

STORING ALFALFA AS ROUND BALE SILAGE

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Hay is the most popular method for storing alfalfa because it stores well for long periods and is better suited to cash sale and transportation than silage. However, silage may be a suitable option when and/or where hay curing is difficult. Due to numerous improvements in baling and wrapping equipment, it is possible to make high quality round bale silage using long (unchopped) alfalfa crops.

Round bale silage (or balage) is the result of cutting forage crops with conventional hay mowing equipment, allowing the forage to wilt to between 40 and 60 percent moisture, baling it into tight bales and wrapping the entire bale in plastic so oxygen is excluded. The forage in the bale then goes through the ensiling process. The plastic wrap keeps air out, allowing anaerobic microorganisms to ferment carbohydrates to lactic acid which lowers the pH of the forage and inhibits the growth of other detrimental microorganisms. The ensiling process uses some dry matter or energy, but this loss is small compared to dry matter losses that commonly result from field curing tedding, raking, baling, outside storage and feeding of hay (Table 1).

Table 1. Losses Associated with Hay and Silage Production.

Activity	Hay	Silage
Field Curing	25%	6%
Harvesting	15%	6%
Storage	35%	5%
Feeding	30%	8%

Advantages of making round bale silage include:

- Plastic cost per bale is low (\$3-4);
- Capital investment required is lower than conventional silage storage;
- Higher quality feed is produced;
- Harvest and storage losses are lower;
- Weather damage is less than hay stored outside;
- Individually wrapped silage bales are more portable;
- Silage can be stored in small packages; and
- Feeding round bale silage does not require specialized machinery.

Disadvantages of round bale silage include:

- Some hay balers cannot handle wilted (40-60 percent moisture) forage;
- Silage bales can be very heavy, leading to larger tractor requirements;
- Plastic wrap material can tear or puncture, leading to spoilage;
- Disposal of used plastic is necessary.

All of the major forage crops grown in Kentucky can be harvested and stored as round bale silage. To improve the odds of success, these recommendations should be followed:

- 1) harvest at the reproductive stage of maturity;
- 2) bale when the moisture content of the cut crop is between 40 and 60 percent;
- 3) time between baling and wrapping should be as short as possible (< 8 hrs);
- 4) a minimum of 4 layers of plastic are required to form an airtight seal; and
- 5) repair holes made during bale transport and storage immediately by taping.

In general, harvesting forage crops between the vegetative (leafy) and reproductive (flowering) will result in the best compromise between yield and quality. Harvest losses (usually from leaf shatter) are greatest for very dry forage but are low for crops handled soon after cutting. However, silage baled and wrapped too wet (>70% moisture) is subject to excessive storage losses due to deterioration from seepage that accumulates within the wrapped bale.

The moisture levels recommended for baled silage are generally between 40 and 60 percent, covering the range between wilted silage and haylage. The ideal moisture content appears to be 40 to 50 percent because fermentation is adequate and heat damage is minimized. In producing bales for silage, it is important to remember that forage in the 50 percent moisture range will weigh about twice what the same size bale would weigh as hay. Bale size is frequently reduced to restrict bale weight to 0.75 to 1.0 ton. Heavier bales may be difficult to safely transport.

Machinery Requirements

Mower-conditioners are not required for making round bale silage, but they are useful because they speed up the wilting process and concentrate the cut forage into a narrow swath. These narrow swaths allow baling without raking.

Bales for silage should be formed as tightly as practical in order to exclude oxygen and help bales retain their shape during storage. Some producers claim belt-type balers make a more uniform bale than chain-type balers, but no research supports this claim. Fixed-chamber balers lack the flexibility of variable-chamber balers to vary bale diameter as a means of reducing bale weight with high moisture crops.

