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G84-738 Management to Minimize Hay Waste

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Management to Minimize Hay Waste

This NebGuide discusses harvest factors that affect hay yield and quality as well as ways to reduce losses during harvest, storage, and feeding.

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- Hay Management Systems
- Reduce Hay Losses

Hay is harvested, stored, and fed under a wide variety of conditions that influence both its yield and feed value. High quality hay is needed by animals that require high nutrient concentrations to reach desired levels of production. These include dairy cows, finishing beef cattle, fattening lambs, and race horses. Excellent hay management is required to produce the hay needed by these livestock. High quality hay is also used as a supplement to lower quality forages, such as crop residues. Hay of lower quality is nutritionally valuable, but should be used in other livestock production systems, such as the wintering of beef cows.

Hay Management Systems

High Quality Hay

High in protein, easily digested and very palatable--these three characteristics are necessary for hay fed to high performance animals. Planning, management skill, and luck with the weather are needed to produce high quality hay.

The growth stage of the plant at harvest influences the quality of hay more than any other factor. As plants grow and mature, the concentration of fiber increases while digestibility and protein content decrease. Low fiber digestibility is associated with the coarseness and rankness of mature plants.

Alfalfa and Other Legumes. Begin harvesting alfalfa when the plants are in the bud stage (several days before bloom), and complete harvest by the time alfalfa reaches one-tenth bloom. Alfalfa flower buds are found at the tips of stems and can be felt as swollen areas near these tips. Unusual conditions, such as the lack or excess of moisture, cloudiness, or insects and diseases that destroy buds, may prevent alfalfa from blooming. If alfalfa plants do not bloom by the time they normally should, examine the

plant at ground level to see if regrowth is occurring from the crown and roots. If new growth is present, harvest the field.

Although 25 to 40 days are normally necessary between alfalfa harvests, base all harvests on stage of maturity, not date. Harvesting too early can reduce hay yield, the vigor of regrowth, and thin the stand. Alfalfa harvested at the one-half bloom, full bloom, or later stages results in hay that is less palatable, lower in protein, and less digestible than that harvested at bud to one-tenth bloom (*Table I*).

Cut other legumes, such as red clover and birdsfoot trefoil, at about one-quarter bloom for high quality hay.

Grasses. Cool-season grasses, such as brome, orchardgrass, and wheatgrass, must be cut at immature growth stages if they are to provide nutrient concentrations as high as legume hays. However, this early harvest results in much lower yields. Harvest cool-season grasses before heading (boot stage) to obtain hay with the best compromise between high yield and high food value. Pinch tops of grass plants to reveal the presence or absence of heads. This type of hay can be an important contributor to the diet of high performance animals, and can often be the major feed source for growing animals.

Native warm-season grasses generally have less feed value than cool-season grasses when harvested at the same stage of maturity. Hay harvested at the boot or early head stage of these grasses provides moderate nutrient levels. However, livestock requiring high nutrient levels may be unable to maintain high performance if this hay is a major portion of the diet.

Table I. Feed value of selected hays[1]

Species	*Stage of maturity*	*Crude Protein*	*TDN*	NE_m	NE_g	NE_1
		percent		Mcal/lb		
Alfalfa	Bud	21.5	63	0.62	0.33	0.70
	Early bloom	18.4	59	0.61	0.28	0.64
	Mid-bloom	15.9	55	0.55	0.25	0.57
	Full bloom	13.5	51	0.53	0.21	0.5
Brome	Early boot	15.0	63	0.62	0.33	0.70
	Early heading	10.5	58	0.60	0.26	0.64
	Early milk	8.0	54	0.58	0.19	0.54
	Mature	6.0	48	0.56	0.15	0.46
Prairie hay	Early boot	10.8	63	0.63	0.34	0.64
	Early heading	8.7	55	0.56	0.26	0.60
	Early milk	6.2	50	0.49	0.21	0.56
	Mature	4.8	46	0.47	0.15	0.50

[1]Values from FEEDMIX DAIRY and FEEDMIX BEEF on AGNET.

