Hay Storage and Feeding

Many of the factors important in storing and feeding hay are simply common sense. Nonetheless, much hay is wasted. Losses are often much more than a producer might think. Those resulting from improper storage and poor feeding practices are particularly objectionable because the expense of producing the hay has already been incurred.

Storage

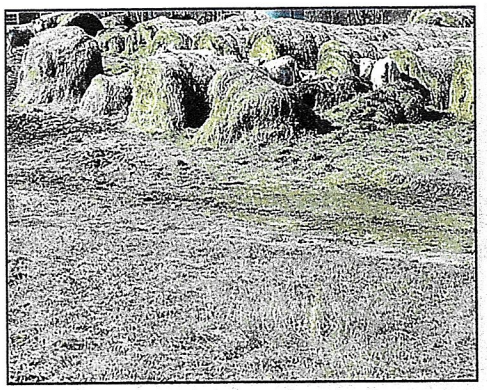
Small rectangular bales of hay should be protected from the elements. Otherwise, weathering losses will be high because of the relatively high level of exposed surface area. Though it is best to store rectangular bales inside, stacks can be stored outside and covered with plastic or a tarpaulin. However, with time, wind may partially or totally uncover the hay. Also, moisture often condenses under the cover at the top of the hay stack, particularly with plastic, resulting in spoilage.

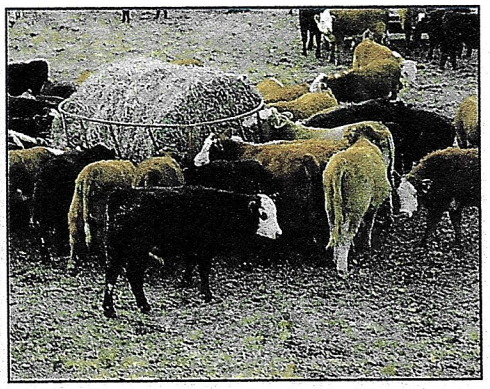
Large round bales and stack systems are popular storage options. One of the selling points for large package balers is that the bales can be stored outside. However, in many cases, this may be unwise.

Some round balers produce bales that sustain less weathering damage during outside storage than do other balers. Some balers compress hay more, resulting in a denser bale that sheds water better. In addition, the larger the bale diameter (other things being equal), the less total hay loss from weathering (see **Appendix A.37**).

While increased bale density reduces spoilage by reducing moisture penetration, it also reduces the rate at which moisture and heat can escape from a bale. Thus, as density increases, it becomes increasingly important to make certain that hay is in a safe moisture range for baling. Unfortunately, leaf shatter from legume hays also increases with decreasing hay moisture levels.

Net-wrapped bales have been shown to shed water better than twine-wrapped bales, thus reducing storage losses when hay is stored outside. In a Wisconsin test,





Great differences can occur in the amount of hay wasted during feeding, depending on management.

twine wrapped bales lost 11% of their weight as compared to 7% for net-wrapped bales, plus there was 1% less hay loss during baling with net-wrapped bales. An even more important advantage of net-wrap balers is that they are considerably faster, and thus it takes less time to bale hay. Net-wrap balers are more expensive, however.

Large-stemmed grasses, such as pearl millet or sorghum-sudangrass hybrids, and crop residues do not form a tight bale and are easily penetrated by water. In addition, high quality hays such as alfalfa are so valuable that even a relatively small percentage of spoilage is costly and should not be tolerated.

Furthermore, legume hays stored outside sustain more damage than most grass hays. With such hay, it is usually best to minimize losses by storing it inside. If this cannot be done, such high risk or high quality hay should be fed early in the season to minimize losses.

Inside storage is most effective in protecting hay from weathering, regardless of the type of hay package. Research has shown that in humid climates such as the Southern U.S., it is common for 30 percent or more of the dry matter of hay to be lost during several months of outside storage. Lower forage nutritive value and higher feeding losses associated with weathered hay further increase the cost of this practice.

The amount of loss incurred with outside storage varies greatly, depending on factors such as the type of hay, bale density, rainfall, humidity, length of the storage period, and storage conditions. However, as a study in Louisiana showed, losses related to storage can be extremely high (**Table 20.1**). Many producers could easily and quickly pay for building a hay barn through savings realized by reducing outside storage losses (see **Appendix A.42**).

