orchardgrass. In mixture, these taller growing legumes and grasses will maintain good levels of productivity under a 'close but not frequent' grazing program and are better suited to a 3 or 4 pasture rotational grazing program. Remember, legumes maintain vigor and longevity best if given a 4 to 6 week 'rest' in September and early October each year.

Regrowth of hay fields can provide needed pasture for some producers.

**Harvested corn fields** are a frequent pasture for horses in Iowa. While horses can glean valuable feed from corn crop residue, the nutritive quality is low after the dropped ears have been consumed. Supplementation to provide extra energy, protein and minerals is necessary.

**Sudangrass and Sudan-sorghum hybrids** are **NOT** recommended for horse pasture. These plants have caused an increasing number of cases termed "cystitis syndrome" in horses.

**Grazing-Management**

Good grazing management involves keeping both the animals and the pasture plants growing and healthy. It's a three component system: the plants, the animals, and you, the decision-maker. Certainly providing palatable, highly digestible forage for the entire grazing season is ideal for the animal component of grazing management. The pasture plants, whether grasses or legumes, remain most productive when they are well fertilized and can maintain several inches of growth throughout the grazing season. You control the system by maintaining appropriate stocking rates for the growth conditions.
Spot grazing and overgrazing can be a problem in horse pastures. Horses are inclined to graze plants close to the ground, and return frequently to the same closely-grazed areas. This kind of grazing will retard the further growth of the pasture plants. If continuous close grazing is practiced, legumes can be completely lost from the mixture and the weakened grass sod will allow weeds to establish in the pasture.

Pasture Rotation When pastures become short, it is best to remove the animals from the pasture. It is good management to have at least two separate pastures for each group of horses you are managing. Three or four pastures per group are better and allow greater flexibility in grazing management. If other pastures are not available, move horses to exercise lots and feed hay for two to three weeks until pastures recover.

Kentucky bluegrass-based pastures should be allowed to reach about 3-4 inches of height before grazing for the first time in the spring, then graze back to 2 to 3 inches. Allow regrowth to reach 3 to 4 inches before grazing again. Taller, more productive grasses, such as smooth bromegrass, or orchardgrass should reach about 4 to 5 inches before grazing for the first time in the spring. Graze back to 3 to 4 inches. Allow a few inches of regrowth before grazing again.

Pasture quality and use can be improved during the season by clipping to remove uneaten clumps, unpalatable growth and weeds. Scattering the droppings also encourages more uniform grazing. Frequent shifting of the salt, shade, and watering devices will also help maintain stands and improve grazing distribution.

Fertilize grass pastures according to soil tests. Generally if grass pastures are medium or higher in phosphorus and potassium, no additional P or K are needed. If the soil tests low or very low, there will be a recommendation for applied P2O5 and K2O annually, with a soil retest in three years. For legume-grass pastures apply annual P and K applications when soil test levels are in the medium or lower category. Grass-based pastures are much more productive when fertilized with nitrogen. Greatest efficiency of nitrogen use comes when a portion is applied in early spring and a portion in late summer. Fertilize Kentucky bluegrass-based pastures with 40 to 80 lbs/A of nitrogen in the spring and an optional 30 to 50 lbs/A in late summer. Taller grasses such as smooth bromegrass or orchardgrass will respond well to 60 to 100 lbs/A of nitrogen in the spring and an additional 40 to 60 lbs/A in late summer. If mixed grass-legume pastures are less than 1/3 legume, treat as a grass pasture and apply nitrogen for increased productivity. Legume dominant pastures generally need no additional nitrogen.

Weeds can become troublesome in pastures. Clipping several times a year and hand digging may be sufficient. However, if low-growing broadleaf weeds become a problem, a herbicide application may be required. Where herbicides are necessary for weed control, expect to see a decline or loss in legume plants. Applying a labeled broadleaf herbicide in the spring when weeds are 3 to 4 inches tall will often be effective in controlling annual broadleaf weeds. A second application in mid-autumn (mid-September through mid-October) may be necessary where dandelions and biennial thistles are a problem. Repeat these twice annual applications until weeds are under control. After that only an occasional spraying or clipping may be all that is necessary for continued control. Perennial weeds and brush offer greater challenges. See ISU Extension Pamphlet 601-a, Weed Control in Small Grains, Pastures and Legume Forages, for more details on weed and brush control. Remember to read and follow label instructions for any pesticide or ag chemical used., and follow recommended animal withdrawal periods.
Renovating and Oversowing to improve Pastures

For pastures with a good grass base, and where there is a desire to incorporate legumes, ISU Extension publications PM-856 Improving Pasture by Frost Seeding; and PM-1097 Interseeding and No-till Pasture Renovation provide information on methods, timing and suggestions for seeding rates. Where ‘starting over’ with a complete renovation is the only recourse, see ISU Extension publication PM-1008 Steps to Establish and Maintain Legume-Grass Pastures.

Other Suggested ISU Extension Publications:

Pm-1771 Titled Guide to Year-Round Forage Supply
Pm-1791 How Pasture Plants Grow
Pm-1758 Estimating Available Pasture Forage
Pm-1713 Pasture Management Guide for Livestock Producers

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