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G97-1342 Feeding Value of Alfalfa Hay and Alfalfa Silage

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Feeding Value of Alfalfa Hay and Alfalfa Silage

This NebGuide discusses the feeding value of alfalfa under different harvesting, storage and feeding methods, as compared to other protein sources.

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In Nebraska, alfalfa is used primarily as a protein source. However, for cow-calf producers it can sometimes be an economical energy source, depending on the prevailing price of feed grains and other sources of energy.

Alfalfa is generally harvested as dry hay or as silage (65 percent moisture). Ensiling at 45 to 55 percent moisture is also common, particularly if the alfalfa is stored in an upright oxygen-limiting structure. Regardless of harvesting and storage methods, some dry matter and nutrient losses occur during the harvesting, storing and feeding processes. These losses must be considered when deciding which methods are best to use.

Dry Matter and Nutrient Losses

Estimates of dry matter losses incurred during harvesting, storage and feeding are shown in *Table I*. These are approximate values and will vary with management practices. Harvesting losses for dry hay are the most variable and can range from 10 to 40 percent, depending on moisture at time of baling and degree of weather damage (rain, etc.).

Table I. Percent dry matter losses of alfalfa from field to feeding.

	Percent Harvest Moisture			
Losses	*Field cured 10 to 15*	*50*	*60*	*65*
Harvest, %	15[a]	8	6	5
Storage,				

Airtight (Upright)	--	4	5	6
Bag[b]	--	--	5	5
Concrete bunker[c]	--	20	15	12
Drystacks	15[d]			
Grinding, %				3
Other, %[e]	5	3	3	3

[a] Losses can be as high as 30 to 40% if alfalfa is weather damaged prior to stacking.

[b] Estimated losses between 4 and 8% would be expected, depending on moisture and degree of packing.

[c] Covered and sealed with plastic. For uncovered, add 5% more loss.

[d] Outdoor storage; indoor storage losses range from 2 to 6%.

[e] Feeding and handling losses from silage or hay pile to feed bunk. These losses will range from 2 to 8%, depending on storage system and management practices.

Losses in dry hay are predominantly of leaf origin. As a percent of the original protein and total digestible nutrient (TDN) content, leaf losses lower protein content more than TDN content. However, with rain damaged hay a larger proportion of the soluble carbohydrates are lost or leached out relative to protein. This can lower the TDN content while the protein content, as a percent of dry matter, may remain the same or even increase although overall protein and TDN yield per acre are lowered.

Silage stored in a bunker can have considerably more dry matter loss than silage stored in sealed structures. However, bunker losses can be minimized with proper chopping and packing, and sealing with a plastic cover. One of the largest factors associated with losses in a bunker silo is the total quantity of silage stored. In general, the larger the pile the lower the percent dry matter loss.

With high moisture feedstuffs, any surface exposed to the air for an extended period of time will spoil and deteriorate. Minimizing the amount of surface exposure will minimize spoilage. With all ensiled feedstuffs, fermentation must occur for proper storage to take place. Even in the best storage systems, dry matter losses due to fermentation will be 2 to 3 percent, and most likely will range from 4 to 8 percent.

Oxygen must be excluded from the silage pile to achieve good fermentation. As the green plant is cut and placed in the silo, it continues to "breathe" for a while. At the same time the fermentation process is started, whereby desirable microorganisms begin to use energy from the plant material and produce acids. As the available oxygen is depleted, the anaerobic (without oxygen) bacteria continue to produce acids until a pH around 4 or 5 is reached. At this point fermentation stops and the ensiled feedstuff will remain in a preserved state as long as it is not disturbed and remains in an oxygen-free environment.

The total cost to produce and feed alfalfa stored under various systems is shown in *Table II*. When good management practices are followed, the cost per ton of alfalfa fed is very similar regardless of harvesting and storage methods used. Harvesting alfalfa as dry hay would probably allow the producer greater marketing flexibility if some of the hay produced is to be sold. The value of the unground hay, sold as such, would be approximately $65 per dry ton since grinding charges and feeding losses are not included in determining the cost.

Table II. Value of alfalfa stored under various systems.[a]

	65 percent moisture silage		
	Dry	*Large*	*Concrete*

	hay	plastic bag	bunker silo
Tons of standing alfalfa needed to obtain 100 tons for feeding[b]	150.2	114.22	123.2
Tons harvested	127.7	108.5	117.1
Tons remaining after storage	108.5	103.1	103.1
Tons remaining after grinding	105.3		
Net Tons for feeding	100.0	100.0	100.0
Total value of standing crop @ $35/dry ton	$5257	$3997	$4312
Total harvesting and handling costs (tons harvested x charge/ton)[c]	$2809	$2713	$2928
Total storage costs (storage cost/ton x tons harvested)	--	$2017	$1757
Grinding costs @ $5/ton	$651		
Costs of alfalfa at feeding/dry ton	$87.17	$87.27	$89.97

[a] All values are on a 100% dry matter basis.

[b] Calculated from Table I; individual losses incurred in each phase from field to feeding were accounted for.

[c] Average harvesting and hauling charges were determined to be $22/dry ton for dry hay and $25/dry ton for silage, although rates may vary depending on harvesting equipment and distances hauled to storage and/or feeding location.

[d] No costs for dry hay storage; custom rate of $20/dry ton for plastic bag filling and storage costs, and $15/dry ton for bunker silo filling and storage costs. Rate for bag does not include cost of solid base, which may be needed where muddy conditions exist and would add $3 to $6 storage cost/dry ton.

