

# DO'S AND DON'TS OF ALFALFA ROUND BALED SILAGE

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## **SILAGE PRODUCTION**

Round baled silage provides an option for outside storage of round bales that protects them from weathering. With shorter field exposure times, silage can dramatically increase forage quality compared with hay. Harvest problems caused by wet weather and/or poor drying conditions during spring and for the freeze-down harvest during autumn could be alleviated by incorporating silage into the harvest system.

Field losses are much lower for silage than for hay due to reduced physical losses, which impact primarily the leaf component (Figure 1). The general relationship between forage moisture concentration at harvest and losses during the field and storage phases is shown in Figure 2. Very wet silage has extremely low field losses but storage losses may be high so moistures in the range of 40 and 60% are recommended. The reasons for field losses in forage harvesting can be understood by looking at what happens during field drying.

### **Silage Fermentation**

Good silage preservation depends upon the development and maintenance of anaerobic conditions. The ensiling process has predictable phases that have been described. For example, the respiration that is normal in the cut crop during curing continues after the forage is ensiled. Plant enzymes oxidize carbohydrates and produce carbon dioxide, water, and heat. Plant proteases can cause proteolysis and form peptides, free amino acids, and amides. Respiration is inhibited as anaerobic conditions develop. Some of the management practices recommended for conventional silage production, such as fine chopping, rapid silo filling, adequate compaction, and tight sealing

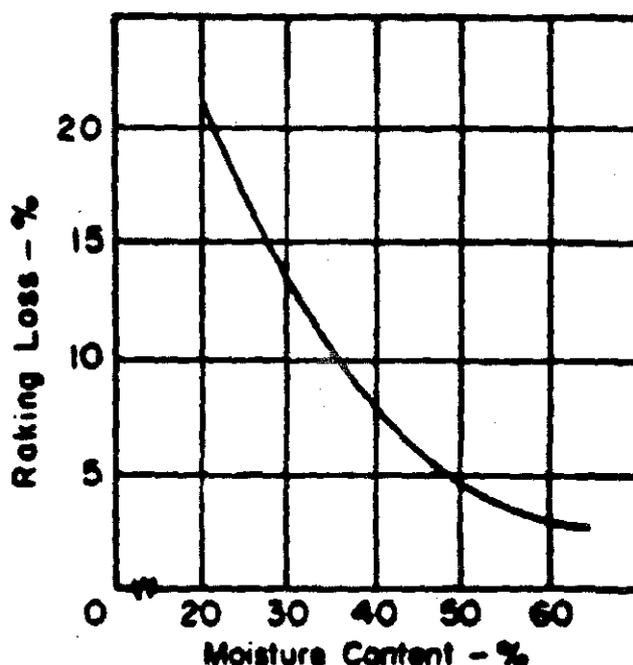


Figure 1. Shatter Losses during Raking of Alfalfa Hay (From Moser, 1980, Crop quality, storage, and utilization. American Society of Agronomy, Madison, WI)

are recommended in order to minimize this aerobic phase. With respect to rapid exclusion of oxygen and tight sealing, these same factors hold for the production of silage in round bales.

