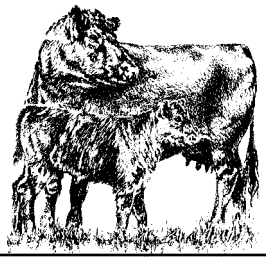

Western Beef Resource Committee

Fourth Edition

Cattle Producer's Handbook

Range and Pasture Section 581

Management to Minimize Hay Waste

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Hay is harvested, stored, and fed under a wide variety of conditions that influence both its yield and quality. Harvest and storage involve both dry matter and nutritive value loss. These losses occur in all phases of getting the hay from the field to the livestock — harvest, storage, and feeding.

Harvest

After cutting, forage plant cells respire until their moisture content falls below 35 to 40 percent. Hay dries rapidly on a warm, dry, breezy day resulting in dry matter losses to respiration of only 2 to 6 percent. If hay dries slowly, however, dry matter losses to respiration can be as high as 15 percent. This can happen when hay is rained on soon after cutting or when soil moisture and humidity levels are high. Overnight losses from hay cut in late evening can be as high as 11 percent.

Respiration loss is due primarily to the breakdown of soluble carbohydrates, which are roughly 100 percent digestible. Therefore, such losses will substantially reduce hay quality.

Losses during curing cannot be eliminated, but cutting hay when good drying weather is expected will reduce respiration losses considerably. Once the moisture content of hay falls below 35 to 40 percent, most harvest losses are caused by weathering and handling. Weathering losses increase with the number of rain showers, amount of rain, and dryness of the hay. Leaching can cause yield losses as high as 20 percent.

Most of the lost nutrients are highly digestible solubles (carbohydrates, proteins, B vitamins, and some soluble minerals, such as potassium). Rain not only leaches nutrients, it can also increase leaf loss because of the extra handling needed to dry the hay. Leaves are the most valuable part of the hay since they have the highest quality. Therefore, losing leaves will decrease hay quality.

Leaf shatter, especially from legumes, can be serious at harvest time. Leaf loss can be minimized by reducing the number of times hay is handled in the field and by handling hay at high-moisture levels. Leaf loss is often 5 to 10 percent greater when hay is cut, conditioned, and raked separately than when all three operations are done at one time.

Alfalfa hay that is raked and packaged very dry can yield 35 percent less dry matter and be of poorer quality than properly handled hay. Producers should rake legume hay at a moisture content greater than 50 percent. Results of raking alfalfa hay at various moisture levels are shown in Fig. 1.

Windrower machines eliminate raking and thus the leaf loss that is caused by raking. Because drying takes longer in the windrow than in the swath, respiration

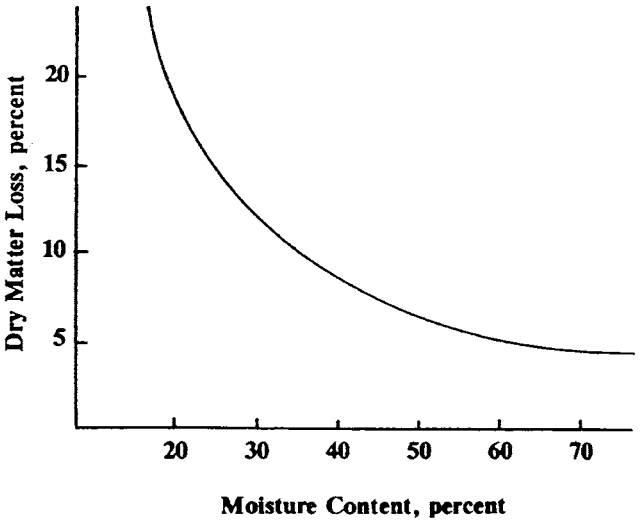

Fig. 1. Losses in alfalfa as influenced by moisture content when raked.[1]

[1]From Hundtolf, E. B. 1965. Cornell Univ. Ag Engineering Ext. Bull. 364. Ithaca, NY.

losses and increased potential of rain damage may reduce this advantage in humid areas. Growers can condition freshly cut forage, especially legumes, to allow the plants to dry rapidly, thus reducing respiration losses and the risk of weather hazards.

Dry matter and crude protein losses are greater with big-package hay making machines than with conventional balers when they are operated in dry, shatter-prone alfalfa hay. There is little difference in dry matter losses from different haymaking systems when hay moisture is optimum.