On-Ground Storage of Alfalfa Silage

Dry matter losses incurred when alfalfa silage is stored on the ground without a solid base or sidewall supports vary tremendously, depending on the size of the silage pile. For small piles of 100 to 250 tons (wet basis), dry matter losses as high as 25 to 45 percent can be expected. In general, storing on the ground without sidewall supports hinders packing on outside perimeters of the silage pile, resulting in greater spoilage losses. However, with large silage piles of 500 to 1000 tons or more, dry matter losses similar to bunker stored silage can be expected. If the silage pile is located on an easily accessible, well-drained site, this method can be the most economical.

Trench silos with dirt, sidewall supports and solid, concrete type floors can also be a very economical storage system in which dry matter losses are comparable to bunker stored silage. Covering all open silage piles with plastic is recommended. The economic benefits will more than offset the costs incurred in covering.

Nutrition and Feeding Value of Alfalfa Hay

As an energy source, alfalfa is generally very similar to corn price per unit of TDN. However, since it seldom supports gains above 1.5 pounds per day, alfalfa is often not considered as an energy source in growing rations. As a protein source, alfalfa usually costs less than half the price of soybean meal per unit of protein. The typical protein content of alfalfa hay harvested at various stages of maturity is shown in *Table III*.

Table III. Average alfalfa protein content.

Maturity	*Crude protein, (dry matter basis)*
Immature	20 to 28
Early Bloom	18 to 24

Mid-Bloom	16 to 22
Full Bloom	14 to 18
Mature	10 to 14

Hay harvested at one-tenth bloom (early bloom) yields the optimum amount of nutrients per acre. Comparative cost of gains associated with feeding different qualities of alfalfa hay are shown in *Table IV*. Rations in this table were formulated to have equal protein and energy densities and projected to produce gains of 1.8 pounds per day. When a constant production price for alfalfa is assumed for immature, early bloom and midbloom alfalfa, cost of gains increase about 2.7 percent with each increase in stage of maturity.

Besides the relative differences in the feeding value of alfalfa harvested at different stages of maturity, some slight differences in the feeding value of alfalfa hay and alfalfa silage exist. Studies conducted at the University of Nebraska Northeast Station have shown that in corn silage based rations feed costs per pound of gain are about 3 percent lower when alfalfa silage is used instead of alfalfa hay.

The lower cost of gain associated with the alfalfa silage ration can be attributed to the greater energy content of the alfalfa when it is harvested as silage. Because of lower leaf loss and less weathering, silage contains more protein and more total digestible nutrients on the average. However, the greater protein content does not necessarily make silage a better protein source.

Table IV. Effect of alfalfa quality on cost of gains in corn silage growing rations.a

	Alfalfa Quality[b]		
	Immature	*Early Bloom*	*Mid-Bloom*
Ration Composition (dry matter basis)			
Alfalfa, %	22	27	32
Corn, %	5	11	17
Corn silage, %	73	62	51
Cost of ration, $/dry cwt	4.08	4.17	4.26
Average daily gain, lb.	1.80	1.80	1.80
Feed costs of gain, "/lb.	36.72	37.53	38.34
Increase above immature alfalfa, %	--	2.2	4.4

[a] Rations balanced for equal protein and energy density.

[b] Assuming per acre production and harvesting costs are equal for each alfalfa maturity; equivalent to $70/ton of dry hay.
Corn price of $2.75/bushel and corn silage price of $27.50/ton were used.

The 1996 National Research Council (NRC) Guide to Nutrient Requirements of Beef Cattle, provides new and updated information on the nutritive content of alfalfa. The 1996 NRC uses metabolizable protein (MP) rather than crude protein to determine the animals protein needs and requirements. Metabolizable protein is defined as the total quantity of protein absorbed by the intestine. With the MP system, estimates of protein available to the animal are more accurately determined. The former, the crude protein system, assumed that all feedstuffs have equal protein degradability in the rumen. This is not the case with either alfalfa hay versus silage or with alfalfa of different maturities. The 1996 NRC indicates the percentage of degradable and undegradable protein, as well as estimates of soluble protein and non-protein nitrogen constituents. For ration formulation purposes, protein constituents are used to estimate metabolizable protein. Generally, alfalfa silage has more of both soluble and degradable protein than alfalfa hay. Early bloom alfalfa also has more soluble and degradable protein than alfalfa hay. When balancing rations using the 1996 NRC, it becomes important to match sources of feedstuffs and constituents. For example, diets balanced for crude protein using ingredients with high levels of rumen degradable protein can limit animal performance. These diets need a source of protein that will escape the rumen undegraded, such as high quality alfalfa. Conversely, diets balanced for crude protein may be lacking rumen degradable protein. This is particularly the case when high-energy, high-concentrate diets are fed when the need for soluble protein to aid in starch digestion is high. In general 75 to 90 percent of the crude protein in alfalfa is rumen degradable with 10 to 25 percent of the protein escaping rumen degradation.

Low Moisture Silage

Research in Kansas and Nebraska has shown alfalfa ensiled between 40 and 60 percent moisture, sometimes called alfalfa haylage, has a feeding value similar to the value of alfalfa hay and silage. When ensiling alfalfa at low moistures, there is a greater opportunity for heat damage unless airtight storage structures are used. If considerable darkening or charring has occurred in the ensiled alfalfa, an analysis for digestible protein may be required. For alfalfa silage, digestible protein should be 60 to 70 percent of crude protein. If it is much less than this and heat damage appears to be extensive, the protein content of the final ration must be adjusted upward to compensate for the increased indigestibility of the protein in the ensiled alfalfa.

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