ALFALFA

The high-quality hay for horses

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Alfalfa is often the preferred forage for horses because of its high quality, high digestibility, and good roughage value. Well-preserved alfalfa hay should be the foundation of a feeding program for young growing horses, recreational horses, and active horses. This publication describes the horse's digestive system and nutritional needs and how to select alfalfa hay. It provides information on purchasing, storing, and feeding alfalfa hay; and uses science to discuss myths and realities of feeding horses.

The horse's digestive system

Horses evolved as grazing animals. Compared to most other non-ruminant species, the horse has a relatively small stomach, a normal-sized small intestine, and an enlarged hind gut (figure 1). This arrangement makes horses better adapted to grazing continuously than to eating one or two large meals a day. Compare the size of a horse's stomach (figure 2) to the volume of hay a horse will consume in a day, and it's easy to see why horses should be allowed access to forage throughout the day.

Food—especially forage—passes relatively rapidly through the stomach and small intestine, but can be retained for many hours in the hind gut (cecum). The hind gut is populated by a diverse microbial population that digests the fibrous components of hay and pasture. The horse's digestive tract is generally not as efficient at digesting fiber as the digestive tract of a cow or sheep. However, for high-quality hays such as early bloom alfalfa hay, the difference is much smaller than for lower quality hays such as late-maturity grass hays.

High-quality hay (or pasture) can be an excellent source of nutrients for most classes of horses, and in most cases should be the predominant type of feed in a horse's diet. However, some classes of horses will require supplementation of their diet with a concentrate. A concentrate feed can be a plain grain such as oats or corn, or it can be a commercially manufactured mixture of grains and other feed ingredients. Concentrate feeds are higher in energy than hay because the cereal grains contain more nonstructural carbohydrates, especially starch.

Figure 1. The digestive tract and internal organs of the horse.

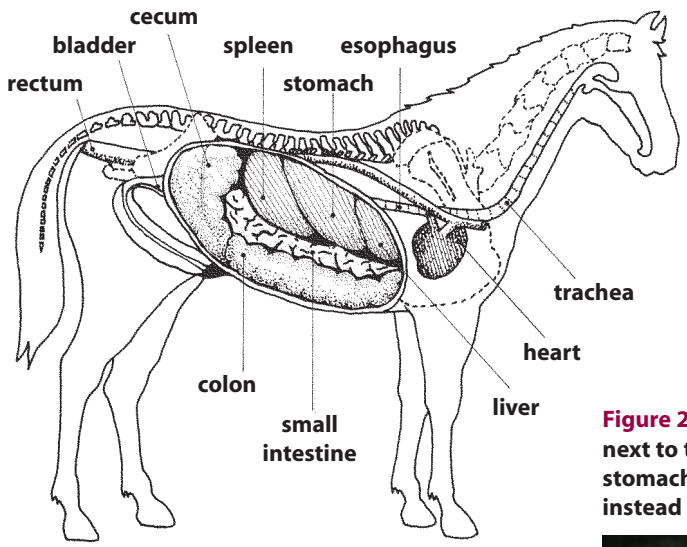


Figure 2. A model of a horse's stomach from an 1100-lb horse shown next to the daily ration (15 lb) of hay. Because of their relatively small stomachs, horses are better adapted to eating forage all day long instead of eating one or two large meals each day.

In horses, starch can be digested in the small intestine and absorbed as glucose. Research has demonstrated that when large amounts of starch are fed, the capacity of the small intestine to digest the starch will be overloaded. The undigested starch is moved on to the large intestine where it is fermented. Fermentation of starch in the large intestine is less energetically efficient than digestion and absorption from the small intestine. More importantly, fermentation of excess starch in the large intestine can result in digestive problems such as diarrhea, colic, and, in severe cases, founder.

When an 1100-lb horse consumes a meal containing more than 2.0–2.5 lb of starch, there is potential for some undigested starch to reach the large intestine. Cereal grains vary in starch content, so the actual amount of grain that can be fed without starch by-passing to the large intestine will vary also. Corn can contain 60–70% starch whereas oats contain 45–55% starch. Many commercially manufactured feeds will have a starch content of 45–55%, although feeds with lower amounts of starch are becoming more available. If a horse is fed a concentrate containing 50% starch, the amount that could be fed in a single meal with minimal starch by-pass to the large intestine would be 4.4 lb. Therefore, when the daily concentrate intake exceeds 10 lb, the concentrate should be divided into three meals per day.