Baling hay above a 20 percent moisture level results in dry matter losses of up to 16 percent from heating, which increases mold content and decreases digestibility. Growers should hold off baling until moisture content drops to less than 20 percent for small square bales, 18 percent for round bales, and 16 percent for large square bales. Baling at these moisture levels should keep storage losses due to high moisture content at around 5 percent.

Storage

Even the best (shed or covered) storage conditions allow about 5 percent of hay dry matter to be lost after one year. Most nutrients maintain nearly constant concentrations when hay is properly stored, although carotene (precursor to vitamin A) concentration declines rapidly.

Losses of dry matter and quality during storage can be considerable when hay is stored too wet. These losses are caused mostly by heating, which will usually occur if hay is packaged above 20 to 22 percent moisture. Grass hay can be packaged at a slightly higher moisture content than hay containing legumes.

Fig. 2 shows spoilage losses in alfalfa hay stacked at different moisture levels. Several types of hay preservatives are available that can prevent spoilage of hay packaged too wet. However, these preservatives are effective only when they are applied evenly throughout the hay at the correct rate. Hay stored outdoors is subject to losses from weathering, but amount of loss is greatly influenced by climatic variables.

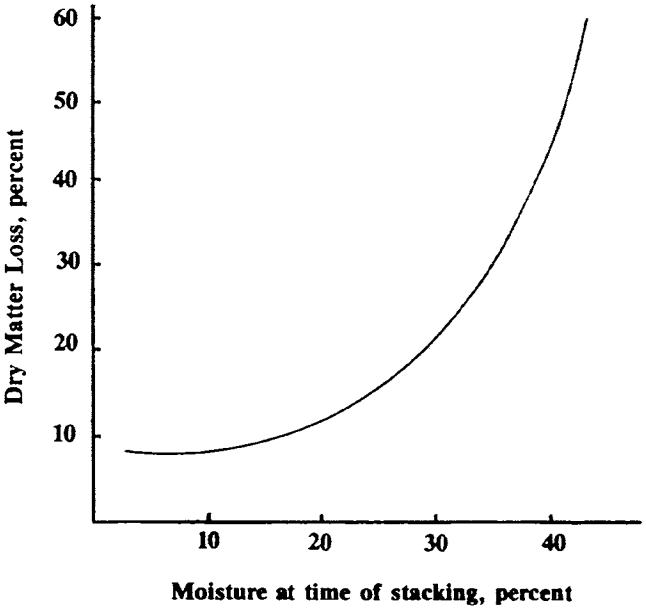

Fig. 2. Loss due to spoilage in alfalfa stacks made at different moisture levels.[1]

[1]From Drew, L. O. 1974. Ohio Rep. Res. Develop. 59:38.

In wetter, more humid climates, more losses occur with hay stored outdoors than in drier climates. Weathering occurs not only on the tops and sides of packages stored outside, but also where hay contacts moist ground.

Research in Indiana has shown that storing bales on crushed rock vs. the ground reduced the weathered portion of the original bale weight from 23 to 11 percent. Thus, outdoor storage losses can be lower if good packages are made, and they are stored on a well drained site. This may not be a problem in most places in the arid West.

Weathering reduces the dry weight of hay and changes its composition. Dry matter losses during outdoor storage range from 5 to 30 percent. Losses of dry matter of loose (non-compressed) stacks usually exceed 10 to 15 percent and are greater than losses from large round bales or compressed stacks.

Length of storage will also influence losses. Maintaining an inventory or carrying over a portion of the previous year's harvested hay crop is often needed to ensure against future hay shortages. However, long-term outside storage of hay may be costly.

Research in eastern Nebraska (Table 1) showed that after 7 months of storage, hay in loaf stacks lost 12.4 percent of its original dry weight, 9.7 percent of the protein, and 12.1 percent of the energy (TDN). By 29 months of storage, 29.5 percent of the dry matter, 53.1 percent of the protein, and 42.1 percent of the TDN were lost. These losses can be attributed to natural processes of deterioration, including losses associated with mold and microbial activity, leaching of nutrients due to excessive moisture, and spoilage at the base of the stack.

Resistence to weather depends on how well the packages are made. In an Indiana study, from 18 to 44 percent of the hay in compressed stacks had weathered after 1 year of outdoor storage. The amount weathered increased to 28 to 50 percent after 2 years of storage.