Good compaction of fine-stemmed grass hay results in minimum weathering loss on the outside of bales (left); prevention of hay/soil contact greatly reduces bottom losses (right). Courtesy of Dr. Vivien Allen.

Once hay is protected from the elements, it loses little nutritional value even if it is stored for several years. However, it will change color and become visually less attractive. Sometimes it is not feasible to store large packages of hay inside. In such cases, round balers should normally be used only for putting up types of hay that form a tight bale that readily sheds water (fine-stemmed grass or grass/legume).

When large round bales or hay stacks are to be stored outside, selection of a storage site is an important consideration. A hay stackyard should b location convenient to feeding areas. It drained spot.

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If placed on a hill, rows of bales s do not act as a dam for surface water. S an undesirable practice unless the stack to storing bales with the flat sides facing sunshine to help keep the bales dry a hi

Large round bales should not be st may attract lightning. Storing hay in mo loss risk. Also, a road next to a stackyard similar nutritive value together in individ

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Table 20.1 Effect of various storage methods on hay losses.

Storage method	Losses (% drymatter)	
	Handling and storage	Animal refusal
On the ground	43	66
On gravel	32	49
On tires	37	43
On a wooden rack	31	38
On a wooden rack with plastic cover	12	14
In a pole barn	2	3

Source: B.D. Nelson, L.R. Verma, and C.R. Montgomery. Effect of storage method on losses and quality changes in round bales of ryegrass and alfalfa hay. Louisiana. Ag. Expt. Sta. Bull. 750.

When large round bales or hay stacks are to be stored outside, selection of a storage site is an important consideration. A hay stackyard should be located in an open, well-drained, sunny location convenient to feeding areas. It is particularly important to select a well-drained spot.

Much of the spoilage in large hay packages stored outside typically results from moisture being absorbed from the ground rather than penetrating from the top. Thus, it is desirable to reduce or eliminate hay/soil contact if possible. This can be done by storing bales on railroad ties, crushed rock, or a concrete pad.

Large bales or stacks should be promptly moved to a storage site to prevent killing spots of grass in the hayfield. It is best to leave a space of about 3 feet between bales to allow good drying after rains. Storing hay bales end-to-end (flat sides together) is desirable, but storing them with the rounded sides touching is not advisable due to the creation of a site where moisture can accumulate.

If placed on a hill, rows of bales should run up and down the slope so they do not act as a dam for surface water. Stacking round bales on top of each other is an undesirable practice unless the stack is to be covered. There may be some benefit to storing bales with the flat sides facing north and south. Theoretically, this allows sunshine to help keep the bales dry a higher percentage of the time.

Large round bales should not be stored near wire fences or other objects that may attract lightning. Storing hay in more than one location will further minimize fire loss risk. Also, a road next to a stackyard may serve as a firebreak. Grouping hays of similar nutritive value together in individual stack-yards can facilitate efficient feeding.

It is advisable to have more hay on hand than one expects to feed. Winters that are longer than expected or summer droughts can increase the amount of hay needed

and often cause severe problems for producers who are not prepared. The minimum length of the winter feeding period varies depending on location, pasture species available, and weather. For a livestock producer in Zone A who plants winter annuals in early autumn, the winter feeding period could be less than 30 days; on the other hand, it may be more than 120 days in Zone D.

A dry beef cow will consume at least 15 lb of hay per day while a lactating cow may consume 25 to 30 lb or more per day. Ruminants will usually consume 2.5 to 3 percent of their body weight in dry matter per day, horses 1 to 2 percent. By using these figures, one can calculate the approximate quantity of hay that should be needed to overwinter a group of animals and still have enough left over for emergency needs (see **Chapter 27** and **Appendix A.46).**

Heating and Fire Hazard

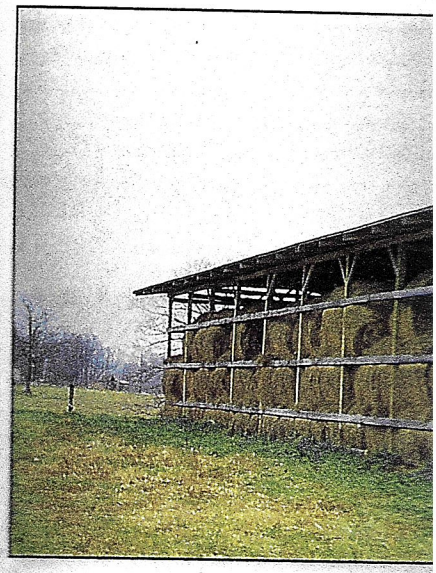
Hay baled at too high a moisture level will heat excessively. In addition to causing reduced digestibility of protein and hemicellulose, the hay may catch on fire. Because of the possibility of fire, fresh green hay should never be stored tightly against older, dry hay.

