Large round bale silage

Making round bale silage consists of wilting a forage to 50 to 60 percent moisture content, baling it in a round baler, and ensiling it within a plastic cover. This silage making technique can be used as a feed option by any farmer who produces forage, and it does not require a large silo or haylage harvesting equipment.

PROS AND CONS

Round bale silage, like any storage method, has its strengths and weaknesses. As a low-cost storage unit for long-stem grasses or legumes, it benefits the small or part-time farmer in particular. The needed storage capacity can be supplied by round bales when silo capacity is lacking during times of forage surplus. The bales can be placed in convenient locations around the farm to provide small feeding units for planned consumption time. In addition, large round bale silage can provide more precise allocation of forages, based on quality, to different classes of animals than can be achieved with either upright or bunk type silos. However, the storage cost per ton of forage is greater than for a permanent storage structure that will be filled twice each year. Disposal of the used plastic wrap or bag is also an environmental concern.

Another advantage is shortened harvesting time, because the cut crop needs to wilt only a few hours before baling. Anticipated rainstorms or high-humidity conditions are a constant risk when working with hay in Pennsylvania, but are less of a problem with silage. The 50 to 60 percent moisture content at baling reduces leaf loss during harvest, which results in a higher quality protein source than field-cured hay. Ensiling does not, however, improve forage quality. The general adage of "garbage in - garbage out" is certainly true with ensiled forage, regardless of the storage structure.

Making and feeding the silage bales are labor efficient processes. One person can complete the steps involved in making round bale silage if adequate equipment is available. However, without a well-designed feeder, feeding and trampling losses are comparable to or greater than hay losses. Assuring tight bale seals is of utmost importance because uncontrollable air leaks can result in varied feed value, mold growth, and excessive spoilage losses.

TYPE AND MATURITY OF FORAGE

Many different species of forage have been used to make large round bale silage, including alfalfa, red clover, perennial grasses, oats, sorghum-sudangrass hybrids, and mixes of grasses and legumes. All of these forages can make good silage, provided the forage has sufficient fermentable carbohydrates. To optimize carbohydrate levels, forages must be cut at the proper stage of maturity and wilted to 50 to 60 percent moisture content.

To obtain the highest yields of high-quality feed while maintaining a productive stand, forage crops should be cut at the following stages:

Crop	Maturity stage
Alfalfa (established) - first cutting	Mid-bud to early bloom
Alfalfa (established) - later cuttings	Late bud to early bloom
Alfalfa (new seeding) - first cutting	Early bloom
Red clover - first cutting	1/4 to 1/2 bloom
Red clover - later cuttings	1/4 bloom
Perennial grasses - first cutting	Heads emerging from boot
Perennial grasses - later cuttings	5 to 6 weeks after first
Small grain	Early head emergence
Sorghum-sudan hybrid	Height of 3 to 5 feet
Grass-legume mix	Based on legume maturity

STEPS IN MAKING ROUND BALE SILAGE

Mowing with a mower-conditioner is best. The mowed forage is left in the swath long enough for it to wilt to 55-65 percent moisture. Drying periods usually range from two to three hours if mowing is done early in the day, to overnight if mowing is done late in the day.

Baling with a fixed-chamber baler makes uniform sized bales which fit easily into bags or stack neatly when wrapped. Some balers will require modifications such as scrapers to prevent gum buildup on belt rollers, or shields to prevent wrapping of the crop. A slow ground speed helps make tight bales which are less likely to spoil. Net tying and plastic twine are recommended; sisal twine should be avoided because the chemical twine preservatives often degrade the plastic used as a bale wrapper. Inoculants can be added, but usually are not necessary. Hauling the bales to a bagging or wrapping site immediately helps ensure feed quality, as well as bale roundness which is important when wrapping.

Wrapping bales is quicker than bagging, but it requires a bale wrapping machine, which means a capital expenditure you don't have with bagging. Wrapping machines cost around $6,000 to $12,000, depending upon the level of sophistication desired. To justify the machine cost, one should wrap a minimum of 100 bales per year. A recent study revealed that two workers can wrap 25 to 30 bales per hour.

Plastic for wrapping usually is one mil (0.001 inch) thick and comes in rolls which are 5,000 or 6,000 feet long. Each roll will cover 25 to 30 bales. The plastic costs $3 to $4 per bale in 1991 prices and can be used one time only. Each bale requires from 1.5 to 2 pounds of plastic, so ask your supplier about a recycling or rebate option for the used plastic.

Quality plastic has a tackiness agent which is crucial to proper sealing. The plastic is typically stretched 50 to 55 percent in order to get the correct tension. Several years ago, instructions were to wrap each bale rotation with a 25 percent overlap of the plastic, therefore providing each bale with four layers of plastic. Today, four layers are still recommended, a better seal is created when the bale is wrapped with a 50 percent overlap and then wrapped twice. Like bagging, the wrap is *not* airtight but it does restrict enough air exchange that fermentation can take place. Best results are achieved when 100 percent virgin plastic is used, which is warranted for a minimum of one year.