Maximum Hay Yield

Cut alfalfa at one-tenth to one-half bloom and other legumes at one-half to full bloom for high yields of hay that is nutritionally adequate to winter beef cows and similar livestock. Harvest warm-season grasses at heading or sooner if they are to be fed to beef cows with little or no protein and/or mineral supplements. Maximum yield will occur if harvest is delayed until seeds are in the dough stage; however, supplements will usually be necessary to adequately maintain beef cows with this hay. Cool-season grasses such as brome, orchardgrass, wheatgrass, tall fescue, timothy, and reed canarygrass can yield large quantities of hay if harvested when heads shed pollen. Later harvest usually produces hay too low in protein in winter beef cows without supplements. *Table II* shows the recommended stages of maturity for harvesting high quality hay or for maximum yields. Forage tests can help determine the feed value of your hay and the amount of supplement needed, provided the sample collected for the forage test is similar to the hay to be fed.

Table II. Recommended stage of maturity for harvesting hay.

Crop	*Stage/or high quality hay*	*Stage/or maximum hay yield*
Alfalfa	1st cutting - bud stage Other cuttings--early bloom	Mid-bloom
Brome, Orchardgrass or Timothy	Boot stage	Flowering
Clovers	1/4-bloom	3/4-bloom
Cereal grains	Boot stage	Dough stage
Warm-season grasses	Boot stage[a]	Late head

[a]May not be sufficiently high in nutrient concentration to feed to livestock requiring high nutrient levels.

Reduce Hay Losses

Hay harvest involves losses in dry matter and in quality. These losses occur during all phases of getting the hay from the field to the livestock--harvest, storage, and feeding. Let's look at each phase to see what losses occur, their cause, and how to reduce them.

Harvest

After cutting, forage plant cells respire until their moisture content falls below 35 to 40 percent. On a warm, dry, breezy day, hay dries rapidly, resulting in dry matter losses due to respiration of 2 to 6 percent. If hay dries very slowly, dry matter losses due 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 during late evening can be as high as 11 percent. This respiration loss is due primarily to the breaking down of carbohydrates. Since these carbohydrates are nearly 100 percent digestible, such losses substantially reduce hay quality.

Losses during curing cannot be eliminated. Cut hay when good drying weather is expected and respiration losses will be reduced considerably.

After the moisture content of hay declines below 35 to 40 percent, most harvest losses are due to weathering and handling. Losses due to leaching increase with the number of rain showers, amount of rain, and the dryness of the hay. Leaching can cause yield losses as high as 20 percent, mostly as digestible soluble nutrients. Carbohydrates, B vitamins, and some soluble minerals, such as potassium,

are readily leached from dry hay.

Rain not only leaches nutrients, it can also increase leaf loss due to 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 can be very expensive.

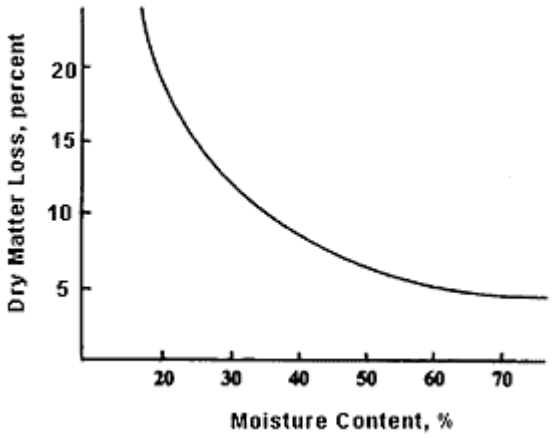


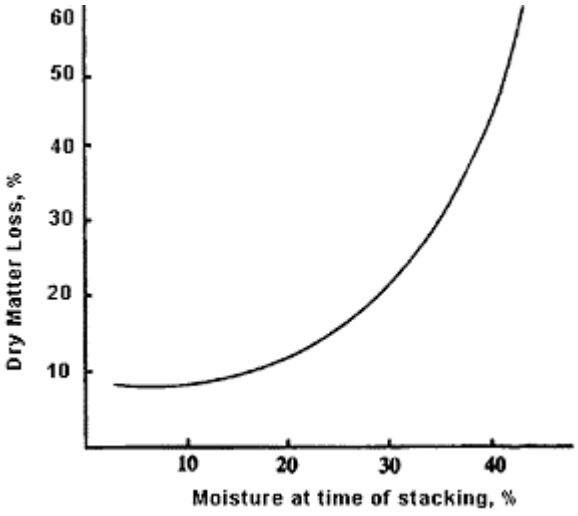
Figure 1. Losses in alfalfa as influenced by moisture content when raked. (Hundtoft, E.B. 1965. Cornell Univ. Agric. Engineering Ext. Bull. 364. Ithaca, NY.)