Hay temperature can be monitored by making a probe out of a 10-foot piece of 2-inch diameter pipe on which one end has been sealed with a sharpened plug. The pipe can then be driven into a stack or large bale of hay followed by lowering a thermometer into the pipe. Readings should be taken at several locations and depths, leaving the thermometer at each location for 10 to 15 minutes. When hay temperatures remain below 120°F, it is considered safe; between 120 to 140°F is considered a caution zone, and the hay should be closely watched. If the temperature goes above 160°F, a fire is likely (see **Appendix A.35**).

Table 20.2 Effect of feeding systems on losses of johnsongrass hay and on steer performance.

Item	Conventional bales on sod	Round bales on sod	Round bales with panels
Hay fed, lb/day	9.1	19.1	12.3
Days on test	79	79	79
Initial wt. (lb)	535	538	538
Final wt. (lb)	615	635	646
Gain/animal (lb)	80	97	108
Average daily gain (lb)	1.0	1.2	1.4
Lb hay required/lb of gain	9.0	15.6	9.0

Adapted from: W.B. Anthony, E.S. Renoll, and J.L. Stallings. Alabama Agric. Exp. Stn. Cir. 216



Storing round bales of large-stemmed

Hay that is heating to an unaccept
a spot where fire will not destroy anythin
generally subside within two to three wee

Feeding

Feeding losses occur mainly from t
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goal should be to develop a grazing progr
feeding system that minimizes hay losses

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rectangular bales in a manger or bunk or
When only a one-day supply of hay is off

Some balers produce small, round b
in place. This system works fairly well, bu
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losses will likely be high (see **Appendix A.**

The first rule of feeding hay is to pr
losses. This can be accomplished by movi
backyard to an area where they will be fed
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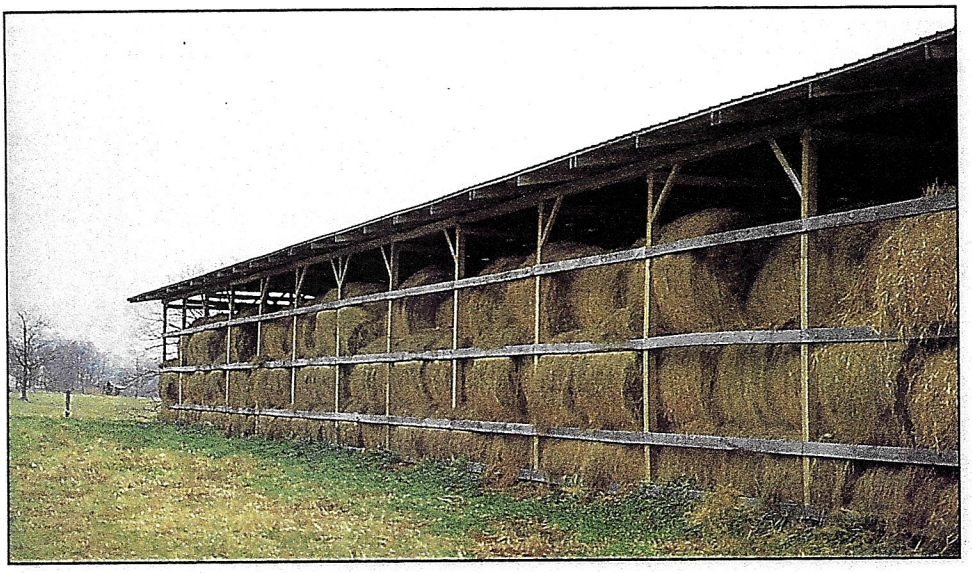
their nutritional requirements are higher.



Storing round bales of large-stemmed or high value hay under shelter can save money.

Hay that is heating to an unacceptable, dangerous level should be moved to a spot where fire will not destroy anything except the hay. The danger of fire will generally subside within two to three weeks.