Meeting the nutritional needs of horses

Horse nutrient needs change with age and production state. Very young horses usually require the most nutrient-dense diets because they are growing rapidly. The diets have to be nutrient dense to meet the animal's high nutrient requirements and limited intake capacity. As horses age, diets that are less nutrient dense are usually required. Lactating mares and horses with strenuous physical activities have much higher requirements than horses that are kept at maintenance or are used for light recreational riding.

Table 1 shows the approximate amounts of several nutrients required by horses in different physiological stages on a daily basis. These values may need to be adjusted for specific horses, particularly if they are exposed to unusually hot or cold weather. For some nutrients, the approximate dietary concentrations are also shown. These concentrations are based on average expected feed intakes of the horses in each physiological class.

To accurately determine the appropriate dietary concentration for a nutrient, it is necessary to know the feed intake of the horse. For example, if a horse consumes 25 lb of feed per day and it requires 2 lb of crude protein, then the feed must contain 8% crude protein (2 ÷ 25). However, if the horse only consumes 20 lb of feed per day, then the feed must contain 10% crude protein to provide the needed crude protein each day. Most horses will consume at least 2 lb of feed (forage and concentrate, 90% dry matter) for every 100 lb of body weight. However, if very low-quality forage is fed, feed intake might be less. Conversely, if highly palatable feed is offered, intake may increase. Some horses, especially lactating mares and growing horses, may consume 3 lb of feed per 100 lb of body weight.

Table 1. Recommended nutrient intakes for horses with an expected mature body weight of 1100 lb.*

Class of horse	Digestible energy**	Crude protein		Calcium		Phosphorus	
	Mcal/ day	lb/ day	% in diet	g/ day	% in diet	g/ day	% in diet
Recreational	20	1.8	10	25	0.30	18	0.20
Pregnant	20	1.9	11	37	0.45	28	0.35
Lactating	28	3.1	13	56	0.55	36	0.35
Weanling	16	1.9	14	35	0.70	20	0.40
Yearling	20	2.1	13	35	0.50	20	0.30
Performance							
Moderate	26	2.2	11	32	0.35	24	0.25
Heavy	32	2.9	12	40	0.35	30	0.25

*Expressed as total daily intakes or dietary concentration on a 100% dry matter basis.

**Digestible energy = (gross energy of food) – (energy lost in feces)

Source: Adapted from NRC (1989) "Nutrient Requirements of Horses"

Typical dry matter intakes (per 100 lb of body weight) for horses are shown in table 2. Also shown are the amounts of dry matter from forage and concentrate in typical diets. Forage should be the cornerstone of horse diets, comprising the largest part of the dry matter intake as a guard against energy-dense feeds such as starch, to meet the need for large particle size for fiber requirement, and for continuous supply of nutrients. These guidelines for feed intake are best applied when mid-maturity forage is used. When early-maturity forage is used, the amount of concentrate in the diet can usually be reduced, whereas when late-maturity forage is used, more concentrate will be necessary.

Mature horses used for recreational activities

Many horses are used for recreation (which includes weekend riding, occasional showing, and similar activities) where the horse is exercised at a low to moderate intensity for less than 5 hours a week. In general, these horses have low to moderate nutrient requirements and nutrient deficiencies are relatively rare. Typically, the biggest nutritional problem facing these horses is excess nutrient intake, especially calories, which can result in obesity.

Table 3 shows two diets using alfalfa hay that will meet, or slightly exceed, the needs of a mature 1100-lb horse used for recreational riding. Both diets meet the nutrient needs of the horse, but which diet is best? One consideration might be cost. Another consideration might be total feed intake. Total feed intake is highest when diet A is used. The lower feed intake with diet B could be an advantage if you have a picky eater. However, diets with low feed intakes often mean more idle time for the horses (especially those confined in stalls or small paddocks) and increased potential for stall vices such as wood chewing. Because these diets use alfalfa hay as the forage source, they provide more protein and calcium than are required for recreational horses. Most nutritionists agree that exceeding the protein and calcium requirements is not harmful for normal healthy horses.

Table 2. Expected dry matter intakes by horses (lb DM/100 lb of body weight).

Class of horse	Total dry matter intake (lb)	Forage intake (lb)	Concentrate intake (lb)
Recreational	2.00–2.25	2.00–2.50	0.00–0.25
Pregnant (last trimester)	1.75–2.00	1.50–1.75	0.25–0.50
Lactating	2.25–2.75	1.50–2.25	0.50–1.25
Growing	2.25–2.75	1.50–2.00	0.75–1.25
Working	1.75–2.50	1.00–1.75	0.75–1.25

Source: Adapted from NRC (1989) "Nutrient Requirements of Horses"

Table 3. Example diets that meet the needs of recreational horses* (1100 lb) and lactating mares (1100 lb).