Some baler manufactures recommend retrofitting older balers with kits that aid in baling high moisture forage for silage. Many manufactures produce balers designed specifically for making balage. Some recent models of both fixed and variable chamber balers include knife mechanisms to chop the forage allowing increased density. University of Kentucky research found that using a “chopping” fixed-chamber baler increased silage bale weighs by about 300 pounds at the same bale diameter.

Traditional bale spears have the disadvantage of puncturing the plastic if the bale is moved after wrapping. Therefore, wrapping the bales after they have been moved to their place of storage will avoid punctures in the plastic and the need for repair. Another more expensive option is the hydraulic bale squeeze that mounts on a front end loader. This implement allows the movement of wrapped bales without making holes in the plastic. Tractors with 50 or more horsepower have sufficient weight and power for safe lifting.

Bale-Wrapping and Bagging Equipment

Individual bags, tubing machines and individual or group bale-wrapping machines all operate on the basic principle of quickly sealing out oxygen from the bale and keeping it airtight until feeding. Use of quality plastic manufactured to withstand the damage of ultraviolet radiation in sunlight is strongly recommended. Some plastic manufacturers also warn that the oil from treated sisal twine can break down the ultraviolet radiation inhibitor in the plastic and recommend using untreated sisal twine or plastic twine instead.

Individual bags

Placing individual round bales in plastic bags is the least popular method for making balage. However, extra equipment is not required and the bags have the potential to be reused to reduce cost. In practice, however, few bags can be salvaged for use the following growing season. The biggest disadvantage to using individual bags for make round bale silage is the difficulty of getting all the air out of the bags and maintaining a good seal on the open end of the bag. Rodent damage also appears to be more prevalent with individual bags compared to wrapped bales.

Individually or in-line wrapped bales

The most popular machines available for making round bale silage are the platform and in-line wrappers. Platform wrappers wrap individual bales. In-line machines line bales up end-to-end and wrap the entire line in a continuous, overlapping spiral of plastic.

The major advantages of platform wrappers are:

- 1) lower equipment cost compared to in-line machines;
- 2) spoilage due to a hole in the plastic is limited to an individual bale;
- 3) greater transportation and feeding flexibility.

The greatest disadvantages of a platform wrapper are higher plastic cost per bale and more time required to wrap each bale.

The major advantages of in-line wrappers are:

- 1) 50% less plastic required compared to platform wrappers;
- 2) requires less labor per bale;

The greatest disadvantage of the in-line wrapper is the higher equipment cost.

Time between baling and wrapping

The time between baling and wrapping is critical to the success of the ensiling process and should be as short as possible. Prior to wrapping, high moisture forage is subject to very high respiration rates and to the growth of undesirable microorganisms. Respiration reduces forage quality by consuming readily digestible carbohydrates. Significant increases in bale temperature are also associated with excessive delay between baling and wrapping of silage bales. Data from the University of Missouri illustrate the importance of rapid bagging after baling (Table 2). Based on these data, even an eight-hour delay between baling and wrapping can result in greater temperatures during storage compared with those bales wrapped immediately after baling.

Table 2. Silage bale temperature (°F) as affected by time between baling and wrapping.

Days after Ensiling	Interval between baling and wrapping (hrs)		
	0	8	24
1	118	129	125
2	111	140	135
3	113	127	132

Source: University of Missouri, 1983 Research Reports.

Round bales should be moved to the storage area before wrapping. This allows the wrapping process to be done on more level, uniform ground. Minimizing the movement of bales after wrapping will reduce the odds of puncturing the plastic and risking spoilage.

Storing alfalfa as round bale silage allows for more timely cutting and harvesting of high quality forage when curing conditions, time and labor may be limiting. In a University of Kentucky research study, baled alfalfa silage at three moisture levels (54, 49 and 43%) was compared 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.

Summary

Round bale silage offers a convenient and inexpensive way for Kentucky farmers to salvage their high quality alfalfa crops that might otherwise be lost due to poor hay curing conditions and reduce leaf losses associated with tedding, raking, baling, storing and feeding of hay.