Feeding

Feeding losses occur mainly from trampling, refusal, and leaf shatter. Some feeding loss is inevitable, but it can vary from as little as 2 or 3 percent to well over 50 percent. Since hay production is a major expense in most livestock operations, a goal should be to develop a grazing program that minimizes the need for hay, and a feeding system that minimizes hay losses (see **Chapter 22**).

Prior to the introduction of equipment that packages hay in large bales, the traditional method of feeding, although labor intensive, was to feed loose hay or rectangular bales in a manger or bunk or to transport them to a sod area for feeding. When only a one-day supply of hay is offered at a time, feeding losses are minimal.

Some balers produce small, round bales that may be left in the field and fed in place. This system works fairly well, but only if feeding losses are minimized by allowing the animals access to only a few days' supply at a time. Otherwise, feeding losses will likely be high (see **Appendix A.42**).

The first rule of feeding hay is to prevent unlimited access, thus reducing losses. This can be accomplished by moving one or a few bales at a time from the stackyard to an area where they will be fed. Use of feeding racks or panels can also greatly reduce losses (**Table 20.2**). Each mature cow needs about 30 inches of linear access space. Feeding first calf heifers separately from cows is desirable, if feasible, as their nutritional requirements are higher.

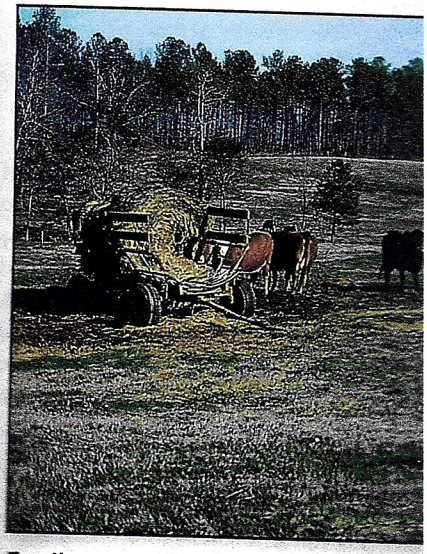
The losses from feeding hay as round bales and as loose stacks were compared in east Texas[1]. In this work, 20 cow-calf units and a bull were group-fed baled hay or stacked hay. Cattle in the stack hay group were allowed access to one stack at a time. Baled hay was fed on the ground, and the number of bales fed was adjusted so that consumption was completed in a two-day period. Waste from the baled hay groups was approximately 3 percent. Hay waste from the stack hay group ranged from 18 to 25 percent. When stacks were enclosed by stack guard panels, hay losses were less than 5 percent. However, it is important to note that labor and fixed costs associated with protecting hay may partially offset the losses to waste.

[1]F.M. Rouquette, Jr., and N.K. Person. Texas Research Monograph RM6C, Texas Agric. Exp. Stn.

Protective devices used for feeding hay vary in effectiveness. In a study done at Michigan State University, dry matter feeding losses incurred using cone, ring, trailer, and cradle feeders (see photographs) were 3.5%, 6.1%, 11.4%, and 14.6%, respectively, In addition, higher feeding losses were associated with more aggressive interactions between animals.

Other methods of limiting animal access such as an electric wire or a gate may also be helpful. In order to minimize losses, access of the animals to the hay must be

Examples of hay feeding devices (clockwise from top-left): Cone, ring, trailer, and cradle. Source: Dr. D.D. Buskirk, Michigan State University.



Feeding round hay bales from a bale w areas will result in better distribution

limited. In situations in which there is no it is important to feed only as much hay a

If hay is fed on sod, the feeding ar soil compaction and sod kill and results distributed. Therefore, it is desirable to s on sod.

Some producers use bale unrollers reduce losses at least in dry weather and at one time. Unrolling also allows timid recycling of nutrients, and tends to reduc

There is less refusal and waste whe the importance of striving to produce hig some producers is to force animals havin feeding area before more hay is fed.

Other Possibilities

Net wrap, plastic wraps of various to reduce hay spoilage losses. These treatr depending on the vulnerability and value period, and amount and seasonal distribu

Barn drying is appealing from the and minimizing the risk of rain damage.