	Recreational horse*		Lactating mare**	
	Diet A (lb)	Diet B (lb)	Diet A (lb)	Diet B (lb)
Bud stage alfalfa hay	0	19	18	0
Full bloom alfalfa hay	24	0	0	8
Mature timothy hay	0	0	0	7
Commercial concentrate**	0	0	8	13
Salt	Free choice	Free choice	Free choice	Free choice

* Note that diet B for a recreational horse provides feed intake below 2 lb /100 lb of body weight.

** Using a typical commercial concentrate formulated for lactating mares containing at least 14% CP, 0.9% Ca, 0.7% P, 30 ppm Cu, 80 ppm Zn, and 0.3 ppm Se.

When good- to high-quality forages are offered free choice, some recreational horses will get fat. These forages are not only more digestible and more nutrient dense than later-maturity forages, they are also usually more palatable, so horses will eat more. An 1100-lb gelding offered early ($^1/_{10}$ bloom) alfalfa hay free choice might consume as much as 25 to 30 lb per day! This would exceed his calorie requirements by about 50–60% and could result in a weight gain of 150 to 200 lb in a year! To keep horses at their ideal weight, it's best to feed them lower-quality hay or limit their access to very high-quality hay.

Broodmares

Good nutrition plays an important role in reproductive efficiency and is a key component of broodmare management. Broodmares in early gestation have nutrient requirements at, or just slightly above, maintenance, and may be fed diets similar to those recommended for recreational horses. However, after about 8 months of gestation their nutrient requirements increase. If additional nutrients are not available from the diet, mares will mobilize their own body stores to meet the needs of fetal development. As shown in table 2, feed intake in pregnant mares may fall below 2 lb per 100 lb of body weight near the end of gestation. This reduction in feed intake may require an adjustment to the diet to ensure that nutrient needs are met. Once a mare foals, her nutrient needs increase greatly compared to gestation (table 1). Again, if nutrient demand for milk production is not met, the mare will mobilize body stores.

Body condition (fatness) can affect reproductive efficiency in mares. A condition scoring system has been developed for horses that scores horses from 1 to 9, where 1 is an extremely thin horse and 9 is an extremely fat horse. Horses in moderate body condition (condition score = 5) have ribs that are not visible, but can be easily felt and are easier to breed than mares with body condition scores below 5. Mares with a body condition score of 6 have a reserve of fat that can be used if the weather turns cold or if they are unable to consume enough feed to meet their requirements in late gestation or lactation. There is no advantage to having extremely fat mares.

Table 3 shows two diets for lactating mares with differing hay maturity. Note that as the nutrient content of the forage decreases from bud alfalfa to full bloom alfalfa and timothy, it is necessary to feed more concentrate, and in some cases it is necessary to feed a highly fortified concentrate. Depending upon the cost of the hay and the grain, one diet may be much more economical than another. When concentrate portions exceed 10 lb per day, divide and feed it in three separate meals to minimize health problems.

Figure 3. This mare is in moderate body condition (score = 5). Mares thinner than this are more difficult to breed.

Growing horses

Nutritional programs for growing horses focus on promoting steady, even growth and optimal skeletal development. Nutrient deficiencies and imbalances can result in developmental orthopedic diseases that may affect the ability of a horse to perform as an athlete. Most foals will start to eat solid food shortly after birth and will be able to consume enough forage and concentrate to meet their nutrient needs at weaning, which usually occurs around 4 to 6 months of age. Young horses should be fed high-quality forage, which is high in digestibility and nutrient density to meet the needs for tissue growth.

Average daily gains for horses at 6, 12, and 18 months of age would be expected to be about 1.5–2.0 lb/day, 0.75–1.0 lb/day and 0.5–0.75 lb/day, respectively. As foals age, their rate of growth slows, although most horses continue to grow through their first 2 years. Table 4 shows typical feeding programs for weanlings and yearlings, based on dry matter intakes of 2.25–2.75% of body weight. The diets shown use alfalfa hay. One of the benefits of using high-quality alfalfa is a reduced need for concentrate in the diet. If a grass hay is used, then the need for concentrate is usually increased, and the concentrate must contain high levels of protein.