Leaf shatter, especially from legumes, can be serious at harvest time. Minimize leaf loss by 1) reducing the number of times hay is handled in the field, and 2) handling hay at high moisture levels. For example, 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 raked and packaged very dry can yield 35 percent less dry matter and be of poorer quality than properly handled hay. Avoid raking if moisture content is less than 50 percent. Results of raking alfalfa hay at various moisture levels are shown in *Figure 1*.

Windrower machines eliminate raking and thus leaf loss due to raking. Because drying takes longer in the windrow than in the swath, respiration losses and increased potential of rain may reduce this advantage in humid areas.

Condition freshly cut forage, especially legumes, to allow the plants to dry more rapidly, thus reducing respiration losses and weather hazards.

Dry matter and crude protein losses are greater with big-package haymaking machines than with conventional balers when operating in dry, shatter-prone alfalfa hay. With more desirable hay moistures, there is no difference in losses from different haymaking systems.



Storage

Figure 2. Loss due to spoilage in alfalfa stacks made at different moisture levels.
(Drew, L.W. et al. 1974. Ohio Rep. Res. Develop. 59 (2):38-39.)

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

Figure 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. Weathering reduces the dry weight of hay and changes its composition. Weathering lowers the feeding value of hay 15 to 25 percent, in addition to any dry matter losses.

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 versus the ground reduced the weathered portion from 23 to 11 percent of the original bale weight. Thus, outdoor storage losses can be low if good packages are made and they are stored on a well-drained site.

Weathering losses are greatly influenced by climatic variables. The higher rainfall and more humid conditions of eastern Nebraska cause more loss from hay stored outdoors than the drier climate of western Nebraska.

Dry matter losses during outdoor storage range from 5 to 30 percent. Dry matter losses of loose (non-compressed) stacks usually exceed 10 to 15 percent, and are greater than losses from large round bales and compressed stacks.

Resistance to weather depends on how well the packages are made. In Indiana, compressed stacks had from 18 to 44 percent of the hay weathered after one year of outdoor storage and 28 to 50 percent weathered after two years. Large round bales had from 18 to 39 percent weathered after two years of storage. Differences in package quality accounted for much of this variation.

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 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.

Feeding

Much expense and many long hours go into harvesting good quality hay and storing it for winter feeding. You wouldn't dream of throwing away one-third of this hay. That is what happens, though, when livestock are allowed unlimited access to hay. Livestock trample, overconsume, foul, and use for bedding 25 to 45 percent of the hay when it is fed with no restrictions (*Table III*).

Table III. Hay wasted by cows when fed with and without racks.

Bale type	*Percent wasted*
Square bale in rack	7
Large round bale in rack	9
Large round bale without rack	45
Source: Bell, S., and F.A. Martz. 1973. Res. Rep. Univ. of Missouri Agric. Exp. Sta. Columbia, MO	

Cattle will waste less hay when the amount fed is limited (*Table IV*). One-fourth more hay is needed when a hay 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 will eat 20 to 30 percent more hay than her needs when allowed free access to hay. This can amount to over 700 pounds per cow over a 4-month feeding period for spring calving cows. 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 needed to replace wasted hay when fed free access.

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 and waste. Daily feeding is more efficient, especially when hay is feed free access.

Table IV. Hay wasted by cows when amount fed was controlled.

Feeding system	*Hay per cow per feeding, lb.*	*Hay re/used or wasted, percent*	*Hay required over rack feeding, percent*
Rack feeding on pasture	---	5	---
No-rack feeding on pasture			
1-day supply per feeding	20	11	12
2-day supply per feeding	40	25	33
4-day supply per feeding	80	31	45
Source: Smith, W.H. et al. 1974. ID-97. Purdue Univ. Coop. Ext. Serv. W. Lafayette, IN.			

Also use restricted access whenever possible. Feed bunks are excellent for feeding small square bales. Round bales should be fed in specially designed racks. Loose or compressed hay stacks should have collapsible racks or electric wire around them to reduce trampling the hay around the edges. Avoid feeding square bales on the ground, unrolling round bales, or any other feeding met that places a large percentage of the hay in an easily trampled position.

No matter how hay is fed, efforts that limit the amount of hay accessible to trampling will save feed. Feed hay at a well drained site or on concrete when possible. Hay racks with solid barriers at the bottom prevent livestock from pulling hay loose with their feet and dragging it out to be stepped on.

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

Table V. Dry matter losses of hay from field to feeding[1]		
	Range	*Average*
	percent	
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 hay	1-5	3
Feeding, % of stack or bale		
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 as much as 20 percent.		

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