



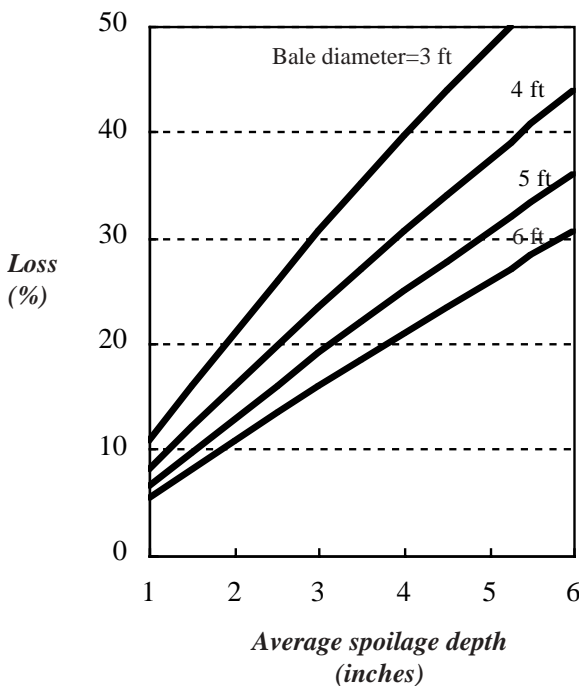
Round Hay Bale Storage

Dennis R. Buckmaster, Associate Professor of Agricultural Engineering

Round bales, a common method of handling and storing forages, can result in substantial losses if they aren't stored correctly. Too many people think that because round bales are somewhat shaped like a roof, they can be stored outside without a protective covering. Research has shown, however, that improper round bale storage often leads to low quality forage for livestock.

Ironically, the same farmer who will go to great lengths to avoid a three or four percent loss during grain harvest will regularly incur a 15 to 20 percent hay loss because of improper storage. The graph below indicates the magnitude of losses for various spoilage depths on round bales of various diameters:

This fact sheet presents information on the many



round bale storage options and will help producers select a better option than outdoor storage.

What Are My Round Bale Storage Options?

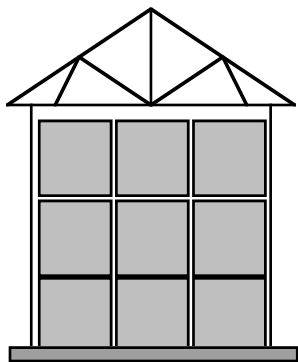
Outside, uncovered storage of round bales is very common. Many times, bales are stored along a fence row. While this method avoids the cost of a storage structure or site preparation, forage losses can be very high. The amount of forage lost during outside storage depends upon several factors, including the duration of storage, precipitation, site drainage, bale density, and bale dimensions. Dry matter loss can range from five percent to more than 40 percent. In the northeast, with storage periods often exceeding several months, forage loss is seldom below 15 percent.

There are rare situations where farmers are better off to “take their losses” than worry about protecting bales. In these cases, stacking bales end-to-end in a north-south direction leaving approximately two feet between rows can help reduce losses. This arrangement allows enough sunlight to keep the bales dry. A base to keep the bales off of moisture-retaining soil also helps. Examples include pallets, gravel, and railroad ties.

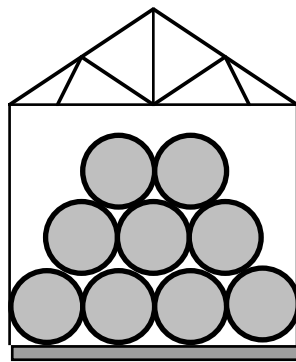
In-barn hay storage can drastically reduce storage losses. Due to respiring microorganisms in hay, some losses will inevitably occur, but in-barn storage can reduce losses to about four percent. The total cost for in-barn storages is usually \$18 to \$22 per ton and includes the structure, extra machinery, and extra labor.

When comparing outside, uncovered storage to in-barn storage, farmers must realize that they may have to purchase a machine that can stack bales appropriately. Machinery probably amounts to less than 25 percent of the total storage cost, but it should be considered. Also, additional labor will be needed to transport the hay to the barn, stack it, and later remove it. Extra labor probably amounts to less than 15 percent of the total cost for in-barn storage.

Many times, an existing barn can be used to store hay. However, at prices of only \$5 to \$10 per square foot, special structures for storing hay can usually be justified. An enclosed building, or one with an open south-facing wall, will help keep rain and snow out of the storage area. Hay storage structures should have ample height (the structure should leave two or three feet above the bales for stacking room), proper ventilation to avoid moisture buildup, and sufficiently strong walls to hold the bale load. Even though it is more difficult, stacking the bales on end is recommended for indoor storage because the barn walls will not have to withstand the weight of the hay stack.

