

Hay Storage Options: How Do They Stack Up?

Why work hard and spend money to produce a quality product and then throw a quarter of it away? That is what many producers do by not investing in quality storage options for their harvested hay.

Various options exist for storing hay bales, be they small squares, large squares, or round bales. The lowest cost alternative is simply leaving them on bare ground, with no covering. However, some researchers have found that bales can lose as much as 30 or 40 percent of their dry matter after just six months when stored this way (see the table of research results at the end of this article).

Ground Covers

If bales are stored on bare ground, they should at least be on a slope that is well-drained. A fairly low-cost option is to spread a layer of crushed rock or gravel on the surface area where bales will be stored. This will reduce the amount of moisture that seeps into the bales over time. An even better base can be provided by arranging used wooden pallets. These not only form a moisture barrier, they also allow air to circulate under the bales, reducing storage losses by two-thirds or more. The cost of pallets can vary widely, depending on the source.

Top Covers

Bales can be protected even further by covering them with a plastic tarp. This choice is more economical when bales can be stacked several layers high. Uncovered bales should not be stacked, however, as this prevents water from running away from them and keeps them from drying out. Low cost plastic requires a minimal investment, but may not be reusable. More costly thick plastic or canvas tarps can be used for

multiple years. Properly positioning and fastening a large tarp may require two or three individuals working together.

Individual covers have become more economical and more popular in recent years. Bales wrapped with plastic netting or sleeves shed water better than those wrapped only with twine. Plastic bags do a very good jobs of preserving hay quality, but require an investment in bagging equipment. They are more expensive, but may be cost-effective for very high quality forage. Bale wraps and bags generally can be used only once, however, and create a disposal problem.

Storage Buildings

For higher quality hay investing in permanent storage facilities may be the most economical choice in the long run, when reduced spoilage losses are taken into account. Storage structures can range from refurbishing an existing barn or shed, to erecting a pole barn with a roof but no sides, to constructing a completely enclosed, new building. These options involve a higher initial cost, so should be undertaken only when a consistent volume of hay is likely to be produced over a longer period of time.

The cost of buildings for hay storage depends on the interest rate associated with the initial capital investment and the expected life of the structure. The Farm Service Agency offers loans at below market interest rates, currently under three percent annually, for hay storage structures. Maintenance costs should be minimal, especially in the early years. Existing buildings often can be refurbished at a very low cost. However, they may offer less convenience for getting bales into and out of storage.

Other Considerations

Labor requirements will vary widely by system. Simply moving bales to the edge of the field and dropping them on a surface requires a minimal amount of labor. Covering them with a tarp will add some more time. Moving bales to a storage building and stacking them inside will require the most labor, and the effort will be duplicated when they are removed. What value to put on the producer's own labor is arbitrary and may depend on what other activities need to be performed during the forage harvesting season.

Livestock producers who need a certain quantity of hay each year to meet their animals' nutritional needs have an extra consideration. Storage systems with a high dry matter loss will require them to devote extra acres to hay production to meet the needs of their herd or flock, adding extra production costs.

Decision Tools Available

At least two spreadsheets are available for analyzing the costs of various hay storage options. The Ag Decision Maker website maintained by Iowa State University Extension and Outreach offers "**Hay Storage Cost Comparison**," which compares up to eight storage choices. It takes into account the annual costs for covers and labor as well as the initial cost of surfaces and buildings. It also factors in the value of storage losses, to compute an overall storage cost for each system. In addition, the user can specify the annual forage needs for the farm or ranch, and the spreadsheet will calculate the total cost of production for meeting that need after adjusting for spoilage loss. This spreadsheet can be downloaded at: www.extension.iastate.edu/agdm/decisionaidscd.html. An example analysis is shown at the end of this article. Users should input values for their own situations as much as possible, however.

Dr. Brian Holmes of the University of Wisconsin Extension Team Forage has developed a slightly different spreadsheet called "**Comparing Round Bale Storage Costs**". It compares storing hay on bare ground, a macadam surface and wooden pallets, with and without cover, as well as in a storage building. Storage periods of both six months and twelve months are analyzed. Look for a link to this spreadsheet under the Hay Storage Sizing and Management section of the Team Forage website at: <http://fyi.uwex.edu/forage/harvest/>.

References

More complete information about the economics of hay storage can be found in the following sources:

Round Hay Bale Storage. Raymond L. Huhnke, Oklahoma Cooperative Extension Service publication BAE-1716. <http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Rendition-6342/BAE-1716web.pdf>

Hay Storage Sizing & Management. Team Forage, University of Wisconsin Extension. <http://fyi.uwex.edu/forage/harvest/#econ>

Hay Storage and Feeding Management. Bob Schultheis, University of Missouri Extension http://extension.missouri.edu/webster/documents/presentations/2014-03-20_RegionalHaySchool/2014-03-20_Hay_Storage_and_Feeding_Management-BobSchultheis-print.pdf

Summary of research results on hay storage losses: percent of dry matter lost after 6 months of storage