Feeding round hay bales from a bale wagon that can be moved to different pasture areas will result in better distribution of dung and urine.

limited. In situations in which there is no feeding rack, panel, or other restrictive device, it is important to feed only as much hay as the animals can eat in one or two days.

If hay is fed on sod, the feeding areas should be rotated. This minimizes soil compaction and sod kill and results in dung and urine being more evenly distributed. Therefore, it is desirable to select less fertile fields or areas when feeding on sod.

Some producers use bale unrollers when feeding hay on sod. This can help reduce losses at least in dry weather and if excessive amounts of hay are not presented at one time. Unrolling also allows timid cows access to hay, facilitates more even recycling of nutrients, and tends to reduce sod damage.

There is less refusal and waste when good hay is fed, thus further emphasizing the importance of striving to produce highly nutritious hay. An approach used by some producers is to force animals having low nutritional requirements to clean up a feeding area before more hay is fed.

Other Possibilities

Net wrap, plastic wraps of various types, sleeves, and tarps can all be used to reduce hay spoilage losses. These treatments may or may not be cost effective, depending on the vulnerability and value of hay to be stored, length of the storage period, and amount and seasonal distribution of rainfall in the area.

Barn drying is appealing from the standpoints of preserving hay nutritive value and minimizing the risk of rain damage. The problems with barn drying are building

an appropriate facility and economically providing the energy for drying. While barn drying is an intriguing concept, it does not appear likely to become popular unless a low-cost system of providing energy for drying is discovered.

The cost of building a shed for storing round bales varies considerably, as does the length of time for which storage may be needed. In addition, the amount of space needed is greatly affected by bale density. For example, it requires about half the space to store high density hay that weighs 10 pounds per cubic foot as for hay baled at a low density of 5 pounds per cubic foot.

Because the feasibility of using various techniques for protecting hay varies greatly, it is difficult to make general recommendations. Producers should rely on local experts and their own calculations when making decisions regarding hay storage techniques.

Some Economic Considerations Associated With Hay

- Having animals graze forage generally results in only one-third to one-half the cost per day of feeding hay.
- Due primarily to equipment expense, purchasing hay would be financially more advantageous for many small producers than producing it. The value of the nutrients in purchased hay or other feed should be taken into consideration because they represent a nutrient flow onto a farm. Grazing animals typically excrete in the form of dung and urine around 70 to 80% of the nutrients they consume.
- Hay bales (even bales having the same dimensions) vary greatly with regard to weight. Estimates of bale weight based on visual assessment tend to be high by 10 to 20 percent.
- Weathering of hay reduces hay weight, lowers hay nutritive value, and increases feeding losses.
- Poor storage techniques often result in losses of 30% or more of hay dry matter.
- Poor feeding techniques can result in hay losses of over 50%.
- In much of the U.S., building a hay barn would, in the long run, be cheaper than incurring yearly losses from hay being stored outside. SF

Silage,

In addition to being harvested directly
mechanically harvested and immediate
harvested forage can also be stored in
forage crop, forage moisture content, avail
options. Well-dried forage (hay) results in
recommended moisture levels for storage
bales, 18% or less for large round bales, an
Appendix A.36). Forage stored at a moist
to heat excessively (perhaps catch fire) and
been treated with organic acids or some ot
development.

Forage that is around 30% moistur
in which there is limited oxygen available
process, after which it is referred to as *sila*
about terminology regarding various form
the definitions of various forage storage te
regard to moisture levels.

Some crops such as corn, can be left
allows some loss of plant moisture during
then cut directly, chopped, and typically s
Haylage is simply low moisture silage. Son
allowed to wilt to lower the moisture cont
Forage to be stored as haylage is often cho
structures. Other things being equal, hayla
value than hay due to lower respiration los
less of a factor in harvesting, thus making

Baleage is a type of haylage (low moist
chopped), wilted, and then baled with equip
general, baleage works best when the forage i
is 55%. Baleage can be made by wrapping in
numerous bales end-to-end and enclosing the
production). In this chapter we will use the te
and haylage) to refer to any plant material tha

Harvesting, preserving, and feeding f
throughout the U.S. It represents a conven
It has been used in beef backgrounding and
increasingly used in cow-calf operations.

Ensilage offers many advantages over
harvest losses than occur with hay (**Figure**
be used; 3) mechanization of harvesting, st
weather damage during harvesting; 5) when
long periods with only small losses of nutrie