Performance horses

Nutrient needs of performance horses are affected by the type and duration of the exercise they perform. Exercise burns up calories, so meeting energy needs is a primary concern. Race horses and horses that work for several hours a day may have calorie requirements that are twice as high as a horse at maintenance. Table 5 shows some example diets that meet the needs of performance horses. Note that when mature grass hay is used, the horse must consume more concentrate to meet its energy needs. Feeding higher-quality hay and less grain should lower the potential for colic or other digestive disorders.

Table 4. Example diets that meet the nutrient needs of weanlings and yearlings with an expected mature body weight of 1100 lb.*

	Weanlings		Yearlings	
	Diet A (lb)	**Diet B** (lb)	**Diet A** (lb)	**Diet B** (lb)
1/10 bloom alfalfa hay	6–8	0	9–15	0
Full bloom alfalfa hay	0	5–7	0	10–14
Commercial concentrate**	6–9	7–9	6–9	7–10
Salt	Free choice	Free choice	Free choice	Free choice
Expected daily feed intake	14–15	11–13	18–24	18–24
Body weight	475–600	475–600	600–880	600–880

* Based on dry matter intakes of 2.25–2.75 lb/100 lb of body weight. In most cases, the lower amount of forage will be fed with the higher amount of concentrate. As horses grow, the amount of forage in the diet is usually increased. These diets will produce a moderate rate of growth.

** Using a typical commercial concentrate formulated for growing horses containing at least 14% CP, 0.9% Ca, 0.7% P, 30 ppm Cu, 80 ppm Zn, and 0.3 ppm Se.

Table 5. Example diets that meet the nutrient needs of horses (1100 lb) performing moderate and intense work.*

	Moderate work		Intense work	
	Diet A (lb)	**Diet B** (lb)	**Diet A** (lb)	**Diet B** (lb)
1/10 bloom alfalfa hay	0	5–6	0	7–9
Full bloom alfalfa hay	16–18	0	15–18	0
Mature timothy hay	0	10–12	0	6–8
Commercial concentrate**	7–8	8–10	11–13	12–14
Salt	Free choice	Free choice	Free choice	Free choice

* Usually the higher amount of hay will be fed with the lower amount of concentrate. When daily concentrate intakes exceed 10 lb, the concentrate should be divided into three separate meals.

** Using a commercially manufactured concentrate feed formulated for performance horses that contains approximately 12% CP, 0.7% Ca, 0.5% P, 20 ppm Cu, 60 ppm Zn, and 0.3 ppm Se.

Some horse owners have concerns about the level of protein and calcium present in high-quality alfalfa hay. There is no research evidence that high-protein diets hurt performance. When alfalfa hay is used, the amount of protein in the concentrate fed for performance horses can be as low as 10 or 12%. However, if a low-quality grass hay is fed, a higher level of protein in the concentrate will be necessary.

Owners and trainers of horses used for racing, three-day eventing, and other strenuous activities often report that horses do not eat enough to maintain their body weight. A key to increasing feed intake in these horses is to use palatable feeds. High-quality hay is more palatable than low-quality hay. As shown in figure 4, the dry matter intake of horses fed high-quality alfalfa (34.1% NDF) is considerably higher than for horses fed medium-quality Matua bromegrass (61.4% NDF) or low-quality timothy hay with seed heads (74.4% NDF).

Adding some legume hay (alfalfa or red clover) to a horse's diet of grass hay and concentrate may also increase total hay intake, as shown in figure 5. When horses had access to the legume hay for 1 hour, they consumed approximately 4.5 lb of the legume and then consumed 16.5 lb of timothy during the remainder of the day. When only timothy was available, timothy intake was the same (16.5 lb/day). By adding the 4.5 lb of legume hay, total digestible energy intake of the horses was increased by about 4–5 Mcal (thousands of calories) per day. For a performance horse, this would comprise a 12–15% increase in daily digestible energy intake. Another way to look at the addition of some legume to the diet would be to evaluate how much concentrate it could replace. In this case, the added legume hay could replace about 3 lb of concentrate.

Alfalfa: An ideal legume hay

Alfalfa is the most important forage legume grown in the United States. It is the most widely adapted perennial forage legume. It has the highest yield potential and the highest feeding value of all adapted forage legumes. Alfalfa is a versatile plant that can be used as a high-quality feed for horses and livestock, as a soil improver, and for human consumption (sprouts, etc.).

Alfalfa and/or alfalfa–grass hay is the most important hay in the U.S. horse industry. Although predominantly fed as baled hay, it can also be fed as chopped hay, cubes, or pellets. It is palatable and the hay of preference for horses. Quality alfalfa hay has high protein, energy, vitamins, and minerals. Alfalfa is highly digestible and usually contains more cell solubles, less cellulose and hemicellulose, higher protein, lower fiber, and higher relative feed value (RFV) than grass (figure 6).