Source	On Bare Ground	On Gravel or Pallets		On Bare Ground, Covered			Inside a Building
	No Cover	No cover	Covered	Tarp	Wraps	Roof	
Michigan State U. 1993	35%	30%		15%	23%		12%
Penn State U. 1992	15-40%						4%
Iowa State U. 1996	10-25%	11%					5%
U. of Georgia	50%	35%	14%	10%			4%
Journal Production Ag. 1993							
Anderson et al 1981	14%						3%
Belyea et al 1985	15%			6%			2%
Verma & Nelson 1983	28-40%			12%	11%		2-9%
Atwal et al 1984	40%			30%			9%
Baxter 1986	33-35%						3-7%
U. Wisconsin (Holmes)	9.5%	8%	4%				2%
Oklahoma State (Huhnke)	5-20%	3-15%	2-4%	5-10%		2-5%	2%
U. Wisconsin (Saxe, 2007)	5-61%	3-46%	2-17%		4-8%	2-10%	
West Va. U. (Rayburn)	7-61%	28-39%	5-10%				
Average	27%	22%	8%	13%	13%	5%	5%

Hay Storage Cost Comparison

Ag Decision Maker -- Iowa State University Extension and Outreach

For information on hay costs, see Information File A2-37, [Hay Storage Options: How Do They Stack Up?](#)

Place the cursor over cells with red triangles to read comments.

Enter your input values in the unprotected, shaded cells.

General Information	Unit	
Acres of hay produced annually	acres	200
Average yield, total for all cuttings	tons/acre	4.5
Width of bale	feet	5
Length or diameter of bale	feet	6
Average weight of bale	pounds	1,250
Tons of hay needed to meet annual needs	tons/year	750
Value of hay at harvest, on farm	\$/ton	\$125
Estimated cost of production for hay	\$/ton	\$90
Long term interest rate for building investment	%	3%
Value of labor used for storing hay	\$/hour	\$15.00



Type of storage		Bare ground, no cover	Outside, on gravel, no cover	Outside, on gravel, under tarp	Outside, bare ground, under tarp	Outside, on bare ground, net wraps	Under roof, no sides	Inside, new building	Inside, existing building
Storage Loss	%	27%	22%	8%	13%	13%	8%	5%	5%
Outside Storage									
Initial cost of gravel base or pallets, per square foot	\$/sq. foot		\$0.80	\$0.80					
Expected years of life for gravel base or pallets	years		5	5					
Cost of plastic tarps, per square foot	\$			\$ 0.20	\$ 0.20				
Expected years of life for covering	years			4	4				
Cost for plastic bale wraps, each	\$/wrap					\$ 1.00			
Inside Storage									
Construction cost of new building, per square foot	\$/sq. foot						\$ 2.50	\$7.00	
Expected years of life of new building	years						30	30	
Approximate value of existing building, per square foot	\$/sq. foot								\$ 2.00
Repair and maintenance rate, annual	% of value						1.0%	2.0%	3.0%
Property tax and insurance rate, annual	% of value						1.5%	1.5%	1.5%
Other Information									
Number of layers of stacked bales	layers	1	1	3	3	1	4	3	2
Total labor needed for storing, covering, and uncovering	hours/year	60	60	80	80	70	150	200	250

Cost Comparison									
Type of storage	Unit	Bare ground, no cover	Outside, on gravel, no cover	Outside, on gravel, under tarp	Outside, bare ground, under tarp	Outside, on bare ground, net wraps	Under roof, no sides	Inside, new building	Inside, existing building
Tons of hay harvested per year	tons/year	900	900	900	900	900	900	900	900
Number of bales stored per year	bales/year	1,440	1,440	1,440	1,440	1,440	1,440	1,440	1,440
Storage area needed--square feet	square feet	45,360	45,360	15,120	15,120	45,360	11,340	15,120	22,680
Initial investment for building	\$						\$ 28,350	\$ 105,840	
Initial investment for gravel or pallets for storage site	\$		36,288	12,096	-				
Ownership cost per year for building	\$/year						1,866	8,026	3,402
Ownership cost per year for storage site	\$/year		7,802	2,601	-				
Labor cost for storage per year	\$/year	900	900	1,200	1,200	1,050	2,250	3,000	3,750
Cost of coverings per year	\$/year			765	765	1,440			
Total cost per year for storage	\$/year	\$ 900	\$ 8,702	\$ 4,566	\$ 1,965	\$ 2,490	\$ 4,116	\$ 11,026	\$ 7,152
Value of spoilage and dry matter loss	\$/year	\$ 30,375	\$ 24,750	\$ 9,000	\$ 14,625	\$ 14,625	\$ 9,000	\$ 5,625	\$ 5,625
Total cost for storage including storage loss	\$/year	\$ 31,275	\$ 33,452	\$ 13,566	\$ 16,590	\$ 17,115	\$ 13,116	\$ 16,651	\$ 12,777
Tons of hay available for feeding or selling	tons/year	657	702	828	783	783	828	855	855
Total cost for storage, incl. storage loss, per ton avail. for	\$/ton	\$ 47.60	\$ 47.65	\$ 16.38	\$ 21.19	\$ 21.86	\$ 15.84	\$ 19.48	\$ 14.94
Value of hay available to feed minus cost of storage	\$/year	\$ 81,225	\$ 79,048	\$ 98,934	\$ 95,910	\$ 95,385	\$ 99,384	\$ 95,849	\$ 99,723
Acres of hay needed to meet annual needs	acres	1,027	962	815	862	862	815	789	789
Total cost to meet annual hay needs	\$/year	\$ 93,493	\$ 95,835	\$ 77,505	\$ 79,468	\$ 79,971	\$ 77,098	\$ 80,725	\$ 77,326

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