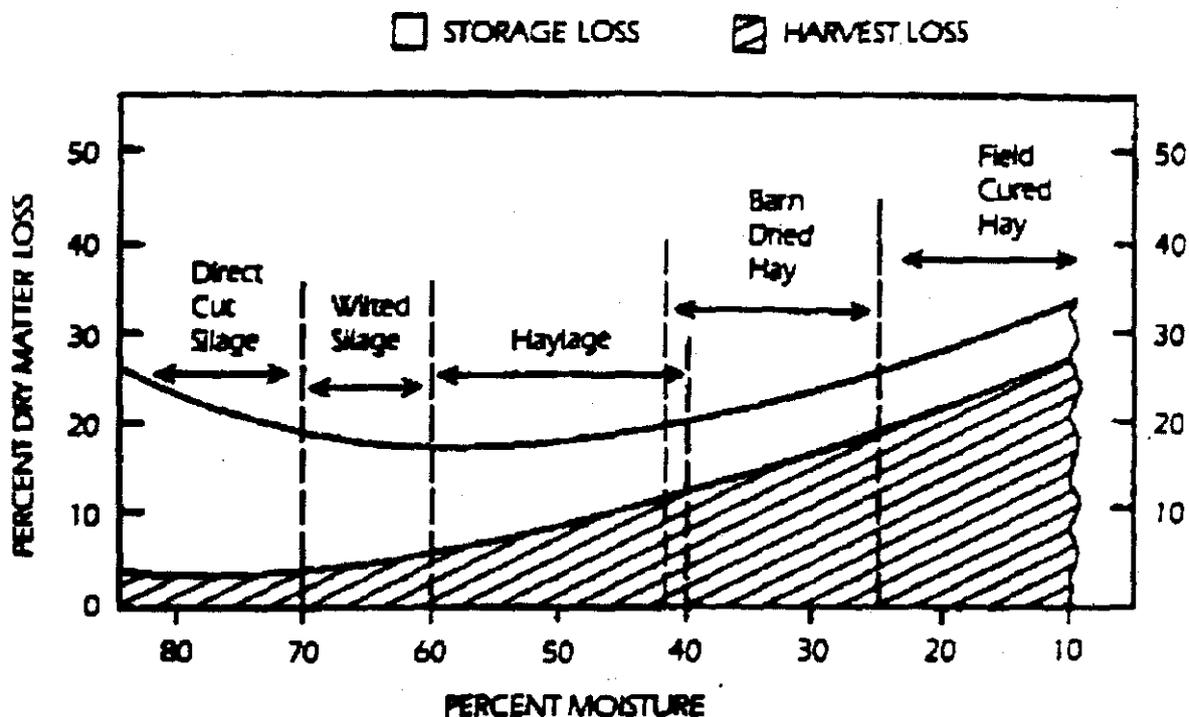


Figure 2. Relationship between forage moisture concentration and field and storage losses.

Silage pH declines due to the production of volatile fatty acids from sugars in the crop. These acids account for the preservation of the silage. Lactic acid bacteria should become the predominant bacteria, and lactic acid is often the predominant acid, although acetic and propionic acids may predominate in legume silages. Lactic acid bacteria are of two types, homofermentative which convert carbohydrates to lactic acid; and heterofermentative which also produce acetic acid, ethanol, and mannitol in addition to lactic acid.

Fermentation of high-sugar crops such as corn silage can reduce silage pH to as low as 3.5, however, wilted alfalfa silage for baled silage production may only reach pH's in the range of 4.8 to 5.2. Such silages are not as stable as more acidic silage but usually have lower fermentation losses. The extent of the pH decline depends somewhat on the amount of fermentable carbohydrates present. Fermentation is limited in haylage because of its low moisture levels and preservation depends on the maintenance of anaerobic conditions during the entire storage period.

Sugars and other readily fermentable carbohydrates are present in high concentrations in some silage crops, such as corn, making their preservation relatively simple. Perennial forages, especially legumes, however, may not have sufficient concentrations of fermentable carbohydrates

to lead to final silage pH levels low enough to preserve the material as effectively as corn silage. Legumes such as alfalfa also have greater buffering capacities, meaning that more acidity is needed to reduce silage pH by a given amount. Grasses are generally easier to preserve than legumes because they have a low buffering capacity and sugar concentrations of 10 to 20%.

## ***MAKING BALED SILAGE***

All of the major forage crops grown in Kentucky can be harvested effectively as balage. In general, harvesting forage crops in the transition stage between vegetative (leafy, immature) and reproductive or flowering stage will produce the best compromise between yield and quality. Round baled silage has several advantages compared with hay or chopped silage but there are also concerns or disadvantages to consider.