Alfalfa is also considered an ideal horse hay because of availability. It is the only forage that is produced and sold in every state.

Figure 4. Horses eat more alfalfa than grass hay.
Source: Voluntary intake of three hays adapted from Guay et al., 2002.

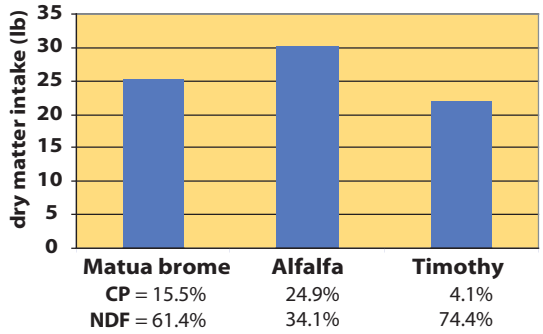
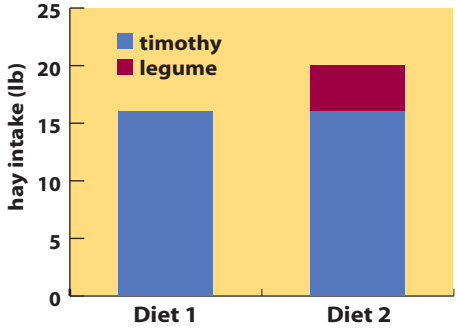


Figure 5. Horses consume more forage when legumes are included in the diet.
Source: Cassill, unpublished data.



How stage of growth affects forage quality

Of all the factors affecting quality of alfalfa hay for horses, the stage of maturity at harvest is the most important and the one where management decisions can have the greatest impact. As the alfalfa plant matures from the vegetative stage to flowering, the amount of fiber increases, while crude protein and digestibility (TDN) decrease (table 6). Early cut alfalfa hay is also more palatable and is consumed in larger quantities. This hay is usually leafier and has finer stems, which results in better texture (softer to the touch).

Classification of alfalfa hay

Forage quality represents the total of the plant constituents that influence a horse's consumption and use of the feed. Forage testing is done to estimate the quality for livestock. Hay classification is based on fiber components, an estimate of energy content, and crude protein. Forage should be tested so it can be allocated to the proper class of livestock. Purchased hay should be selected based on the quality your horse needs and price. Typically, the seller is responsible for sending hay samples to a laboratory for testing. (For a current list of certified laboratories, visit the National Forage Testing Association web site at www.foragetesting.org.)

Physical characteristics of high-quality hay

Leafiness — High-quality hay contains a high percentage of leaves. Leaves provide 50–75% of the digestible matter, 75% of the protein, and 90% of the carotene (relates to vitamin A content) found in hay. Any leaf loss reduces the nutritive value of hay.

Color — A bright-green color indicates proper curing and high carotene content and usually indicates the absence of weathering, mold, dust, or heat damage. However, color may be deceiving and overrated. In general, color is more important to the person who is buying-selling-feeding than it is to the horse, as the horse is color blind and cannot distinguish green from brown.

Foreign material — Weeds and other foreign material (wire, dirt, rocks, sticks, insects) lower the palatability and feeding value of the hay. The presence of blister beetles indicates a high probability of the toxin cantharidin, which is very dangerous to horses.

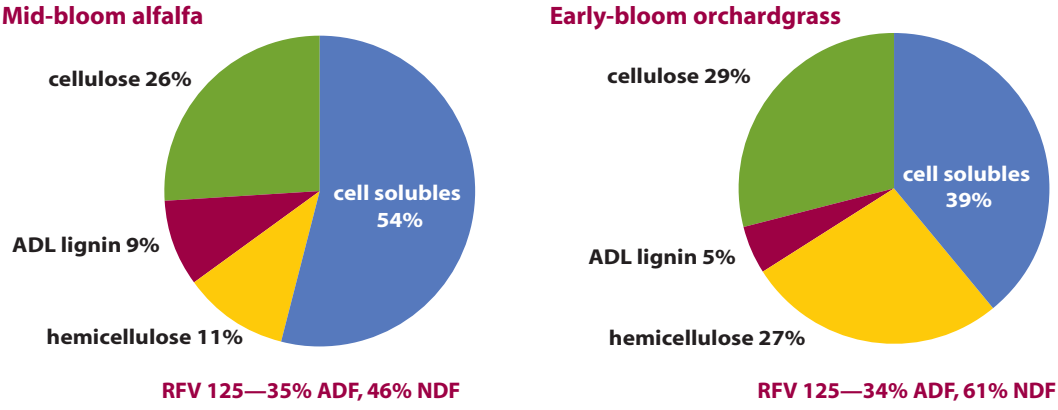
Table 6. Change in alfalfa quality with advancing plant maturity.