Table 1. Percent of initial quantity of dry matter, crude protein and total digestible nutrients (TDN) lost from loaf stacks of alfalfa hay stored outside.[1]

	Months after harvest	
Nutrient	**7**	**29**
Dry matter	12.4	29.5
Crude protein	9.7	53.1
TDN	12.1	42.1

[1]From Mader, T. L., J. Dahlquist, and C. Shapiro. 1990. Long-term storage effects on alfalfa losses and quality. Nebraska Beef Cattle Rep. MP-55.

Large round bales were from 18 to 39 percent weathered after 2 years of storage. Tight hay packages, such as round bales, shed more water than stacks, which reduces losses during long-term storage. However, moisture content at harvesting is of greater concern with round bales than with loose stacks. Therefore, the choice of packaging may depend upon moisture content of hay, machinery operator skill, and length of time hay is expected to be stored outside.

To reduce storage losses, be sure the package is dense and evenly formed, especially with compressed stacks. This allows rainfall to run off rather than settle in depressions and soak into the stack. Store hay packages on a well-drained site with air spaces between packages to allow drying after rain. Round bales can be butted end-to-end with little increase in loss from storage. Do not stack round bales unless they are covered with plastic.

Fig. 3 shows a bale that has experienced weathering down to a depth of 12 inches. This would be a weathering loss of greater than 50 percent of the baled hay volume! This is extreme, but on a 5-foot by 6-foot bale, a 2-inch weathered depth would equal an 11 percent loss, 4 inches equals a 21 percent loss, 6 inches equals a 31 percent loss, and 8 inches equals a 40 percent weathered loss. Cattle will pick through some of this damaged hay, but much will be refused and returned to the ground as organic matter without being processed by the animal.

To avoid this loss, begin with the bale itself. Make a tight, dense bale that will hold its shape. If it's stored outside, some weathering and thatch formation on the outside of the bale is good because it aids in water shedding. However, coarse-stemmed hay such as sorghum sudan or Johnsongrass will not form a dense thatch layer as well as fine-stemmed, leafy hays like bermudagrass, nor do they produce as dense a bale, which subjects coarse-stemmed hays to higher weathering loss.

When storing bales outside, expect losses of 5 to 50 percent. Pay attention to your storage site, and try to imagine how it will look after 2 inches of rain along with a week of daily travel using a truck or tractor to retrieve bales. Avoiding direct contact with the ground by placing bales on some type of pad can drop losses to 3 to 35 percent. Combine a pad with a cover for the top of the bale and losses go down to 2 to 10 percent.

The variation in percent dry matter loss is dependent on the amount of rainfall and storage time. Higher rainfall with longer storage time would cause higher losses. When storing bales outside, place bales butt to butt in north to south rows at least 3 feet apart to maximize wind flow and sunlight penetration.

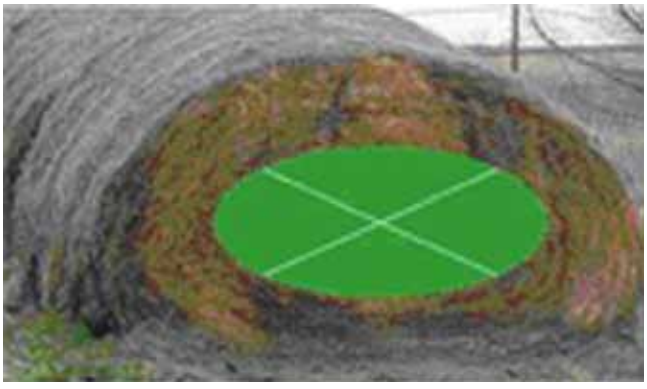

Fig. 1. A bale weathered down to a depth of 12 inches.

Feeding

How are you feeding hay? When feeding hay, an acceptable range of loss to aim for is 3 to 6 percent. In poorly managed situations, this can go up to 60 percent.

Much expense and many long hours go into harvesting and storing good quality hay for winter feeding. You wouldn't dream of throwing away one-third of this hay. That is what happens when livestock are allowed unlimited access to hay, however. Livestock trample, over-consume, contaminate, and use for bedding 25 to 45 percent of the hay when it is fed with no restrictions (Table 2). Cattle will waste less hay when the amount fed is limited (Table 3). One-fourth more hay is needed when a 4-day supply of hay is fed with free access than when a 1-day supply is fed.

Excessive hay consumption can be a major problem when large hay packages are fed without restriction. A dry, pregnant cow may eat 20 to 30 percent more hay than she needs when allowed free access. This can amount to over 700 pounds per cow over a 4-month feeding period.