### **Advantages of round bale silage (balage) include:**

1. Lower cash cost than conventional silage
2. Lower capital investment than conventional silage
3. Higher quality feed than hay
4. Lower harvest losses than hay
5. Baled silage is portable
6. Lower storage losses than round baled hay stored outside
7. Can be made using present round bale equipment

### **Disadvantages of round bale silage include:**

1. Forage crops are harder to ensile than corn (especially legumes)
2. Long forage has less free carbohydrate for fermentation than chopped silage
3. Some balers cannot easily handle wilted (40 to 60% moisture) forage
4. Silage bales can be heavy (about twice the weight of hay)
5. Plastic wrap material can tear or puncture, leading to spoilage
6. Disposal of used plastic is an environmental and cost concern

## ***GUIDELINES***

Since baled silage is wet and heavy, bale diameters should range from 42 to 48 inches to avoid overloading either the baler or the transport equipment. Bales should be formed as tightly as practical. Fixed chamber balers are not recommended unless equipment is available to accommodate full sized silage bales. The ground speed of the baler should be lower than speeds used in making field-cured hay. Downshifting one gear should guarantee a tighter, denser bale. Lighter windrows also help to produce dense bales. If triple windrows are normally used for baling hay, double windrows should be considered when producing silage. A dry-matter density of 10-12 lb per cubic foot is considered ideal. A typical silage bale (4 feet in diameter by 5 feet in

length) should weigh 1300 to 1550 pounds and contain 600 to 650 pounds of dry matter.

Transport equipment is typically a single-prong spike fixed to the front of a bucket loader. Tractors with 50 or more horsepower provide the best ballast for safe lifting. In producing bales for bagged or wrapped silage it is important to remember that forage in the 50-60% moisture range will weigh about twice what the same size bale of hay would weigh.

Consider moving freshly baled forage to the storage area for wrapping. This sequence avoids the need to spear bales that have already been wrapped. It also allows the wrapping process to be done on more level and uniform ground. Bales can 'walk off' the wrapping platform if the machine is not level. Minimizing movement of wrapped bales will reduce tearing of the plastic.

### **Wrappers and Baggers**

There are many ways to exclude air from the freshly baled forage including individual bags, tubing machines, and individual bale wrappers. All operate on the principle of quickly sealing out oxygen and maintaining this air tight condition until the balage is fed. Be sure plastic is treated to withstand damage due to the ultraviolet light in sunlight.

**Individual bags.** Using individual bags has the advantage of not requiring extra equipment and reuse of bags can reduce the cost. In practice, few bags can be salvaged for use in the next growing season. Other disadvantages include the difficulty of getting all of the air out of the bags and maintain a good seal on the open end of the bag. Making balage in individual bags is less reliable than with wrapping equipment.

**Long Tubes.** Round bales can be loaded mechanically into long plastic tubes which are mechanically stretched during filling and then allowed to contract. This helps reduce the amount of air trapped inside the bag with the bales. The number of bales per tube is flexible (plastic can be cut and sealed). Disadvantages include the need for uniform ground for tube placement (if large) and sizing bales to the tube. Also, a hole in a long tube exposes a large amount of silage to potential spoilage. Finally, large tubes of bales are less portable than individual bales.

**Individually Wrapped Bales.** The most popular form of baled silage is the individual bales wrapped mechanically with stretch plastic. Wrappers vary widely in cost (\$4000 to \$15,000) depending on features and whether it produces a completely wrapped bale. The least expensive wrappers require a second person (or getting off the tractor) and manually moving the roll of stretch plastic while the bale is rotated on a spear much like twine is applied to round bales of hay. The plastic is lapped over the ends of the bale about 12 inches. Jamming multiple bales together (flat end to flat end) allows the plastic from one bale to stick to the next, forming a tube.

More expensive wrappers completely cover each bale. Most of these units revolve and rotate the bale simultaneously while feeding plastic from a stationary roll. Some have hydraulic lifts to elevate bales onto the unit. Others require a second tractor with lifting capabilities to put the bale on the wrapper.