Maturity	TDN (%)	CP (%)	ADF (%)
Pre-bud	65	21.7	28
Bud	62	19.9	31
1/10 bloom	58	17.2	34
1/2 bloom	56	16.0	38
Full bloom	54	15.0	40
Mature	52	13.6	42

Abbreviations: TDN = total digestible nutrients, **CP** = crude protein, **ADF** = acid detergent fiber. All values are expressed on a dry matter basis.

Source: Nutrient Requirements of Dairy Cattle, National Academy of Science, Publ. 1349.

Figure 6. Mid-bloom alfalfa has higher forage quality than early-bloom orchardgrass.
Source: Neal Martin, U.S. Dairy Forage Research Center.



Odor and condition — Odors in hay, such as musty or rotten odors, indicate lower hay quality that is more objectionable to horses than to other livestock. These odors result from storage of hay that is too moist or weather damaged. Dust also reduces hay value.

Forage quality terms and definitions

Laboratories analyze forages by chemical analyses or near infrared reflectance (NIRS) methods. A forage test typically includes measurements of moisture, crude protein, acid detergent fiber, neutral detergent fiber, and total digestible nutrients. Each term is defined below:

Moisture — Hay moisture content is important because the higher the moisture content, the lower the dry matter and nutrient contents per pound of feed. A high moisture content (above 15%) increases the likelihood of mold damage during storage.

Crude protein (CP) — Determined by measuring the nitrogen content of the sample and multiplying by 6.25, since protein in forages contains about 16% nitrogen. The general quality of hay is closely associated with crude protein, and both are related to stage of maturity and leafiness.

Acid detergent fiber (ADF) — ADF is the percentage of highly indigestible plant material present in the forage. It contains cellulose, lignin, and silica. ADF is a useful predictor of energy and digestibility of forages. Low ADF values mean higher energy value and digestibility, therefore low ADF values are desirable.

Neutral detergent fiber (NDF) — NDF represents all of the structural or cell wall material in the forage. NDF is partially available to animals. NDF is closely related to animal intake of the forage: as NDF increases, intake decreases. Like ADF, low NDF values are desirable.

Total digestible nutrients (TDN) — TDN represents the total of all digestible nutrients in the forage. It may be the sum of measured quantities or less accurately estimated from ADF.

Figure 7. Up to 40% of the hay will go to waste if round bales are not placed in a feeder.

Alfalfa products

Alfalfa is harvested, stored, and fed to horses in many package sizes and shapes: hay in small, medium, and large rectangular bales; round bales; stacks; cubes; pellets; and haylage/silage.

Small rectangular bales — Bales weighing 40–80 pounds are readily available, conveniently sized, and easy to handle. Most horse owners prefer small rectangular bales that can be easily divided into individual portions (flakes). Price per ton for small rectangular bales is usually higher due to the extra time and labor involved in harvesting and increased transportation costs.

Large hay bales (round and rectangular) — These bales generally weigh over 500 lb each and offer cost savings for horse owners. The reduced labor of large package haying equipment for making various size rectangular and round bales and stacks have greatly increased the availability of these types of bales. One of the drawbacks to large bales is that they do require equipment to move.

Round bales (figure 7) are not recommended for horses. They are difficult to break apart or unroll by hand. Allowing horses to feed on the entire bale without a feeder can mean up to 40% waste. Further, large round bales that are stored outside have much higher amounts of mold and dust along with a general "low quality" reputation.

Large rectangular bales are becoming very popular in the commercial hay industry and will likely become more readily available than small rectangular bales. They can be efficiently moved and stored and break apart into 30–40 lb flakes for feeding.

Cubes — Alfalfa cubes (approximately 1 1/2 inches x 2 inches) are made from coarsely chopped alfalfa hay. They are similar to long-stem hay in digestible energy, crude protein, calcium, and phosphorus levels. Though more expensive than hay, cubes offer the benefits of being less dusty, easily handled and transported, requiring less storage space than hay, and less waste because of reduced selectivity. However, it is important to control the amount fed to prevent horses from developing digestive disorders or becoming overweight. When cubes are the major source of feed, horses are more likely to develop stall vices such as wood chewing.