A 100-cow herd may overconsume 35 tons of hay if the cows have free access to hay. This is in addition to the extra hay needed to replace that wasted during free-access feeding.

Table 2. Hay wasted by cows fed with and without racks.[1]

Bale type	Percent wasted
Square bale in rack	7
Large round bale in rack	9
Large round bale without rack	45

[1]From Bell, S., and F. A. Martz. 1973. Univ. of Missouri Ag Exp. Sta. Rep.

Table 3. Hay wasted by cows on pasture when amount fed was controlled.[1]

Feeding system	Hay per feeding	Hay refused or wasted	Hay required over rack feeding
	(lb)	(%)	(%)
Rack feeding		5	
No rack feeding			
1-day supply	20	11	12
2-day supply	40	25	33
4-day supply	80	31	45

[1]From Smith, W. H. 1974. Purdue Univ. Coop Ext. Ser. ID-97.

Hay loss and waste can be reduced by feeding hay daily according to diet needs. Compared to feeding a several-day supply each time hay is provided, daily feeding will force livestock to eat hay they might otherwise refuse, overconsume, trample, or waste. Daily feeding is more efficient, especially when hay is fed free-access. Restricting the animal's access to hay will decrease waste. Efforts that limit the amount of hay accessible to trampling will save feed.

Hay racks with solid barriers at the bottom prevent hay from falling out or being pulled out by livestock and getting stepped on. Loose or compressed hay stacks should have collapsible racks or electric wire around them to reduce the amount of trampling around the edges.

Feed hay on a well-drained site or on concrete when possible. Feed bunks are excellent for feeding small square bales. Round bales should be fed in specially designed racks. When feeding square bales on the ground, unrolling round bales, or using other feeding methods that place a large percentage of the hay in an easily trampled position, spread hay so that all animals have access. In addition, limit feeding to an amount that will be cleaned up within a few hours. Otherwise, cows will use the hay for bedding after meeting their immediate intake needs.

If you are feeding on the ground without a bale ring, move the feeding site around. Place bales on well-drained spots to avoid bogging and unnecessary pasture damage. If you make the decision to feed at only one well-drained location, you may want to create a permanent feeding pad for bale placement or feed your well-weathered hay first, which will create a thatch layer that can be used for placement of higher-quality bales later.

Try to feed hay in quantities to match herd demand with adequate feeding space. This shortens the time that hay is consumed and reduces trampling wastes. If you need to put large quantities of hay out at a time, use a bale ring or some sort of feeder to restrict access and reduce feeding wastes.

Summary

How do all of these costs add up? Let's start with a ton of hay and place a cost of production on it of $30, $15 in fertilizer, and $15 in harvest costs, and see how a 25 percent loss adds up:

(Base value $30/ton or 1.5¢/pound)

- Baled at too high moisture content - 5% loss = 100 lb or $1.50
- Improper outside storage and 4-inch weathering loss - 10% = 200 lb or $3.00
- Poorly managed feeding method - 10% loss = 200 lb or $3.00
- Total per ton = 500 lb or $7.50
- Adjusted hay cost, including wastes = $37.50/ton

Putting this in context, a 1,100-pound cow will consume about 30 pounds of dry matter per day valued at $30/ton equals 45¢/day. To compensate for the 25 percent loss, an additional 7.5 lb/head/day will need to be offered to avoid underfeeding.

The 37.5 pounds now cost 1.8¢/lb. to pay for the 25 percent loss in baling, storage, and feeding, giving a total per head per day cost of 71¢. Some loss is unavoidable, but excessive loss is giving money away.

Table 4 lists the dry matter losses that occur when handling hay from field to feeding. By the time hay is fed, losses can essentially increase the amount of production needed from the original standing crop by 35 percent. Production costs can be reduced and hay making can be more profitable when the amount of hay lost and wasted during harvest, storage, and feeding is controlled.

Table 4. Dry matter losses of hay from field to feeding.[1]

	Range	Average
Mowing	1-6	3
Raking	5-20	10
Swathing with conditioner	1-10	5
Plant respiration	2-16	5
Baling, % of windrow	1-15	5
Storing, % of stack		
Outside	5-30	15
Inside	2-12	5
Transporting	1-5	3
Feeding, % of bale or stack		
With feeder	1-10	5
Without feeder	2-45	15
Total, % of original standing crop	10-80	35

[1]Without rain damage. Rainfall can reduce yields up to 20 percent.

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