Bagging is trickier than wrapping. After a few bales are made, check the bag fit. Bag at the storage site only, because this area already should be cleared of obstacles and nuisances that puncture the bags. Once the bag is over the bale, push out excess air before sealing. To seal the bag, a strong hand is needed to twist and stretch the bag end while a second hand or a second person ties a knot with rope. Twist tightly and tie once, then bend the twisted plastic back onto itself and tie the two twists together. Polyethylene (PE) plastic film used for these bags is not airtight. In fact, low density PE is four times more permeable by carbon dioxide gas than it is by oxygen gas, allowing the bags to vent excess carbon dioxide gas as fermentation begins.

Patch holes found in a bale bag as soon as possible, because wind causes loose plastic to bellow and provide an air exchange which usually spoils most of the outer layer of the bale. Duct tape and masking tape last about three weeks before they fall off, but bag suppliers have a polyethylene tape which adheres for bag life. Bags are rarely reusable because of minor pinholes.

No research has revealed that any bag color is better than another as far as silage quality is concerned. Black plastic bags have an ultraviolet inhibitor, called carbon black, which limits bag degradation under sunlight. White and green bags will degrade quicker. If a bag is made from quality materials, the supplier should be willing to guarantee it for one year.

Bags cost from $6 to $8 each in 1991 prices. Table 1 compares costs of wrapping versus bagging when 150 and 300 bales are made each year in Pennsylvania. Although the numbers may vary from one region to another, they show some of the factors which must be considered when deciding on a storage method. For comparison, it would cost about $52 and $30 per ton to ensile similar amounts of

Table 1. Comparative costs of wrapping versus bagging for two typical circumstances.

			— 300 bales/year —		—150 bales/year—	
Inputs			Wrap	Bag	Wrap	Bag
Plastic	Price	$/bale	3.50	7.00	3.50	7.00
Labor	No. workers		2	3	2	3
	Bales/hour		25	20	20	16
	Wage	$/hour	6.00	6.00	6.00	6.00
Machine	Price	$	6,000	5,000	6,000	2,000
	Interest	%/year	10	10	10	10
	Life	Bales	4,000	5,000	4,000	5,000
	Salvage value	%	20	20	20	20
Size	Bale weight	lb DM	600	600	600	600
Results						
Plastic cost		$/bale	3.50	7.00	3.50	7.00
		$/ton	11.67	23.33	11.67	23.33
Labor cost		$/bale	0.48	0.90	0.60	1.13
		$/ton	1.60	3.00	2.00	3.75
Machine cost		$/year	787.23	602.66	641.03	206.96
		$/bale	2.62	2.01	4.27	1.38
		$/ton	8.75	6.70	14.25	4.60
Total cost		**$/bale**	**6.60**	**9.91**	**8.37**	**9.50**
		$/ton DM	**22.01**	**33.03**	**27.91**	**31.68**

Source: D.R. Buckmaster, 1991. unpublished data.

forage (150 and 300 bales, respectively), in long tube-type bags. The cost to ensile the equivalent of 300 bales in a concrete stave silo is over $42 per ton if the silo is filled only once and $21 per ton if the silo is filled twice each year.

BALE HANDLING EQUIPMENT

There are numerous bale handling devices to move or transport the bagged or wrapped bales, with new ones being introduced regularly from other countries. Most seem to have the following design characteristics.

1. Spears, either mounted on a front-end loader or on a three-point hitch
2. Twin moveable forks with rollers which slide under and cradle the bale
3. Disks which clamp and squeeze the bale while lifting
4. Grapples with overhead arms
5. Trailer mounted sleds which slide under bales

Regardless of the design, each requires at least a 50 hp tractor in order to safely move the bales.

BALE STORAGE

The storage site will give better results if stubble and sharp objects are cleared. Some people lay an old piece of plastic on the ground prior to placing the bales. Spray the perimeter of the stack to kill weeds which harbor insects and rodents. Do *not* cover the bales with an extra layer of plastic because it makes an ideal nesting site for rodents. Rodents can chew through the plastic wrap or bag and greatly increase storage losses. Find a shady area, preferably on a north facing slope, to avoid temperature fluctuations which can degrade both the silage as well as the plastic.

To increase bale density in storage, consider stacking the bales as follows:

1. Above 75 percent moisture content, use a single-layer stack.
2. Between 65 and 75 percent moisture, use a double-layer stack, pyramid fashion.
3. Below 65 percent moisture content, stack up to three layers high, pyramid fashion.

BALE FEEDING

Feeding round bales of silage is similar to feeding large round bales of hay when conventional bale feeding rings can be used. With the high investment for wrapping bales, it is essential to control feeding losses. Some studies have shown up to 50 percent loss when large round silage bales are simply unrolled on the ground. This loss can be reduced to less than 10 percent by using a simple ring feeder. Mobile feed carts, especially designed for unrolling or grinding large bales within narrow barn alleys, are now available in the United States. Tub grinders can be used, but plugging of the grinder with the large bales of silage may be a concern.

The feed quality of large round bale silage, especially those bales with a high proportion of legumes, may cause overfeeding to some classes of animals. Consider using the bales with high proportion of legume for classes of animals that require high quality forage, and restricting the amount of bales available at any time.

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