Pellets — Like cubes, pellets are made from chopped hay, although they are more firmly ground and pressed into smaller units (usually around 3/16 to 1/2 inches in diameter). Alfalfa pellets can be an excellent source of nutrients and are best used to supplement lower-quality hay and to extend short hay supplies. They should never be fed as the sole source. Some long-stem hay is necessary to reduce the incidence of wood chewing. Incidence of gastric rupture from excessive intake has been reported. In addition, some horses have choked on pellets by eating too fast. Horses should be closely monitored when feeding pellets. Pellets are more expensive than hay.

Silage/haylage — Silage/haylage is plant material that has been fermented in a silo or plastic bags or wraps. An excellent feed for horses, its use in the United States has been limited due to availability, difficulty in handling, low quality, problems with mold and ammonia, and tradition. Introduction of baleage has caused some producers to reconsider, but it is presently not used to any extent within the industry.

Differences in cuttings

Which cutting of alfalfa or alfalfa-grass should I buy? This is a common question among horse owners. To address this question, we must first recognize that there is more variation in quality within cuttings than among cuttings. First cutting is often discriminated against because rainy weather frequently delays harvest and interferes with curing, so that plants are at a more-advanced stage of maturity and the resulting hay is lower quality. Also, it is not uncommon to have more undesirable weeds in the first cutting. Second and later cuttings may be able to be cut on time and have better hay-making weather; however, weather-related problems can occur on any cutting.

The most important question to ask is not "which cutting?" but what was the stage of maturity when harvested, are there any undesirable weeds, and what is the quality analysis?

Preservatives

Preservatives (organic acids, yeast cultures, enzymes, etc.) have long been used to permit baling alfalfa hay at higher moistures to prevent mold growth. Organic acids, with the most common being buffered propionic acid, have proven effective in preserving hay containing up to approximately 25% moisture. Research has shown that, where horses were offered a choice, acid-treated hay was not as palatable as untreated; however, after a short conditioning period, horses will consume acid-treated hay. Limited research has shown that acid-treated hay is safe for horses as long as no mold or dust is present.

Blister beetles

Blister beetles (ash gray, black, margined, and striped) contain cantharidin, a toxin that can irritate and blister internal and external body tissues. As few as 25 beetles consumed by a small horse may kill it, while larger horses may suffer serious internal damage. Blister beetles are a serious problem in the South and West and are occasionally a problem in the Upper Midwest. Beetles typically cluster together and therefore may affect only a few bales from a field. Blister beetles tend to be more of a problem in late summer than in spring or early summer. The beetles are more likely to be present during years when large numbers of grasshoppers occur because the larval stages of blister beetles develop on grasshopper eggs.

Blister beetles are attracted to flowering plants and weeds. Therefore, harvesting alfalfa before it flowers will help to minimize beetle populations in the hay. Also, avoid conditioning hay as the crushed beetles remain toxic. Hay harvested without conditioning allows beetles to crawl off onto the ground. Certified blister-beetle-free hay is available in some areas.

Figure 8. Blister beetles in hay can cause severe internal damage and death.

Purchasing and transporting hay

Most of the problems relating to buying and selling hay stem from poor communication between the buyer and seller. The hay buyer should have a clear understanding of what kind of hay they wish to buy and should clearly communicate this to the seller. Traditionally, few horse owners have used a hay test or asked for specific protein and energy levels. Lacking this objective analysis, it is not uncommon for a load of hay to be rejected at the barn because of difference in "perception" between buyer and seller on what constitutes high quality, early cut, green, leafy hay. In addition, terms such as dust-free, mold-free, weed-free, and free of insect damage, dirt, spoilage, and other foreign material are subjective since all hay has these factors to some extent. Poor communication during the purchase may readily lead to frustration, loss of sale, and loss of a hay supply.

We have observed that better communication exists when: 1) there is a hay test, and 2) both parties know and understand hay test report results.

Horse owners need to decide how much hay they need (refer to table 2). The storage available will determine whether you can purchase your entire hay needs at one time or make several purchases at different times as storage space becomes available.

One area of buyer-seller communication problems concerns bale weight. Horses eat hay by the pound, not by the bale. To ensure that you have enough hay for your horses, it's critical to buy baled hay based on total weight rather than on number of bales. Otherwise, you may find yourself needing to buy additional hay much sooner than expected.

Many sources of hay are available—individual producers, hay brokers and dealers, feed and seed stores, hay associations, auctions, and the internet. Each source can supply quality hay at fair prices. Conversely, problems can exist with any source. Rely on sources that provide a quality product, fair prices, consistent supply, and proven track record.