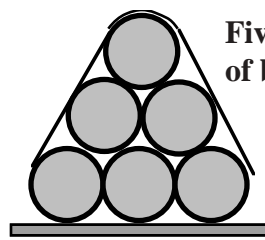


- More difficult to stack
- Lower wall loads
- Average stack height of 3
- Better use of floor space



- Easier to stack
- Higher wall loads
- Average stack height of 2.25
- Poorer use of floor space

Group covering of a large stack of round bales is a good alternative to in-barn storage. A heavy covering material can reduce weather damage. Many times bales are stacked in a triangular shape, with three bales forming the triangle base. (The average height of the stack is then two bale lengths.) The tarp used to cover the stack should be about five feet wide for each foot of bale diameter. For example, a 25-foot wide tarp will cover five-foot diameter bales that are stacked three high in a triangular formation. It is important to prepare the storage site for proper drainage. One- to three-inch stones laid about four inches deep will work well. Try to locate the storage on a site with few wind gusts, and make sure the tarp is adequately fastened to the bales. It is probably best to keep the stack ends open for ventilation. Some stakes or small posts may be needed to keep the stack from rolling apart.



Five feet of cover per ft of bale diameter

Four inches of stones

Average stack height of two over the site width

Losses in a well-constructed group covering will be considerably less than those incurred with outside storage, but they will be higher than in-barn storage losses. Generally, a loss of seven percent is unavoidable. The total cost of a group covering system lies in the neighborhood of \$10 per ton. The covering material accounts for about 25 percent of the cost, the added labor another 25 percent, the machinery 40 percent, and site preparation 10 percent. Costs will vary in different situations, so each farm should determine its own cost. If no charge is made for labor, for example, the total storage cost will be about eight dollars per ton; if no additional machinery is needed, it will be seven dollars per ton.

Individual wrapping with a bale wrapper can reduce weather losses considerably. It is still important to have excellent drainage at the storage site, however, to avoid water accumulation in the bottom of the bales. If the bales are properly wrapped and the site is well-constructed, individual wrapping will result in losses similar to group covering losses.



Generally, the cost of bale wrap is higher than the cost of group covering material, but individual wrapping has the convenience of not having to cover many bales at once. A definite disadvantage to using bale wrap is the problem of how to dispose of the used material. In most cases the benefits of individual wrapping outweigh the costs for machinery, labor, site preparation, and bale wrap, which typically range from \$10 to \$15 per ton.

Hand bagging, or covering with “sleeves,” “bonnets” or bags, can reduce storage losses although one research study showed higher losses with sleeves than without. This high loss was due to water accumulation in the bottom of the bales. Therefore, excellent site drainage is a must. Losses with hand bagging vary greatly, but with a well-constructed site, they should be low enough to more than justify the costs.

Other Round Bale Hay Considerations

Feeding round bales to livestock poses some interesting challenges. There are many feeders on the market, and many farmers build their own. A primary consideration when designing round bale feeders is to make the animals reach for the hay. This allows the animal to pull what hay it wants while minimizing the amount that drops on the ground. The hay should be covered and held off the ground. From a nutritional perspective, it is probably best to chop the hay and feed it in a totally mixed ration, especially for high-producing animals like lactating cows. Chopping hay might not make economic sense, however, because large amounts of energy are required.

Many times, when round bales are stored outside, they accumulate a significant layer of spoilage. A common question is whether to feed the spoiled portion or remove it. The answer depends on the animal and the level of spoilage. If high-producing lactating cows or other animals with high nutrient demands are being fed, remove the rotten material. If these animals are fed spoiled hay they may not eat as much, which will result in decreased performance. Because removing the material takes a considerable amount of time, it may be best to let animals of lower productivity eat away the poor quality material before the bale is fed to high-producing animals.

The density of round bales varies widely. A typical density is about 10 pounds per cubic foot. This corresponds to a 1,000-pound bale that is five feet in diameter and five feet long. Bale weights will vary according to baler and operator differences and can vary as much as 100 percent. With variations this high, it behooves a farmer to get a good bale weight estimate so hay yields can be properly estimated and feeding programs can be appropriately adjusted. Never assume that bales weigh what the baler advertising literature states.

Some producers think they can bale wetter hay in round bales than they can in rectangular bales that are stacked in a barn. This is not true. Heat dissipates very slowly out of a round bale, and heat buildup from microbial activity at high moisture levels will reduce available protein and increase storage losses. When round baling, compromise between harvest and storage losses—harvest hay when it is at or near 18 percent moisture. (See fact sheets I-105 and I-106 for moisture measurement techniques, I-107 on forage losses, and I-109 on round bale silage.)