## **Other Considerations**

Recommended moisture levels for baled silage are generally between 40 and 60%, covering the range between wilted silage and haylage. The ideal moisture appears to be 50-60% because there is some fermentation in that range and less heat damage is observed. As an alternative to rain damage on windrows, baling and wrapping at lower moisture levels around 30% may salvage the crop, however, our observations indicate that the extent of molding is much greater on balage produced below 40% moisture.

Damage to plastic during handling or storage can introduce oxygen into the bale and allow spoilage. Any holes made during bale transport and placement into storage should be repaired immediately by taping. Holes allow oxygen to enter and lead to the same problems that occur if bagging is delayed too long. To minimize storage losses due to spoilage, we suggest in Kentucky that bagged silage bales be fed during the winter following their production and that baled hay be carried over if excess feed is available. The storage period for bagged or wrapped silage is also reduced by baling the fall cut of alfalfa or other forages that comes during October or November in this area when hay curing conditions are generally very poor.

## **Cost**

Wrapping bales costs approximately \$6.60 per bale or \$22.01 per ton if costs for machinery, labor and plastic are included and if 300 bales were made each year (Vough and Glick, 1993). For the same number of bales, bagging cost \$9.91 per bale or \$33.03 per ton. The higher per ton cost of bagging was due to greater labor inputs and to the higher cost per bale of the bag, \$7.00, compared with plastic, \$3.50. These values compared favorably with the \$30 per ton cost of putting chopped silage in a tube-type silo or the \$21-42 per ton cost of storage in a concrete stave silo. Custom rates for bale wrapping are in the \$6 to \$8 per bale range.

## **Benefits**

Storing wet forage as balage will allow more timely cutting and harvesting of high quality forage crops. UK research (Table 1) compared baled alfalfa silage at three moisture levels with field cured hay (stored outside on the ground). Baled silage retained initial protein and in vitro digestibility levels of the fresh forage better than the field cured hay. Field cured hay declined significantly in digestibility and had large dry matter losses compared to baled silage.

**Table 1. Forage Quality and Dry Matter Losses of Alfalfa Balage and Hay, Pre and Post Storage.**

	Protein		Digestibility		Bale Weight		DM Loss
	Pre	Post	Pre	Post	Pre	Post	
	-%-	-%-	-%-	-%-	-lb-	-lb-	-%-
Balage 46% DM	23.7	22.6	63.0	63.8	548	554	--
Balage 51% DM	23.1	22.3	62.0	65.0	537	541	--
Balage 57% DM	22.1	21.0	65.1	64.4	587	583	--
Hay	18.2	17.5	67.2	51.9	609	495	18.7

Source: Mike Collins. 1995. Unpublished Research. University of Kentucky. Storage period May to December. Hay is outside stored on the ground.

## **SUMMARY**

Baled silage offers a way for Kentucky farmers to conveniently and inexpensively produce silage with present hay making equipment (adapted to wet forage). Bale wrappers vary in cost from approximately \$4000 to over \$14000 depending on the level of automation and control desired. The benefits of making baled silage come from more timely harvest, lower dry matter losses during curing and storage, less chance for rain damage, and better retention of leaves in high quality forage crops like red clover and alfalfa. Disadvantages include handling heavy bales, maintaining plastic integrity, adapted baling equipment to handle wet forage, and plastic disposal.

Considering the factors discussed above, the following recommendations should be considered when planning a round bale silage system:

### **Do :**

1. Bale alfalfa between 40 and 60% moisture
2. Wrap as soon as possible after baling (preferably within 8-12 hours)
3. Make tight bales
4. Consider reducing bale diameter to reduce weight
5. Use 4 to 6 layers of stretch-wrap plastic depending upon storage time
6. Transport bales to the storage area before wrapping for easier transportation

### **Do Not:**

1. Bale overly dry material (below 30% moisture leads to molding)
2. Bale overly wet material (moistures above 65% lead to excess weight and greater fermentation losses).
3. Allow holes or tears in plastic to remain open