Hay storage

Storage of alfalfa hay in a barn or hay shed is the best option to preserve the quality. Covering bales with vinyl or plastic tarps is next best. Tarps must be firmly tied down and edges set out from the stack to allow water to drip away from the stack. Store bales where water will drain away from the stack. Place bales on a crushed-rock pad, wood pallets, or tires to break the contact between the hay and the soil or concrete. Moisture from the ground can ruin as much hay as leaving the top uncovered.

Feeding hay

Before feeding, inspect hay for dust, mold, or other contaminants. Moldy hay should never be fed to horses as they may develop a respiratory allergy to the hay. The most severe form of this problem is referred to as chronic obstructive pulmonary disease, or heaves. Horses with heaves suffer permanent lung damage. These horses are usually unable to be exercised and thus are not useful for many physical activities. Symptoms of heaves (coughing, difficulty breathing) may be minimized by controlling dust and mold in a horse's environment. Three common management techniques include good ventilation, soaking hay in water to prevent dust, and using hay cubes instead of long hay as a forage source.

Hay may be fed in racks or tubs, or it may be placed on the ground. Putting hay in a rack or a tub usually reduces waste, especially when groups of horses are fed together. When hay is fed on the ground to a group of horses, 20–40% of the hay may be wasted. Waste will be greater with late-maturity grass hay that is low in palatability. When alfalfa is fed on the ground, leaf loss may be high. This is significant because the leaves contain the most nutrients. When using hayracks or

mangers, be sure they allow enough space for all horses in an enclosure to eat comfortably at the same time. If there is inadequate space, some horses will be excluded or injuries may occur as they compete for space. The rack or manger should be placed in a location that allows safe and easy access for horses and humans. Hay racks that tip over easily are unsafe, as are feeding devices that horses can jump into (such as some cattle feeders). Hay feeders must be cleaned regularly to prevent the buildup of material that can mold when wet.

Large round bales may be used for horses under some circumstances. Unless they are placed in a feeder, the amount of waste from a round bale may be relatively high (up to 40%). Large round bales that have been stored under cover are safe to feed if they are mold free. Bales that have been stored outside may be used if the outer, weather damaged layer is first removed. Twine or netting must also be removed. Round bales are most effective for feeding large groups of horses where the hay is consumed rapidly. Round bales that stay in the paddock for several days are likely to become wet and moldy.

When hay is fed in pasture or paddock to several horses at the same time, it is helpful to group horses by physiological state. This will allow the appropriate matching of the nutrient needs of the horses to the amount and quality of forage offered. For example, if a 600-lb idle pony and a 1200-lb pregnant mare are allowed access to the same hay, it is likely that either the pony will be overfed or the pregnant mare will be underfed. In most situations, very high-quality alfalfa hay should not be fed free choice. Because it is highly palatable and nutrient dense, free access often results in obesity in horses with moderate to low nutrient requirements (most horses kept for recreational purposes). A better hay choice for these horses would be full bloom alfalfa hay or an alfalfa-grass mix.

Myths and realities

Myth: The excess protein in alfalfa hay will damage the kidneys.

Reality: Normal healthy horses can metabolize and excrete the extra protein in alfalfa hay without damaging their kidneys. However, horses consuming high-protein diets may drink more water and produce more urine as part of the normal excretion process. All horses should have access to clean water at all times.

Myth: Alfalfa is too rich for horses.

Reality: As with any feed, the nutrient content of hay should be matched to the nutrient needs of the horse. Early-maturity alfalfa hay is very nutrient dense and is suitable for mares and growing horses. If fed to recreational horses, the intake of early-maturity alfalfa hay must be restricted. Late-maturity alfalfa hay is less nutrient dense and is suitable for horses with lower nutrient requirements.

Myth: The calcium content of alfalfa is too high, especially for young growing horses.

Reality: Calcium has been fed at more than five times the requirement without detrimental effects, provided the phosphorus level is adequate.

Myth: Alfalfa makes horses cough.

Reality: Any hay (alfalfa or grass) that contains dust or mold may make a horse cough. Horses should only receive hay that is free of dust and mold. Ventilation in the feeding area can greatly reduce the effect of dust in hay on horses.

Myth: Preservative-treated hay isn't safe for horses.

Reality: Most preservatives applied to horse hay contain organic acids that are the same as those found in the horse's gastrointestinal tract. Application of preservatives helps produce mold-free hay. Initially, some horses may prefer hay without preservative, but if they are not given a choice, horses will consume the same amount of preservative-treated and non-treated hay.

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