Large round bales can be deadly due to their tendency to roll. See fact sheet E-13 for guidelines on safe practices.

What Is The Best Hay Storage Option?

With several hay storage options available, selecting the best option becomes very difficult. In-barn hay storage is nearly always better than outside, uncovered storage—even if in-barn storage means building a barn, buying an attachment for handling bales, and hiring someone to do the extra handling. Round bale storage protection to reduce loss will nearly always increase profits.

The availability and cost of labor and machinery and the location of hay fields, storage sites, and feeding sites all play an important role in determining the best storage option. It would be nice if we could just say that one option is better than the rest, but such generalizations are not true. Individual farms should analyze each option—then make a decision.

An example that will give insight to primary cost factors is included on the back page. Changes in the prices of labor, machinery, site preparation, covering material or barns can change the total cost; however, some protection from weather will most always increase profits.

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Agricultural and Biological Engineering Department
246 Agricultural Engineering Building
University Park, PA 16802
Telephone: 814-865-7685
FAX: 814-863-1031

Example Round Hay Bale Storage Analysis

General:

Bale diameter:	5 ft
Bale length:	5 ft
Average bale weight:	1000 lb
Loss during outside storage	20%
Hay value into storage	\$80/ton
Annual hay production	200 tons/year
Interest/discount rate	9%
Price of fuel	\$1.15/gal
Pro-rated tractor fixed costs	\$6.00/hour
Price of labor	\$6.00/hour
Time between first and last harvest	110 days

Re-usable covering analysis:

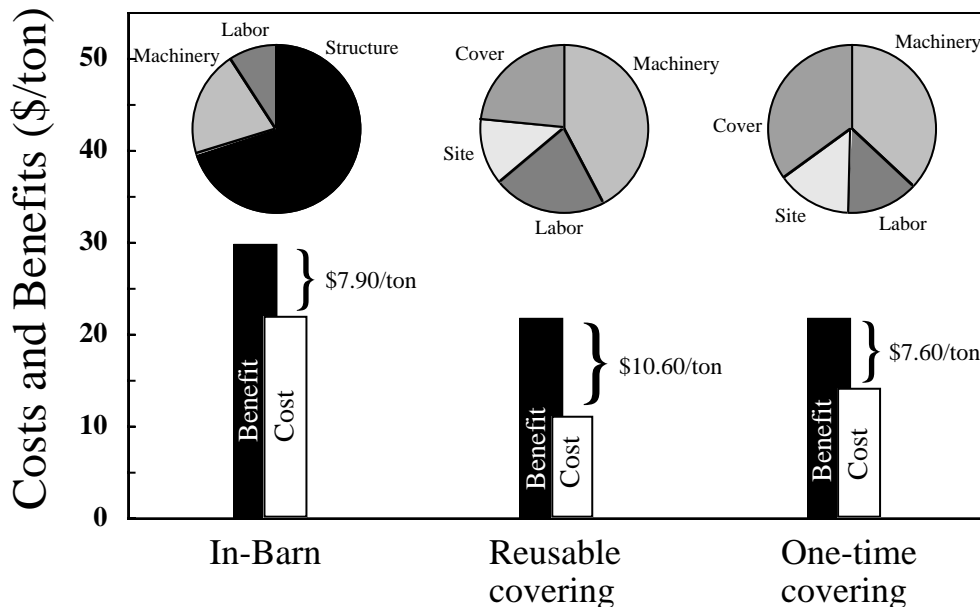
Average stacking height	2 bales
Unit price of the site preparation	\$0.50/sq ft
Site life for amortization	10 years
Unit price of covering material	\$7.00/bale
Covering life for amortization	5 years
Price of added machinery	\$1200
Machinery life for amortization	5 years
Added machinery time	10 min/bale
Fuel consumption rate	2.5 gal/hour
Added labor	12 min/bale

In-barn storage analysis:

Average stacking height	3 bales
Unit price of the barn	\$7.50/sq ft
Barn life for amortization	10 years
Price of added machinery	\$1200
Machinery life for amortization	5 years
Added machinery time	10 min/bale
Fuel consumption rate	2.5 gal/hour
Added labor	10 min/bale

One-time use covering analysis:

Average stacking height	1.5 bales
Unit price of the site preparation	\$0.50/sq ft
Site life for amortization	10 years
Unit price of covering material	\$2.50/bale
Price of added machinery	\$1600
Machinery life for amortization	5 years
Added machinery time	10 min/bale
Fuel consumption rate	2.5 gal/hour
Added labor	10 min/bale



Example of costs and benefits of round bale storage options as compared to outside storage. Pie charts illustrate the breakdown of costs among key factors.

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